Expert group joint opinion

Evaluation Procedure: Assessment of Study Field

Higher Education Institution: University of Latvia

Study field: Physics, Material Science, Mathematics, and Statistics

Experts:

1. Dainis Jakovels (Chair of the Experts Group) (Employers' Confederation of Latvia)
2. Mats Boij (Secretary of the Experts Group)
3. Linda Krāģe
4. Petar Pavesic
5. Uldis Žaimis
6. Artūrs Černiševs (Student Union of Latvia)

Summary of the Assessment of the Study Field and the Relevant Study Programmes

Summary of the Assessment of the Study Field and the Relevant Study Programmes

The management of the study field is well-structured with efficient decision-making and with distributed responsibilities for the quality of education within the study field. The SWOT-analysis and the development plan that builds on it have been obtained by involving both teachers and stakeholders in the industry. The development plan sets reasonable and measurable goals for almost all areas. Admission processes follow institutional regulations and are adequate. Assessment in the courses within the study field follows a well-structured scheme which is in line with the basic principles that have been set on the national level. The system for plagiarism control and the information to the students about it is sufficient to build a culture where plagiarism is avoided.

UL and FPMO in particular have established a highly effective internal quality assurance system. The recommendations of students and lecturers are taken into account in improving and developing the study process. UL has developed and implemented the procedure for submitting and checking student proposals and complaints. The developed mechanism for submitting student complaints and suggestions is effective, promotes the implementation of improvements, and students are informed about such opportunities and receive feedback.

The UL and the FPMO have a well-established and effective resource management system. The funding of the study field is managed at a faculty level, therefore, there is the possibility to subsidise study programs where the expected number of students is not reached. The FPMO is located in a recently built Science Building which was specially designed for study process and research. Auditoriums and laboratories are modern and well-equipped for an effective study process in both modes – face-to-face and distance learning. The open-space type library and many co-working places are available for students 24 hours a day. Students have free access to all necessary literature as well as software. The teaching staff is elected in open and democratic elections and is well supported by the FPMO in the development of study courses and research activities. The main threat to the financial sustainability of the study fields is the number of students in study programs (especially at the master level) which is slightly above the margin to maintain the cost-effectiveness and profitability of study programs in the study field. The management is aware of this risk and appropriate changes in the content and implementation of study programs have been introduced to potentially attract more students. It takes time to see the effect of the changes made. The requirement to implement state-funded study programs in the Latvian language limits the international competitiveness of the study field to attract guest lecturers as well as foreign students.

Scientific and applied research in the field of studies is closely linked to the study process at all levels (bachelor, master and doctorate), supplementing and improving it. During the study process, the balance of scientific and academic work is ensured and the competence of the academic staff is improved. International cooperation in the field of scientific research and applied research within the study field and the relevant study programmes is ensured.

HEI in the frame of given SF has developed mechanisms for the involvement of teaching staff and students in scientific research and applied research, they are well-functioning and efficient.

The directions of scientific research and applied research are fully compliant with the development goals of the higher education institution and are relevant to the study field and industry. The quality and quantity of research in the field of studies are sufficient to support doctoral studies.

Sufficient cooperation with national and international institutions and companies within the framework of the study field has been established, achieving the aims and learning outcomes of the SF and the relevant study programmes.

Appropriate criteria for choosing partners are applied. Cooperation types are diverse - joint study programs, exchange of teaching staff, use of material and technical base, student practice, the attraction of potential students in schools, etc. A System to promote mobility within the study field has been developed. Teaching staff and students participate in both outgoing and incoming mobility, which provides added value to the implementation of the study process and the quality of studies.

The number of outgoing and incoming mobilities of students and staff members in the frame of Erasmus+ projects is relatively low (SAR), especially for outgoing students.

UL and FPMO have acknowledged all previously given recommendations and implemented them. Some recommendations have not yet been implemented, but that is due to the fact that the due date is yet to come. Those recommendations should be implemented till their original deadline. Implementation of previously given recommendations has allowed them to clearly define learning outcomes for study programmes, to develop English language skills for academic staff and to further develop cooperation with other HEIs in Latvia and abroad.

Overall, significant changes have been implemented recently in bachelor and master-level study program contents (e.g. new study courses, and specialisations) to meet the requirements of the labour market and make them more attractive to potential students. More time is needed to assess their impact on the quality of the study process, and the dynamics of the number of students, as well as to get feedback from students, graduates and employers. Therefore, it is recommended to continue the good practice in the internal study quality monitoring to evaluate the impact of these changes in the next study field accreditation.

I - Assessment of the Study Field

I - Assessment of the Study Field

1.1 Management of the Study Field

Analysis

1.1.1. The study field Physics, Material Science, Mathematics, and Statistics now has six study programmes. The doctoral programmes in Mathematics and Physics previously in the field have been moved to broader study fields in line with the strategic development on national and institutional level. The bachelor and master programmes currently in the study field are important for the national supply of graduates on bachelor level and master level in physics, mathematics, and statistics. The doctoral program is in line with the strategic goals towards Latvian involvement in CERN.

The aims (targets) of the study field are building on the institutional strategic directions and objectives (SAR Table 2.1.1.2). For example, the FS target “Ensure international visibility of directional studies and international recognition of study programmes” builds on the UL Stategic objective “University as an internationally recognized science centre” and the UL Development Direction “Science excellence”.

In SAR 2.1.1. it is also explained how the UL Strategic Objectives and UL Development Directions have been developed to meet the needs and trends in society and national economy. This is clearest

from the UL Development Direction “Investment in society” and the UL Strategic Objective “University action as the basis for Latvia's growth” leading to the FS target “Develop a field of study as a knowledgeable, trusted and supportive partner for Latvian society” as seen in SAR Table 2.1.1.2.

The bachelor programs ABSPM and PBSPMS are clearly linked through a number of common courses during the first year. The academic master programs clearly build on the academic bachelor programs and a rather large proportion of the students in the master programs are coming from the bachelor programs. Some overlap of course content was mentioned (Visit – meeting with students.) between bachelor and master programmes. Examples of pairs of courses with some overlap are Algebra 2/Applied algebra, Introduction to abstract algebra/Abstract algebra, Discrete mathematics/Graphs, networks, Introduction to topology/Topology.

1.1.2. The work that has led to the SWOT analysis (SAR Table 2121) and the development plan (Annex 2.1) for the study field has involved many of the teachers in addition to directors of study programmes and heads of departments. There has also been input from industry representatives. The major strengths and weaknesses have also been visible in the visit. Major strengths are the competence of teaching staff and their engagement in the study programmes, the infrastructure, and the employment opportunities for the students in their field of studies. Major weaknesses are the small number of students and the difficulty in recruiting teaching staff with international experience. Some of the goals in the development plan might be hard to reach, for example the number of international students.

1.1.3. The structure of the management of the study field and its study programmes is decided on a central level at UL. This structure includes a clear distribution of responsibilities for the quality of the education. The system has components of quality control as well as development. The Study Field Council involves relevant stakeholders in addition to the directors in order to make sure that decisions on the development of the study fields and its study programs are well founded. Decisions are taken at different levels in the structure where more strategic decisions are taken at a higher level and operative decisions at lower level. This seems to ensure efficiency. Most of the administrative support is on the central level in the Academic Departments and the Department of Study Services. There are some locally employed technicians for the laboratories in physics, but otherwise the support is given centrally by the Department of Information Technology and when it comes to infrastructure by the Infrastructure Management Department. From the visit, we could see that this was working very well. The teaching staff and the students were satisfied.

1.1.4. The admission of students for bachelor programs is administered on a national level with some local benefits for students that have been successful in for example mathematics and physics competitions during high school. Admission to the master programmes is administered by the faculty but since AMSPP is a joint program, the admission is coordinated with Daugavpils University. Admission to the doctoral program is administered centrally at UL. In all cases, the criteria for admission are transparent and are available to prospective students. When students transfer from other universities, or come back from exchange studies, there is a system for recognition of the previous studies. In the case of Erasmus students, there are learning agreements that are set up before the exchange. Assessment of students’ non-formal education seems to be rare. Assessment of professional experience is also rare but the SAR reports on one instance where this has been done successfully.

1.1.5. The courses in the Study field all have two types of assessment, interim assessment and final assessment. The weighting differs between courses within stipulated bounds. The information about

the assessment for each course is available for the students in the e-learning platform. The grading system is determined centrally by UL but each course can use different algorithms for calculating the final grade from the various parts of the assessment. The assessment is continuously analysed and developed where surveys are used to get feedback from students and teaching staff analyse the results. UL has established procedures so that the assessment of students follows the five basic principles defined by cabinet regulations in Latvia.

1.1.6. In order to enforce academic integrity, UL has developed a system for plagiarism control where all final theses are uploaded. The system is used in collaboration with several other higher education institutions in Latvia. After analysis, the result can be passed on to the panel that evaluates the final thesis if needed. According to the meeting with students, they are well aware of these procedures and this should help in creating a culture where plagiarism in thesis work is avoided. This is part of the efforts of the university to establish academic integrity among the students and focusing on courses where students are writing papers.

Conclusions on this set of criteria, by specifying strengths and weaknesses

The management of the study field is well-structured with efficient decision-making and with distributed responsibilities for the quality of education within the study field. The SWOT-analysis and the development plan that builds on it have been obtained by involving both teachers and stakeholders in industry. The development plan sets reasonable and measurable goals for almost all areas. Admission processes follow institutional regulations and are adequate. Assessment in the courses within the study field follow a well-structured scheme which is in line with the basic principles that have been set on the national level. The system for plagiarism control and the information to the students about it is sufficient to build a culture where plagiarism is avoided.

Strengths
1.The development plan for the study field is well established among teaching staff.
2.Well developed and varied assessment with a mix between formative and summative assessment.

Weaknesses
1. There is some overlap between courses on bachelor and master level.
2.Too optimistic goal on increase in international students.

1.2. Efficiency of the Internal Quality Assurance System

Analysis

1.2.1. UL has established and published the Quality policy, which is publicly available on website accordingly:
https://www.lu.lv/fileadmin/user_upload/LU.LV/www.lu.lv/Dokumenti/Dokumenti_LV/2._POLITIKAS/LU_Kvalitates_politika_1_.pdf

Information provided under the links presents a short description that repeats the overarching goal of the university. The higher education institution has established procedures and regulations for quality assurance. The aim of the UL quality policy to "promote the University of Latvia's progress towards continuous quality improvement, visions, missions and the implementation of guidelines and the achievement of strategic development goals, determined by the set of principles related to quality and the actions necessary to achieve them in science, in studies and cooperation with society" corresponds to UL's mission, vision and values, defined on UL's website: https://www.lu.lv/par-mums/zimols/misija-vizija-vertibas/. The University of Latvia maintains and

continuously improves the quality policy, which is described in detail in paragraph 2.2.2 of the SAR. The existence and successful operation of the quality management system in parallel with the SAR is confirmed by interviews with the experts of the head of the quality management department, teaching staff and students.

The quality assurance system contributes to the achievement of the objectives and study results of the study direction and relevant study programs - this can be seen in the consistently high quality of study implementation, renewal of programs and timely preparation of students for future challenges. For example, in a relatively short time, the master's program in Physics has been modified, significantly increasing the options for choosing specializations, learning the Python programming language has been introduced, and linking the learning of embedded systems with databases, etc. innovations. The update is based on following industry trends, constant connection with the industry, regular interviews of academic staff and students - thus the system ensures continuous improvement, development and effective implementation of the study direction and relevant study programs.

1.2.2. The procedure for developing and revising study programs is clearly described in paragraph 2.2.2 of the SAR. The quality of the field of study and the study programs included in it is managed using the plan-do-check-act cycle, or the Deming cycle, planning the development and improvement of the field of study for a six-year period, cascading its goals and tasks to each study for the level of the program and for the needs of effective planning, regularly monitoring the requirements, needs and initiators of the parties involved, in accordance with the LU strategy, taking into account the national and international positions and trends of the sectors, as well as the influence of global environmental trends on the operation of the LU up to the level of study programs. The application of the quality management system at work is confirmed by teaching staff during the interview with experts, as well as the answers of the head of the Quality Management Department during the interview. Student interviews confirm the response of UL management to the identified shortcomings, the use of feedback acquisition, for which students give positive feedback.

Study program management in all evaluated programs confirmed the organization of internal quality management through student surveys, lecturers' meetings and analysis of program documentation. Employers confirmed in interviews that they are involved in program improvement and trend analysis. In the interviews, the students gave feedback on completed surveys about the quality of studies, relevance of courses and availability of resources; student evaluation of the program is high.

1.2.3. The mechanism for submitting student complaints and suggestions is clearly described in section 2.2.3 of the SAR. The procedure determines in what form students individually or in groups can submit proposals and complaints in writing, as well as the procedure for their registration and evaluation. Proposals and complaints about the study process can be submitted to the deans of the faculties (about the list of classes, the organisation of studies at the faculty, the quality of studies implemented by the faculty and its improvement, non-fulfilment of the duties of faculty employees, etc.) - ibid. UL has developed and implemented the procedure for submitting and examining student proposals and complaints (LU order No. 1/21 of 18.02.2002), which is published on UL's website in both languages (https://www.lu.lv/fileadmin/user_upload/LU.LV/www.lu.lv/Dokumenti/Dokumenti_LV/3._STUDIJU_UN_ZINATNES_PROCESU_REGLAMENTEJOSIE_DOKUMENTI/6_STUDJO_1.PDF). Interviews with experts of UL management, teaching staff and students of all levels show that the developed mechanism for submitting student complaints and suggestions is effective, promotes the implementation of improvements, students are informed about such opportunities and receive feedback.

1.2.4. The statistical data collection mechanism established by UL management is clearly described in section 2.2.4 of the SAR. Information is provided on the periodicity and purposes of data collection. The statistical data collection mechanism created by UL is effective, it ensures regular collection and analysis of information (statistics) about the study programs corresponding to the field of study. The mechanism for obtaining and providing feedback, including from students, graduates and employers, is effective and focused on the improvement of the study direction. A confirmation of this can be found in Appendix 2.11. The periodicity of student statistical data collection was confirmed to the experts by the management of the FPMO (in the person of the dean, heads of study areas and program directors), while students of all levels confirmed the management's interest in the students' opinion on the content of study courses, practice, coursework and final theses - topics, quality. The information collected by the internal quality and control system is used to improve the study area as a whole and study programs individually. So, for example, the teaching of programming in the bachelor's program in physics was supplemented with the teaching of the Python programming language, following the industry trend and the recommendations of employers.

1.2.5. The information published on the LU website www.lu.lv about the study programs corresponding to the field of study is clearly described in SAR section 2.2.5. The information generally corresponds to the information available in the official registers (VIIS and E-platform), and provides applicants and students with essential information that is published in Latvian and English. However, there is a significant difference in the operability of information - for example, if the date of the last news in Latvian on the day of the analysis (12.02.2023) is dated 10.02.2023 (in the "News" section) and 09.02.2023 (in the "Discover LU" section), then in English, on the same day of the analysis, the last records provided are dated 02.02.2023 (in the "News" section) and 09.01.2023 (in the "Discover UL" section), where the latter is considered a long delay in restoring the records. The second entry in the same section is dated 09.09.2022.

Conclusions on this set of criteria, by specifying strengths and weaknesses

All sections of the Internal Quality Assurance System have been analysed according to the specified criteria. No non-compliance with the evaluation criteria was found. The only weakness is the provision of information on the UL website in English, which refers more to University events than to decisions and orders regulating study work.

A quality assurance policy has been developed, made public and available to all parties involved. An effective study program improvement, student engagement and feedback policy has been developed, published and is being implemented. In general, the system looks sustainable and is able to ensure the stability and development of the study process towards excellence.

Strengths
1.UL has developed, published and implemented a strong Internal Quality Assurance policy.
2.An effective study program improvement, student engagement and feedback policy has been developed, published and is being implemented.

Weaknesses
1.The provision of information in English on UL's website lags behind information in Latvian.

Assessment of the requirement [1]

1 R1 - Pursuant to Section 5, Paragraph 2.1 of the Law on Higher Education Institutions, the higher education institution/ college shall ensure continuous improvement, development, and efficient performance of the study field whilst implementing its internal quality assurance system:

Assessment of compliance: Fully compliant

There is full compliance with the Law on Higher Education.

2 1.1 - The higher education institution/ college has established a policy and procedures for assuring the quality of higher education.

Assessment of compliance: Fully compliant

UL has established policies and procedures for quality assurance of higher education, they are clearly described in sections 1.3 - 1.4, 2.2.1 - 2.2.4 of the SAR and are consistent with the answers given by management, teaching staff and students in expert interviews.

3 1.2 - A mechanism for the development and internal approval of the study programmes of the higher education institution/ college, as well as the supervision of their performance and periodic inspection thereof has been developed.

Assessment of compliance: Fully compliant

A mechanism for the development and internal approval of university study programs, as well as their implementation monitoring and periodic review, has been developed, made public and is in operation.

4 1.3 - The criteria, conditions, and procedures for the evaluation of students' results, which enable reassurance of the achievement of the intended learning outcomes, have been developed and published.

Assessment of compliance: Fully compliant

Provided in SAR (in section 2.1.5) and student interviews confirm that the criteria, conditions and procedures for evaluating student results have been developed and published.

5 1.4 - Internal procedures and mechanisms for assuring the qualifications of the academic staff and the work quality have been developed.

Assessment of compliance: Fully compliant

Developed internal procedures and mechanisms for ensuring the qualification and quality of work of academic staff are developed and clearly described in SAR section 2.3.6.

6 1.5 - The higher education institution/ college ensures the collection and analysis of the information on the study achievements of the students, employment of the graduates, satisfaction of the students with the study programme, efficiency of the work of the academic staff, the study funds available and the disbursements thereof, as well as the key performance indicators of the higher education institution/ college.

Assessment of compliance: Fully compliant

Interviews of graduates confirm UL's interest in program graduates, collecting statistics on employment, opportunities and mechanisms for improving academic work.

7 1.6 - The higher education institution/ college ensures continuous improvement, development, and efficient performance of the study field whilst implementing its quality assurance systems.

Assessment of compliance: Fully compliant

SAR analysis, interviews with experts from UL management, faculty management, and students and graduates confirm UL's continuous improvement, development and effective execution of

the course of study while implementing its own quality assurance systems.

1.3. Resources and Provision of the Study Field

Analysis

1.3.1. UL has established a funding system of study fields which corresponds to requirements of the national level as well as internal regulation. The primary funding source for the study field is a state budget fund for covering the study cost of budget students. The breakdown of the costs is well described and is appropriate for the effective implementation of the program. Currently, there are few paid students in study programs in this study field making up an insignificant part of income in comparison with budget students. The overall budget of the study field is managed at the faculty level, therefore, there is a possibility to subsidise programs where the number of students is lower than the critical one to maintain profitability. Different options are available for the development of the study programs - revenue from lifelong learning and other FPMO services as well as a centralised UL fund. The academic staff has available funding for research activities (e.g. publication of scientific papers, development and participation in international research projects) which is covered by the funding of the study program (if activities are related to the development of the study program) or by research projects. The university has a specific financial motivation program for academic staff - a 1000 euro bonus if publishing their work in Quartile 1 scientific journals. Academic staff representatives confirmed that the faculty provides good conditions and support for their scientific work and self-development. It was observed that the faculty has established an effective funding system to support both the study process in study programs with a different number of students as well as research and self-development activities.

However, the number of students is slightly above the margin to maintain the cost-effectiveness and profitability of study programs in the study field. The management of the study and study programs are actively looking for solutions to increase the number of students (e.g. reorganisation of master-level programs in physics and mathematics, implementation of specialisations, changes in the offer of study courses based on the feedback from employers and students, support of outreach activities for the popularisation of physics and mathematics studies among high school students), and it takes time to see the impact of these changes on the number of students in the study field.

1.3.2. The FPMO is located in the Science Building (Jelgavas 3) of the UL which has been commissioned in 2019, therefore, having appropriate planning and modern equipment for the implementation of the study program. The technical support to the study process has received significant investments (150000 euros over the last 3 years) and has been recently modernised. The faculty building with many coworking rooms and individual workplaces is accessible to students 24 hours a day. Two computer rooms with 30 seats and shared-use portable computers with regular specialised software (e.g. Mathematica, Ansys, COMSOL, MatLab, LabView) are available for use at the FPMO building. Specialised software could be used also on students' personal computers. Improvement of purchase of material, methodological and informative provision is organised centrally at a faculty or university level. The development of study programs might be supported additionally by the FPMO revenues from lifelong learning and other services as well as the LU centralised funds. Available facilities, equipment and resources to students and teaching staff are sufficient for the effective implementation of the study process.

1.3.3. Improvement and purchase of methodological and informative provisions are organised centrally at a faculty or university level. UL library is a modern open-space type library with many study process suitable working places accessible 24 hours every day. It ensures access to a wide range of thematic literature both in printed and electronic format. Students have access to all main

scientific databases (e.g. Web of Science, Scopus) as well as scientific journals (e.g. Nature, Oxford Journals, Physical Review Journals). The provided methodological and informative provision is sufficient for the effective implementation of the study programs.

1.3.4. UL students and employees are provided with the MS Office 365 application package, which is used to support the study process. For example, MS Teams was actively used to ensure the remote study process during the Covid-19 pandemic when onsite studies were not possible. MS Teams video call option is still used as a popular choice for remote lectures.

Moodle platform is used to ensure an e-study environment. During the Covid-19 time, the teaching staff was forced to improve the study content in the e-study environment and practise distance learning through video calls. As a result, the amount of available/possible study resources in the e-study environment has increased.

Overall, information and communication technologies used to ensure the study process are appropriate, up to date and effective. The remote study process caused by the Covid-19 pandemic has been a trigger for significant improvement in the uptake of information and communication technologies in the study process.

1.3.5. UL has defined and implemented clear and transparent procedures for attracting qualified teaching staff. Open and centralised calls are organised for academic positions - professor, associate professor, docent, leading researcher, lecturer, researcher, assistant, and scientific assistant. Information on open calls is available at the UL website, as well as the National Scientific Activity Information System and State Employment Agency of the Republic of Latvia vacancy portal. Everyone who could fulfil the requirements can apply for the position.

The main obstacle to attracting qualified teaching staff from abroad is the requirement to know the Latvian language as all state-funded study programs should be implemented in Latvian. Such national-level regulation limits the international competitiveness of the study programs. The possibility to implement state-funded study programs in the English language would provide an opportunity to attract both qualified teaching staff as well as students from abroad.

1.3.6. The UL and the FPMO ensure different opportunities for the teaching staff for professional and didactic development. Vocational development is organised centrally by the UL. Observation of lectures is organised to learn from colleagues as well as provide feedback to them. Teaching staff are informed about student survey results, as well as perform annual self-assessments. The teaching staff is encouraged and supported to carry out scientific activities and participate in scientific conferences. UL has introduced an excellence-oriented personnel policy, e.g. academic staff can get a financial bonus for publishing their work in Quartile 1 journals. From discussion during the visits, it was understood that an effective feedback loop and support system is established in the FPMO, to ensure a favourable environment for personal professional growth.

1.3.7. In 2021/2022, 108 teaching staff were involved in the implementation of the study field programs, of whom 75 have doctoral degrees and 31 have master's degrees. Many of them are also involved in research activities within the FPMO or scientific institutes. The distribution of the workload between academic, research and administrative duties may vary, however, no one expressed complaints about workload balance. Experienced teaching staff involved in the implementation of several study courses is well supported by younger colleagues, thus providing an appropriate environment for succession. The teaching staff is well supported on administrative issues from the FPMO, therefore, can focus more on academic and research work.

1.3.8. Students have access to academic support at both UL and FPMO levels. The first-year bachelor students are provided with the curator from the FPMO student union. The student union is involved in all decision-making bodies at the FPMO and UL, therefore, can represent students' opinions. The FPMO performs regular student surveys, discusses results and possible solutions. There are several cases when the teaching staff was changed based on student survey results, thus demonstrating that students' opinion is taken into account. Career development and psychological support are also available at the UL level. Students receive sufficient support from the FPMO in the case of the ERASMUS mobility activities. The FPMO building is well adapted for students with special needs, the accessibility was evaluated in collaboration with the Apeirons association and recommendations were taken into account.

Conclusions on this set of criteria, by specifying strengths and weaknesses

The UL and the FPMO have a well-established and effective resource management system. The funding of the study field is managed at a faculty level, therefore, there is the possibility to subsidise study programs where the expected number of students is not reached. The FPMO is located in a recently built Science Building which was specially designed for study process and research. Auditoriums and laboratories are modern and well-equipped for an effective study process in both modes – face-to-face and distance learning. The open-space type library and many co-working places are available for students 24 hours a day. Students have free access to all necessary literature as well as software. The teaching staff is elected in open and democratic elections and is well supported by the FPMO in the development of study courses and research activities.

Strengths
1.The study provision is ensured by experienced and well-equipped units from UL, thus providing the best available options for physics and mathematics studies.
*2.The material-technical, informative and methodological base for ensuring a high-quality study process is appropriate and up to date, including open space type library and co-working places available 24 hours every day.
3.The teaching staff is motivated and is well-supported by the FPMO in the development of courses and research activities ensuring close collaboration with scientific institutes and access to their facilities.

Weaknesses
1.The number of students in study programs (esspecially in the master level) is slightly above the margin to maintain the cost-effectiveness and profitability of study programs in the study field, thus creating a risk for the financial sustainability of the study field.
2. The requirement to implement state-funded study programs in the Latvian language limits the international competitiveness of the study field to attract guest lecturers as well as foreign students.

1.4. Scientific Research and Artistic Creation

Analysis

1.4.1.The directions of scientific research and applied research are fully compliant to the development goals of the higher education institution and are relevant for the study field and industry. This is evidenced by the number and level of projects implemented by teaching staff and researchers involved in the field of study (SAR - Annex 2.8). According to Annex 28. And 2.9. of SAR, the number of publications is high, and the main part of them are indexed to the Web of Science or SCOPUS. For example, in the year 2019 in total 218 publications are published, in 2020 - 213 and in 2021 – 201, which could be regarded as a good indicator.

In SF in general the research is very extensive, thematically diverse and includes both fundamental and applied research. Seven institutes of university (AI, AXIS, ISSP, PI, GWGS, ICP, IMM) are closely associated with related areas, which include more than 300 scientists in total (SAR 2.4.1.). It has been indicated (SAR 2.4.1.), that International Assessment of Scientific Institutions in 2019, the UL ISSP acquired 4, while the remaining units as part of the UL Science cluster 3 out of 5 points in the overall assessment, while 4 out of 5 points in the scientific quality assessment, what is a high international rating. Research areas in which lecturers of the study direction work are listed, research topics are relevant, corresponding to the priority research directions and providing coverage of the sub-fields of physics and mathematics necessary for the implementation of the study process. A number of international scientific conferences, events, seminars, etc. have been regularly organized (SAR 2.4.1.). Good collaboration with CERN.

The quality and quantity of research in the field of studies are sufficient in order to support doctoral studies. Besides doctoral theses, PhD studies are concluded with publications included in the world's leading scientific databases. Over the last two years, UL implemented the consolidation of doctoral programmes with other doctoral programmes that have existed in the field of studies, thereby ensuring a single, interdisciplinary approach in the preparation of new science dockets and promoting cooperation between scientific study fields.

Examples of the defined directions of scientific research and applied research in SF could be mentioned as following:
* algebraic and topological structures and methods, their generalisations in the context of non-strict logic;
* discrete and continuous dynamic systems, their qualitative analysis;
* mathematical modelling in technical and natural sciences, with emphasis on analysis of fluid and gas movements and modelling of heat and transfer processes;
* mathematical statistics and other methods of data analysis;
* modern elementary mathematics;
* the didactics of physics and mathematics;
* nanoscale electronic device theory and quantum computing physics;
* photonics and its applications, including biophotonics;
* atomic physics, molecular spectroscopy;
* astronomy and astrophysics;
* solid-state physics and material science;
* magnetohydrodynamics, magnetism and soft environmental problems;
* nanophysics, nanotechnology, etc.

1.4.2. Scientific and applied research in the field of studies is closely linked to the study process at all levels (bachelor, master and doctorate), supplementing and improving it. The teaching staff in parallel to the study process work in science. Research experience, results and developed methods obtained by teaching staff during the research process are integrated into study courses, especially those of free choice thus ensuring continuous learning of knowledge and skills for students (from the interview with the lecturers), several examples are mentioned also in SAR (2.4.2.). The majority of students are involved and also employed in research projects during the development of their diploma and course works, thereby essentially gaining first work experience in the industry already during studies.

During the study process, the balance of scientific and academic work is ensured and the competence of the academic staff is improved.

1.4.3. Most of the research is with international character. This is due to the fact that there are no topics of local physics or mathematics and only studies that are innovative at global level can be competitive. This presupposes that successful research can only exist within the framework of international cooperation. All scientific research groups cooperate with foreign counterparts (SAR – 2.4.3.). The budget of research projects of foreign origin is impressive, which in some years (e.g. 2018 and 2020) even exceeds the study budget of both the field of physics as well mathematics, it clearly characterises intensive and competitive international cooperation (SAR – 2.4.3.). Some examples are mentioned, e.g. the international cooperation of the UL ISSP in the framework of the CAMART2 project resulted in a module of the AMSPP specialisation studies "Physics of Solid State and Materials (CAMART2 courses)" of 32 CP. The list of FMOF physics and mathematics international projects for 2020 is given. Most of the projects are financed by EC. It should be appreciated that there are two H2020 projects in the list of international projects, however, not all projects have indications of the source of funding (SAR – 2.4.3.).

International cooperation in the field of scientific research and applied research within the study field and the relevant study programmes is ensured.

1.4.4. According to the number and quality of publications of teaching staff, their degree of involvement in scientific work is high (SAR – Annex 2.9.). At the same time - scientific personnel are involved in study work as well. In order to stimulate the international competitiveness of academic staff, involvement in research is encouraged and supported by several mechanisms: 1) the performance of scientific activities (publications, project writing, the creation and management of a research group); 2) the planning of the study process is accommodating (welcome to changes related to research visits, conferences and other activities); 3) additional resources and activities are available for the development and exchange of staff experience. During the interviews it was possible to gain confidence about the effectiveness of these mechanisms.

The list of presentations by teaching staff involved in the implementation of the program at international conferences and congresses is impressive (SAR - Annex 2.8 and CV of teaching staff, Table 2.4.4).

The scientific qualifications of academic staff (e.g. of the field of physics) greatly exceed the requirements of Latvia, such as the Hirsch Index, for the vast majority of all 28 staff members, it is above the minimum requirement for professors.

At university level, a professional development system for UL academic staff and a science excellence support programme have been developed and implemented, providing material support for publication in category Q1 according to the classification of the Web of Science database. At university level, material support has also been provided for the participation of academic staff in international conferences. Participation of academic staff in international conferences and publication of research results at international level is supported at the level of faculty departments.

A summary of the SF quantitative data on scientific and/or applied research activities during the reporting period is given.

It could be concluded that the higher education institution has developed mechanisms for the involvement of the teaching staff in scientific research and applied research, they are well-functioning and efficient.

1.4.5. Main mechanisms to promote the involvement of students in scientific research and applied

research are as follows: regular participation in scientific (often even international) conferences and workshops, participation in research projects, preparation of publications. Main part of students at all levels are involved in the research work already from the first year of studies. Final theses are elaborated in scientific institutes and laboratories, with certain exceptions in companies or in cooperation with companies. A great proportion of students are also employed in scientific institutions during their studies (interview with students). For the most part, funding for student engagement comes from research projects (LZP FLPP and TNP, ERDF, etc.). The active and serious involvement is also evidenced by scientific publications in which students are co-authors or even first authors. Specific examples are provided, where students at the end of the master's studies were already among the authors of several publications. The list of titles of theses and the scientific institution where it was developed are provided. Supervisors of graduation works are scientists of a high level with experience of managing diploma theses, high number of publications and a Hirsch index (SAR Table 6.2.1.). In order to support scientific activity of the 1st year students of master's level special scholarship are established; the list of scholarship recipients is provided in SAR.

1.4.6. The innovations applied to the implementation of the SF are indicated to be as follows: organisational innovation, marketing innovation, infrastructure innovation, learning process innovation, information technology innovation. Indicating the influence and benefits to different study aspects, each innovation is described in detail (SAR – 2.4.6.).

As most significant could be highlighted the innovations in the learning process, mainly regarding remote study process, development of teaching materials, including the creation of video recordings of lectures as well as the modernisation of training and research infrastructure.

Conclusions on this set of criteria, by specifying strengths and weaknesses

Scientific and applied research in the field of studies is closely linked to the study process at all levels (bachelor, master and doctorate), supplementing and improving it. During the study process, the balance of scientific and academic work is ensured and the competence of the academic staff is improved.
International cooperation in the field of scientific research and applied research within the study field and the relevant study programmes is ensured.
HEI in the frame of given SF has developed mechanisms for the involvement of teaching staff and students in scientific research and applied research, they are well-functioning and efficient.
The innovations applied to the implementation of the SF are indicated to be as follows: organisational innovation, marketing innovation, infrastructure innovation, learning process innovation, information technology innovation.
The directions of scientific research and applied research are fully compliant to the development goals of the higher education institution and are relevant for the study field and industry. The quality and quantity of research in the field of studies are sufficient in order to support doctoral studies.

Strengths
1.Good possibilities to involve a great number of students (52 students during period 2019-2022., SAR 2.4.5., tab. 2.4.5.3.) from all levels in different scientific research activities.
2.High performance of scientific and teaching staff - large number of internationally cited publications, patents, research projects and other research activities (e.g. there are 1156 International scientific publications indexed to Scopus and/or Web of Science databases during 2016 - 2021, Annex 2.8.).
3.Material stimulation mechanism for performance of scientific and teaching staff.

Weaknesses
No weaknesses were identified.

Assessment of the requirement [2]

1 R2 - Compliance of scientific research and artistic creation with the level of development of scientific research and artistic creation (if applicable)

Assessment of compliance: Fully compliant

High performance of scientific and teaching staff, high level of students involved in different research activities.

1.5. Cooperation and Internationalisation

Analysis

1.5.1.Cooperation with various enterprises of Latvia is described in detail - several higher education institutions are mentioned (there are joint study programs with 2 HEIs), secondary schools, companies (which, for example, provides student internships), scientific institutes, professional and non-governmental organisations.

In SAR it has been indicated that the most important criteria for choosing partners are their scope and competence, while the types of cooperation can be divided into program implementation (e.g. joint programs, teaching staff, practice) and development (opinion, new teaching staff), as well as competence dissemination (schools, society, associations) and in development (teaching staff). The process of attracting the partners occurs considering the development trends of the field, the interest of students, the employment of graduates, as well as cooperation offers from companies or associations.

Cooperation with institutions from Latvia contributes to the achievement of the aims and learning outcomes of the study field and the study programmes.

In order to provide student internships, 17 contracts have been concluded with various companies (the companies are listed in SAR). The internship provider’s feedback and evaluation of the students serve as feedback for evaluating the student's knowledge and skills.

Types of cooperation are well described - joint study programs, exchange of teaching staff, use of material and technical base, student practice, attraction of potential students in schools, etc. (SAR).

Examples of Latvian iInstitutions with which LU has cooperation:
Daugavpils University, Riga Technical University, Latvian Agricultural University, Novikontas Naval College, a number of UL institutes - Astronomy Institute, the Institute of Physics, the Institute of Material Mechanics, the Institute for Atomic physics and Spectroscopy, the Institute for Chemical Physics, the Institute for Solid State Physics.
There are also 17 practice assurance contracts with the following companies: UL Mathematical and informatics Institute, TNS Latvia, AS 4 finance, Accenture Oy, Creamfinance Latvia, Dukascopy Bank SA, Central Statistical Bureau, Gamhanger Audio Ltd., SIA Light Guide Optics International, Electronics and Computer Science Institute, SIA Hackmotion, RTU Institute of Mechanics and Mechanical Engineering, Department of Theoretic Mechanics and Materials Resistance, Ventspils University College, UL Institute of Solid State Physics, UL Astronomy Institute, SIA RAA Consulting.
The teaching staff of FS PMSMS certifytheir professional participation by acting in both professional

and non-governmental organisations, such as the Latvian Astronomy Society, the Latvian Physics Society, the Latvian Association of Mathematics Teachers, the Latvian Association of Statisticians, the Latvian Association of Actuaries, the Latvian Association of Physics Teachers, Association of New Scientists, Association of Latvian University Professors.

1.5.2. In total, 23 cooperation agreements with foreign HEIs have been signed within the framework of the Erasmus+ project and 6 in the frame of FORTHEM (list of partners are provided in SAR). Cooperation with Merseburg Technical University in Germany, provides additional opportunities for students and teaching staff to have international experience. Both for students and teaching staff there is very fruitful cooperation with CERN (from the interviews with students and teaching staff). Teaching staff are involved also in 14 international associations and organisations, list of which is provided in SAR.

New cooperation partners (higher education institutions) are searched through the scientific contacts of the staff. Offers of cooperation from other HEIs are accepted as well, but only if the criteria of SF are met. It is indicated that the most important criteria for selecting foreign partners are scope and competence, as well as mutual interest.

A large part of international activities takes place within the framework of international research projects (from the interview with study programme directors and teaching staff).

Cooperation with institutions from abroad contributes to the achievement of the aims and learning outcomes of the study field and the study programmes.

Examples of foreign iInstitutions with which LU has cooperation:
UL has concluded 23 cooperation agreements with foreign universities on Erasmus+ studies in physics and/or mathematics: University of Ostrava (Czech Republic), Universität Bremen (Germany), Gottfried Wilhelm Leibniz Universität Hannover (Germany), Technische Universität Kaiserslautern (Germany), Universität Rostock (Germany), University of Tartu (Estonia), University of Helsinki (Finland), Universitat de les Illes Balears (Iceland), University of Oulu (Finland), Grenoble INP Institute of Engineering and Management (France), Sorbonne Université (France), Universitė Jean Monnet (France), University of Patras (Greece), Vilnius University (Lithuania), Utrecht University (Netherlands), Pedagogical University of Cracow (Poland), Umeå Universitet (Sweden), University of Ljubljana (Slovenia), Izmir Institute of Technology (Turkey), Kocaeli University (Turkey), AGH University of Science and Technology (Poland), University of Łódź (Poland), KTH Royal Institute of Technology (Sweden).
In the frame of FORTREH: Johannes Gutenberg University Mainz (Germany), University of Valencia (Spain), University of Burgundy (Frane), Universidad de estudios de Palermo (Italy),
University of Jyväskylä (Finland), Universitetet i Agder (Norwey).

There also is a cooperation with the Merseburg Technical University in Germany nad many international associations and organisations.

1.5.3. As a measure to attract foreign students it is indicated to be mainly cooperation with recruitment agencies abroad as well as the information in English in the faculty website.

The fact that the main part of study programs is in Latvian is indicated as one one of the reasons for the low number of incoming students. Hence it is planned to provide some programs in English thus increasing the number of foreign students.

The number of outgoing and incoming mobilities of students and staff members in the frame of Erasmus+ projects is relatively low (SAR). During the interview with students from all programs, one of the reasons indicated was the circumstance that most students during their studies have started to work (there is a great demand for them in the labour market) and thus they are not interested in losing their jobs during absence. At the same time, the development plan of SF for 2021-2027 (Annex 2.1.) includes measures in order to increase the number of incoming staff and students.

Conclusions on this set of criteria, by specifying strengths and weaknesses

Sufficient cooperation with national and international institutions and companies within the framework of the study field has been established, achieving the aims and learning outcomes of the SF and the relevant study programmes.
Appropriate criteria for choosing partners are applied. Cooperation types are diverse - joint study programs, exchange of teaching staff, use of material and technical base, student practice, attraction of potential students in schools, etc. A System in order to promote mobility within the study field has been developed. Teaching staff and students participate in both outgoing and incoming mobility, which provides added values to the implementation of the study process and the quality of studies.
The number of outgoing and incoming mobilities of students and staff members in the frame of Erasmus+ projects is relatively low (SAR), especially for outgoing students. During the interview, the main part of students complained of being involved in the practical work, and that was why they found participation in the study mobility being a problem.

Strengths
1.The number of local and foreign partners is great (17 practice cooperation agreements with local enterprises, 23 Erasmus+ agreements, 6 FORTHEM contracts, SAR 2.5.2., tab. 2.5.2.1., tab. 2.5.2.2., Annex 2), so there is a good possibility for different types of collaboration
2.New cooperation partners (higher education institutions) are searched using the scientific contacts of faculty employees (researchers and teaching staff).

Weaknesses
1.Starting the course of work prevents students from participating in study mobility abroad.
2.There is difficulty in recruiting permanent teaching staff with international experience.

Assessment of the requirement [3]

1 R3 - The cooperation implemented within the study field with various Latvian and foreign organizations ensures the achievement of the aims of the study field.

Assessment of compliance: Fully compliant

Good cooperation with local industry companies in providing internships and scientific cooperation; international cooperation within Erasmus+ and other international projects at a good level. However there is a difficulty to attract permanent teaching staff with international experience.

1.6. Implementation of the Recommendations Received During the Previous Assessment Procedures

Analysis

1.6.1.accreditation;
The previous evaluation of the whole study field happened in 2012. Since then, there have been

additional licensing procedures with additional recommendations. (SAR p. 98, annex No.3.)

1. It was recommended to define learning outcomes of study programmes in a more structured way. This recommendation is fully implemented. This study field has revised their study programme learning outcomes at least twice during the time period.
2. It was recommended to define stricter criteria to bachelor programme entrants to reduce drop-out rates. The university has not supported this recommendation, however set goals for lessening drop-out rates and provide more supporting measures for supporting first year bachelor students. The main point of not defining stricter criteria for admission is the chance of scaring away potential students and the possibility of not being able to sort a full group. To lessen the amount of drop-outs a curator system has been implemented and was well regarded during student and graduate interviews as well as meta-courses. It is completely logical and understandable that the university did not define stricter criteria therefore they implemented it in a different way.
3. It was noted that the age of leading professors is close to critical in some fields - yearly since 2013 there have been new positions for professors and associate professors. The study field has included this risk in their plan of development (2021-2027) with a long term goal to promote growth of academic personnel with local and international docents.
4. It was advised to pay more attention to developing academic staff English language skills and to provide some master study courses in the English language. These recommendations have been fully implemented. 25 academic staff related to this study field have recently participated in English language courses. With re-accreditation of the study field, it is planned to start master study programmes fully in english too, therefore all the study materials are prepared for the whole programme study courses.
5. It was recommended for the academic staff to use the moodle system more efficiently. At the time of the visit, it was concluded that different sorts of modules and abilities are used in moodle to use it efficiently and its successfully integrated in daily work for teachers and students. University highlights that this is a recommendation that is constantly improved. This recommendation is fully implemented.
6. It was recommended to involve more students in the quality management system. This recommendation has been implemented fully. During the visit it was clear that the student council works closely with study field administration to provide different sorts of feedback. Students regularly discuss study course survey feedback and possibilities to improve them. Student council has implemented mid-semester surveys and later presented results to study programme directors. This opportunity allows them to fix any up-coming problems in study courses while they are still ongoing in the same semester.
7. It was recommended to pay more attention to extending the content of Master programmes to modelling and application directions. This recommendation is fully implemented, both master study programmes have study courses which are corresponding with these directions.
8. It was recommended to increase cooperation with other HEI’s in Latvia including Daugavpils University and Liepāja University. This recommendation is fully implemented. University did not see the necessity to increase cooperation with Liepāja university due to their low student amount, however significant cooperation increase with Riga Technical University (creating a joint doctoral programme and promotion committee, as well as developing a nanoengineering study programme) and Daugavpils University (creating a joint Masters programme).
9. It was recommended to increase information availability about erasmus possibilities. This recommendation is fully implemented and was confirmed during the visit, student’s confirmed that they are well informed and know that the staff is very forth-coming with erasmus possibilities and go to great lengths to acknowledge their study courses learnt abroad.
10. Previous group of experts strongly recommended creating study courses together with foreign HEI’s with whom they have signed agreements. This recommendation has been implemented fully

with the resources that were possible. The most realistic approach was for the University to create different seminars as a part of specific study courses, e.g. seminars in Applied statistics and others.
11. It was strongly recommended to involve other academic staff of other institutions in the internal evaluation of the study programmes results. This recommendation is fully implemented. Study field involves other academic staff from RTU and DU in the mathematics professor council and various final work commissions. Mathematicians yearly participate in the international conference “Teaching mathematics: retrospective and perspectives” (2013-2018) where they share their expertise.
12. There was observed a lack of cooperation between Physics and Mathematics departments and it was recommended to develop further cooperation within the faculty. This recommendation has been fully implemented. According to annex no. 3, there is regular cooperation between lecturers in these departments, providing study courses for each other’s study programmes, participating in organising conferences and in research.
13. A very strong dependance on ESF availability was observed. This recommendation is not applicable anymore because ESF are not determining Faculty’s daily work and many of academic staff get involved in different scientific fund attraction.
14. It was observed that the quality of Master’s and Doctoral students is decreasing. This recommendation regarding renewing study programmes is fully implemented. Due to some changes in the university and study fields, both previous doctoral programs are now a part of a different study field. University regularly gathers information about graduate employment statistics and has determined that graduates are highly valued in the labour market. This was confirmed by employers during the visit.

Regarding additional recommendations for mathematics study programmes:

1. Study materials for training were not available digitally. This recommendation has been fully implemented as seen during visit (Moodle system presentation and panels with academic staff and students), moodle system is very actively used and there are many different tests and study works available online.
2. It was recommended to use the Moodle systems more in grading etc. This recommendation has been fully implemented. Students and academic staff confirmed that all evaluations are available in Moodle.
3. It was recommended to include more practical works with different programmes in certain study courses. This recommendation has been fully implemented, study courses dependent on IT software usage have been renewed and offer IT software which is up to date with relevant programming knowledge.
4. It was recommended to modernise equipment. This recommendation is fully implemented, because starting 2018 this faculty has moved to new facilities, which have new computers with renewed licences and good services overall. Other recommendations were identical to the ones given for the whole study field and are explained with the same conditions for the programmes.

Regarding additional recommendations for physics programmes:

1. It was recommended for the study programme director to take more responsibility. This recommendation has been fully implemented and supported by internal rules of University of Latvia which determine study programme director responsibility.
2. It was recommended to teach more practical skills. This recommendation is fully implemented. Academic bachelor study programme has study courses such as “Academic practice (2CP)” and “Academic practice II (2CP)”. Other practical skills necessary for the labour market are learned in study courses such as “Computer Networks Laboratory” (2 CP), “Processing images in physics” (2 CP), “Planning, implementation and control of an experiment” (2 CP).

3. It was recommended to develop problem solving skills and to describe learnt outcomes more clearly. This recommendation has been implemented fully in different study courses such as “Introduction to Mathematics for Physicists” (4 CP).
4. It was recommended to modernise equipment. This recommendation is fully implemented, because starting 2018 this faculty has moved to new facilities, which have new computers with renewed licences and good services overall.

Other recommendations were identical to the ones given for the whole study field and are explained with the same conditions for the programmes.

Licensing of study programmes (if applicable);

During the evaluation period (2012-2022) two programmes got licenced. One of them is a joint academic master study programme with University of Daugavpils.

Regarding short-term recommendations.

1. It was recommended to develop algorithms for financial and academic affairs when a student admitted to a single university nevertheless chooses to specialise in a second university. This recommendation has been fully implemented and was confirmed during the visit. The procedure is clear and students also know that they can choose courses from the other university.
2. It was recommended to make changes to the study contract on the DU side. This recommendation has been fully implemented, the contract now includes information on the declared place of life of the student.
3. It was recommended to consider a system which would guide students better to choosing limited-choice study courses. This recommendation is fully implemented and was confirmed during the interviews with students. They were aware of the possibilities and which courses to better choose.

Regarding long-term recommendations.

1. It was recommended to develop an active applicant attraction activity with a view to increasing the number of students. This recommendation has been fully implemented. LU has set up a joint plan with DU to reflex engagement activities according to available resources. It’s planned to review this plan annually with a view to improving it.
2. It was recommended to focus on ensuring equal opportunities for UL and DU students using annual student surveys and in the process of day-to-day studies, in order to identify and address problems in time. It is not possible to determine whether this recommendation has been implemented, since evaluation is happening during the first semester of implementing the new study programme. It is advised to keep evaluating this recommendation until the end of the next evaluation period.
3. It was recommended to create a more favourable environment to promote Erasmus+ opportunities and raise awareness of these possibilities. This recommendation has been fully implemented and confirmed by students during the interviews.
4. It was recommended to survey additional partner schools, which would be able to provide studies to continue to specialise in the study programme and potentially develop cooperation at Baltic level. This recommendation is soon to be fully implemented, because the due date has not been reached yet. University did provide experts with information about developing a new international study programme with partners from all Baltic States, therefore it is safe to assume that this recommendation will be implemented in one way or another.
5. It was recommended to improve the cross-university communication system by focusing directly

on communication between teaching staff, avoiding fragmentation of study courses. This recommendation can't be fully evaluated yet, but so far it is implemented fully. It is advised to keep evaluating this recommendation until the end of the next evaluation period.
6. It was recommended to improve the overall quality management system, prepare an analysis of marketing capabilities etc. This recommendation is in the process of being implemented. It is advised to review this recommendation at the next evaluation.

The other licenced study programme is joint doctoral study programme with Riga Technical University.

Regarding short-term recommendations:

1. It was recommended to identify and supplement study courses with never sources of literature by the beginning of the study programme. This recommendation is fully implemented. Since this programme is closely implemented in cooperation with the Baltic CERN group, they receive various feedback about different topics constantly and are ready to implement these changes as fast as possible.
2. It was recommended to establish and describe or regulate a quality assurance system. This recommendation is fully implemented. Both universities have developed a joint study programme board, which ensures bilateral cooperation.
It was recommended to include in the RTU study contract the credentials, an indication that the joint DSP will be implemented and a reference to the agreement with UL. This recommendation has been implemented fully.

Regarding long term recommendations:

1. It was recommended to establish research laboratories relevant to the direction of the study programme. Since the deadline for implementing this recommendation is the year 2025, it is not easy to determine its implementation stage at this moment. It's understandable that this recommendation has been taken into account.
2. It was recommended to develop an appropriate master's training programme to attract and prepare graduates for doctoral study programmes. This recommendation has been taken into account. At the moment, there has been received funding from the Erasmus Mundus project for developing such a programme. It is planned to be a joint programme between all Baltic states.
3. It was recommended to include in the materials of the publication of the study programme information that applicants must have good English language knowledge while also studying in latvian. This recommendation has been fully implemented.
4. It was recommended to specify study programmes in both universities in which students would be admitted if this study programme loses a licence. This recommendation is fully implemented and the conditions are described in the bilateral cooperation agreement concluded on January 15 2021.
5. It was recommended to include teaching practices as part of the compulsory study process. The university has fully implemented this recommendation in a different way - the teaching practices are integrated in daily work, in participating in presentations, conferences etc.

Conclusions on this set of criteria, by specifying strengths and weaknesses

The University of Latvia has acknowledged previous recommendations and has implemented them to improve the study field and study programmes. There are recommendations that have not yet been implemented such as no. 2, 4.,5. and 6. (long-term reccomendations from licencing of Physics master programme) and no. 1. and 2. (long-term recommendations from licencing of doctoral

programme), but that is due to the fact that the due date is yet to come.
Those recommendations should be implemented till their original deadline.

Strengths

1. Well regarded study programmes in the labour market.
2. Students are aware of the Erasmus possibilities and know that University will be forthcoming to acknowledge study courses learnt abroad.

Weaknesses
No weaknesses were identified

Assessment of the requirement [4]

1 R4 - Elimination of deficiencies and shortcomings identified in the previous assessment of the study field, if any, or implementation of the recommendations provided.

Assessment of compliance: Fully compliant

Most of the recommendations have been fully implemented and acknowledged. It was not possible to evaluate some of the recommendations from licencing of programmes due to them still being in the process of implementing.

1.7. Recommendations for the Study Field

Short-term recommendations

1. Review the master courses for possible unnecessary overlap with bachelor courses.
2. Use opportunities to implement study programs in the English language to attract foreign students and raise international competitiveness, especially at the master's level. The doctoral study program "Particle Physics and Accelerator Technologies" should be implemented only in the English language, there is no reason or practical justification to maintain it in the Latvian language.
3. Continue implementation of all long-term recommendations given to joint master and joint doctoral study programmes since licensing and review the progress every year.

Long-term recommendations

1. Evaluate the impact of implemented changes in study programs on the dynamics of the number of students in the study field and consider other options to attract more students, e.g.: - Positioning mathematics programs in marketing activities as an option to study data science with a specialisation in mathematics; - Developing (or getting involved) interdisciplinary professional bachelor programs in collaboration with industry and other UL units or universities where physics and mathematics are the core fields.
2. Develop mechanisms in order to recruit permanent teaching staff with international experience.
3. Continue implementation of all long-term recommendations given to joint master and joint doctoral study programmes since licensing.

4. Review the goals on the number of international students in the development plan to see if they are possible to attain within the given time span.

II - "Mathematician Statistician" ASSESSMENT

II - "Mathematician Statistician" ASSESSMENT

2.1. Indicators Describing the Study Programme

Analysis

2.1.1. As it results from Annexes 3.9 and 3.10 all field-specific courses and more than 80% (90 CP out of 114) of all courses that constitute the curriculum of the Professional Bachelor's Study Programme “Mathematician Statistician” (code 42460), belong to the Klasius classifications 054, 058 and 059 (Mathematics, Statistics and Natural Sciences), thus we may conclude that the programme is fully compliant with the Study Field Physics, Material Science, Mathematics, and Statistics.

2.1.2. Upon the fulfilment of all requirements the students are conferred the Professional Bachelor’s degree in Statistics Mathematics. The duration of the study programme is four years. Its goal is to prepare qualified mathematicians and statisticians for Latvian state institutions, as well as private sector companies. The aims, learning objectives and outcomes are closely interrelated and suitable for the achievement of the stated goals. The admission requirements are secondary school education and the competition for places is based on the results of centralised examinations.

A legal issue was noticed concerning the professional standard. The professional standard “Statistics Mathematician” (2120 20) mentioned in the description of the study program has expired. Currently, “Statistics Mathematician” is a specialisation within the professional qualification “Senior Data Analysis Specialist” (Standard No PS-224, approved 12.10.2022.). The management of the study program wanted to keep the professional qualification name “Statistics Mathematician”. As a compromise, it was agreed that the professional qualification will be changed to “Senior Data Analysis Specialist” with a specialisation “Statistics Mathematician” to correspond to standard No PS-224.

The particular issue was discussed also with teaching staff, students, alumni and employer representatives during meetings. The majority agreed that the new professional qualification “Senior Data Analysis Specialist” corresponds well to the gained skills as well as actual employment of alumni, and could be used for marketing purposes to attract more new students. During discussions with students and alumni, it was understood that Computer Science (including Data Science) study programs are the main competitors for Mathematics and Physics study programs. It is recommended to reevaluate the marketing approach of the study program and consider its positioning as a branch of Data Science with advanced Mathematics knowledge. It might help to increase the popularity of the study program among high school graduates.

The duration of the study program is 4 years, which corresponds to common practices of professional bachelor study programs. Currently, the study program can be implemented only in the Latvian language which limits its target audience only to graduates of Latvian high schools. From meetings with management, teaching staff, student, alumni and employer representatives, it was understood that the requirement to implement a state budget-funded program in Latvian limits its international competitiveness. The possibility to freely choose an implementation language between Latvian and English would increase the international competitiveness of the study program and

would allow it to expand the target audience.

2.1.3. The recommendations from the previous assessment have been thoroughly analysed and all recommendations resulted in specific action plans that have been already implemented or are in the course of implementation. The only exception is suggestion no. 1.7 regarding the introduction of stricter admission criteria, the HEI argues that such an action would be counterproductive as in recent years they occasionally had problems with achieving the full number of students in the budget. In contrast, the HEI has introduced mentors for first-year students and additional preparatory courses to help achieve the necessary basic knowledge. Implemented actions demand more effort and resources from the HEI, however, are reasonable and might lead to a reduced drop-out rate.

The overall purpose and duration of the program haven't changed since the previous accreditation. However, several relevant changes could be observed in study courses which were implemented based on recommendations from employers or by Cabinet regulation 512 and led to increasing of the field-specific professional specialization courses (Part A) by 10 CP on behalf of practice (Part A) and restricted elective courses (Part B). During the interviews, students and graduates confirmed that implemented changes in study courses are relevant and improve the linking of the program content with the needs of the labour market. It was observed that the feedback loop from employers, graduates and students works well in the improvement of the study program, including in defining the necessary changes in the study courses and their content.

2.1.4. PBSPMS was created in 1997 in response to requests from the economic, financial and insurance sectors for good professionals able to work competently and qualitatively in the field of statistics. Specialist statisticians are also required in public administration in various planning and control positions (ministries, municipalities, audit firms, insurance companies, etc.). According to the official analysis of the Ministry of Economics, the demand for statisticians is still very high and fully justifies the need for the study programme. The enrollment in the programme in the period 2011-2021 has been essentially stable, oscillating between a minimum of 102 (in 2021) and a maximum of 148 (in 2017). A similar assessment holds for the number of graduates which oscillated between a minimum of 15 (in 2016) and a maximum of 33 (in 2015). The values for the last two years (20 and 23) are around the median. Virtually all graduates that do not continue their studies find employment immediately after graduation.

2.1.5. N.A.

Conclusions on this set of criteria, by specifying strengths and weaknesses

Study programme Mathematician Statistician (PBSPMS) is a professional bachelor programme for the training of competent graduates possessing a good blend of mathematical and statistical skills, complemented with some basic literacy in econometric, actuarial and financial sciences. The basic structure, duration and learning outcomes are compliant with national and international standards, however, the legal issue with the reference to the new professional standard No PS-224 in the description of the program should be resolved. The programme has a good number of students and graduates. Graduates are in high demand in the labour market.

Strengths
1. Graduates are in high demand on the job market and can easily find good employment or continue their studies in mathematics or other related fields.
2. Solid enrolment and a number of graduates.

Weaknesses
1. The professional qualification in the description of the study program refers to an outdated professional standard; it should be changed to an updated version according to the new professional standard No PS-224.
2. The number of student dropouts is considerable (around 40%).

2.2. The Content of Studies and Implementation Thereof

Analysis

2.2.1. The general structure of the study programme is a combination of general courses (economics, Latvian legal system, entrepreneurship, and communication), mathematical courses (analysis, algebra, geometry, programming), probability and statistics courses (including random processes, random series, actuarial science, statistical programming), elective courses, practice, final examination and thesis defence. About two thirds of the courses are compulsory, others are elective and give students the opportunity to shape their course of studies according to personal interests and employment plans. A bachelor thesis is required for graduation. The content of the study programme is designed and regulary (every three years) improved based on feedback from internships, employers, student and graduate surveys and directions from teaching staff who conduct scientific and applied research in the field of mathematics. As a result, the programme is able to meet the needs of the labor market, as witnessed by the excellent employability of the graduates. Mapping of the study courses (Annex 3.8) shows that the upon completion of their studies the students are able to achieve all main goals of the programme, namely knowledge and understanding of the axiomatic architecture of mathematics, theoretical results and algorithms, key proof techniques; understanding of the the course materials and IT technologies; ability to solve standard problems, proves results and successfully use IT technologies. In particular, the table 3.2.1.1 in SAR gives a detailed analysis of the coverage of learning outcomes by individual courses. The curriculum (Annex 3.9) shows continuity and increasing level of complexity of the courses which cover all the intended learning outcomes of the programme. Continuity of courses is central, as all courses regularly use concepts and theorems learned in previous courses as prerequisites. For example, students must master the basics of algebra and mathematical analysis before studying further topics in higher analysis and algebra. These are also a base for courses in probability and statistics, differential equations, numerical mathematics etc. The more advanced courses form a core of field-specific specializations, e.g. Actuarial Risk Management, Random Processes, Introductory Course Working with Data,Time Series Analysis, Mathematical Statistics, Course Work Using the Package R, Probability Theory and for most elective courses. The continuity of the courses of study is represented by the prerequisites required to take a particular course. The entire course of studies covers the majority of applied mathematics topics and gives the students a good base either to continue their studies or to proficiently apply their skills in the work place. Compliance with the national education standard and with the professional standard is documented in Annexes 3.6 and 3.7.

2.2.2 N. A.

2.2.3. Most courses are implemented in the form of lectures (introductory, interactive, summary, problem-oriented) and tutorials. Specific courses consist of practical exercises, student seminars and individual and group project work. Practitioners, professionals from different institutions are invited to teach individual lectures in study courses. Small workshops are organised to improve presentation and discussion skills of the students. Courses are coherently designed, are

interconnected and with a very low content overlap. E-learning is extensively used. There is a reasonable amount of student mobility (Annex 2.10). Compliance with national standards is assessed in Annex 5.6. Student centred learning and teaching principles are present in various aspects of the curriculum. Considerable number of elective courses allow the students to choose courses that best fit their interests. Active participation to research projects is encouraged, especially related to the preparation of the Bachelor thesis. Practical tasks, seminars, individual and group work, discussions and project work, visits to external employers and industries are widely used.Student evaluations are used to improve and actualize the teaching process. In particular, they are of central importance for the planning and implementation of updates to the general curriculum and to the contents of individual courses. Formulation of learning outcomes promote students' understanding, self-assessment and ownership of their own learning.

2.2.4. An internship is foreseen and regulated (Annex 5.11). It is frequently related to the students' future employment. Integral to the internship is a detailed report on the work done. Alumni described their internships as a very helpful and formative experience. The practice duration is 20 weeks (20 CT) or 800 hours and is scheduled during the 7th semester. The practice is supervised by the Director of the Bachelor of Mathematics programme, internship supervisor and an employee at the institution where the internship takes place. Each student receives a cover letter from the practice organizer indicating what type of tasks would be expected to be performed at the institution of practice. In loco the students familiarize with the institution's structure and the specific tasks involving mathematical content. The student must agree with the head of practice on one concrete problem to be solved during the practice. At the end of practice, the student prepares a report on the practice institution, problems dealt, methods and an analysis of the results. The report and a reference letter from the practice organizer are submitted to the internship supervisor. Finally the student gives a short presentation to a committee that gives a final evaluation of the practice.
The following titles exemplify the type of internships in the past years: Verification of seasonal air temperature forecasts, Method of logistic regression with application in an ageing study, comparison between Latvia and Sweden, Model selection for monthly analysis of the number of approved leasing applications, Laser-induced fluorescence (LIF) spectral line approximation of potassium-caesium (KCs) spectral lines.

The stated goals of the internship are to become acquainted with the place of practice/internship and its organization, to develop and improve theoretical knowledge acquired by students in practical operation, to acquire professional competence corresponding to the study programme, to apply acquired competences in real situations and to prepare students for the development of bachelor's thesis; These goals are in accordance with the aims of the study programme and its learning outcomes by providing a set of knowledge, skills and competences in accordance with level 6 knowledge, skills and competence of the framework structure specified in the Latvian education classification and to ensure the achievement of scientifically based wide-profile study results

The internship is regulated by "Mathematician Statistician" Regulations of practice/internship (UL FPMO 02.02.2022, Council Decision No 21-2/22) and the corresponding description of PBSPMS study course "Basic Practice for Mathematician Statistician" (20 CP). The internship implementation complies with the regulation requirements.

2.2.5. N. A.

2.2.6. The titles of bachelor theses are mainly related to topics in statistics and financial mathematics, and require integration of contents of different study courses. Part of the final examination are employer's representatives. High final grades witness a high level of knowledge,

skills and competence achieved by the students during their course of studies.Typical examples of bachelor theses with mainly statistical content are Confounding bias and confounder selection, Methods of analysis of hydrological data, Epidemiological study designs, Fallacies and paradoxes in statistics. Typical examples of bachelor theses related to financial mathematics are Real estate price index calculation and forecasting, Oligopoly in the context of Game theory, Clustering analysis in non-life insurance. Other theses topics include Bayesian estimation of the SIR model parameters and Epidemiological study designs (epidemiology), Queueing networks, Recommendation model based on machine learning Collaborative filtering in recommendation systems (big data analysis).

Conclusions on this set of criteria, by specifying strengths and weaknesses

The contents of the study program comply with national regulations and international standards. Basic courses in mathematics and statistics are complemented by a wide range of elective courses and some soft skills. Student mobility is very low. The titles of final theses indicate a high connection with the study program. The content of studies and gained skills correspond to the professional qualification “Senior Data Analysis Specialist” with a specialisation “Statistics Mathematician”.

Strengths
1. Good combination of basic and applied courses which results in very high employability.
2. Final thesis defence and examination contribute to the enforcement of standards and of a high level of graduates.
3. Well-organized practice internship.
4. Strong relations with employers.

Weaknesses
No weaknesses were found

Assessment of the requirement [5] (applicable only to master's or doctoral study programmes)

1 R5 - The study programme for obtaining a master's or doctoral degree is based on the achievements and findings of the respective field of science or field of artistic creation.

Assessment of compliance: Not relevant

N/A

2.3. Resources and Provision of the Study Programme

Analysis

2.3.1. The study program is implemented by the Department of Mathematics of the UL FPMO in collaboration with other departments from the faculty and other UL units. Three teaching staff members are not from the UL - one is from Riga Technical University and two are from the industry - KPMG Baltics Ltd and Evolution Latvia, thus ensuring the link between the industry (potential employers) and the study process. The department has the necessary experience and resources to ensure a high-quality study process, it is also responsible for the implementation of masters and doctoral-level study programs in mathematics. The study program is implemented mainly in the Science Building (Jelgavas 3) of the UL which has been commissioned in 2019, therefore, having appropriate planning and modern equipment for the implementation of the study program.

UL library is a modern open-space type library with many study process suitable working places

accessible 24 hours every day. It ensures access to a wide range of thematic literature both in printed and electronic format. Students have access to all main scientific databases (e.g. Web of Science, Scopus) as well as scientific journals (e.g. Nature, Oxford Journals). Two computer rooms with 30 seats and shared-use portable computers with regular specialised software (e.g. Mathematica, Ansys, COMSOL, MatLab, LabView) are available for use at the FPMO building. Specialised software could be used also on students' personal computers.

Moodle platform is used to ensure an e-study environment. During the Covid-19 time, the teaching staff was forced to improve the study content in the e-study environment and practise distance learning through video calls. As a result, the amount of available/possible study resources in the e-study environment has increased.

2.3.2. N. A.

2.3.3. The state funding (2445,17 euros per year per budget-funded student) is the primary funding source for the study program. The breakdown of the costs is well described showing that the cost-effectiveness of the study program is achieved with 82 or more budget students. According to the last available data from 2022/2021, there were 102 students enrolled in the study program of which 8 were paying for their studies. The total number of students has decreased (from ~140 to ~100). Currently, the study program is financially sustainable and profitable, however, the negative trend in student numbers indicates potential risks to maintaining the cost-effectiveness of the study program in future. From discussions with students, it was understood that computer science (including data science) programs are more popular among graduates of high schools as well as study options abroad. The FPMO has spent a lot of effort in the popularisation of mathematics studies through different outreach activities. Students are highly motivated and most of them have participated in mathematics olympiads during high school. From the discussion with alumni, it was understood that most graduates successfully build their careers as data scientists. Although, the professional qualification will be changed to "Senior Data Analysis Specialist" with a specialisation "Mathematics Statistician". Therefore, it might be used for the marketing of the study program among high school students. Currently, study programs can be implemented only in Latvian according to Latvian legislation that limits possibilities to attract foreign students as well as those Latvians who choose to study abroad. Implementation of the study program in English might also provide new opportunities to increase the number of students.

Conclusions on this set of criteria, by specifying strengths and weaknesses

The study program was implemented by the Department of Physics of the UL FPMO in collaboration with other departments from the faculty and other UL units including also guest lecturers from the industry, thus ensuring the best available teaching staff, laboratory equipment and other study resources for students. The material-technical, informative and methodological base for ensuring a high-quality study process in bachelor-level mathematics statistics studies is appropriate and up to date. The classrooms are well equipped to support modern teaching methods as well as distant learning. Available state budget funding is sufficient for the implementation and development of the study program. However, the negative trend in the student number indicates potential risks to maintaining the cost-effectiveness of the study program. The FPMO has spent a lot of effort in the popularisation of mathematics studies through different outreach activities but talented high school graduates (potential students) tend to choose computer science (including data science) study programs or study mathematics abroad.

Two potential opportunities to attract additional students to the study program were identified:

- Implementation of a study program in English to attract foreign students as well as Latvians who choose to study abroad but in such case, the regulatory framework regarding the use of the Latvian language should be changed
- Positioning mathematics bachelor program in marketing activities as an option to study data science with a specialisation in mathematics statistics

Strengths
1. The study provision is ensured by experienced and well-equipped units from UL FPMO, thus providing the best available options for mathematics statistics studies at the bachelor level.
2.Two guest lecturers are from the industry, thus ensuring a link between the industry (potential employers) and the study process which is very important for a professional bachelor program.
3.The material-technical, informative and methodological base for ensuring a high-quality study process in bachelor-level physics studies is appropriate and up to date.

Weaknesses
1. The number of students (102 in 2021/2022) is sufficient to ensure the financial sustainability of the study program, but a negative trend in student number indicates potential risks to maintaining the cost-effectiveness of the study program, therefore, it remains the main risk for the profitability and financial sustainability of the study program.

Assessment of the requirement [6]

1 R6 - Compliance of the study provision, science provision (if applicable), informative provision (including library), material and technical provision and financial provision with the conditions for the implementation of the study programme and ensuring the achievement of learning outcomes

Assessment of compliance: Fully compliant

The study provision is ensured by experienced and well equipped units from UL FPMO in collaboration with scientific institutions, thus providing best available options for mathematics statistics studies in the bachelor level in Latvia.

2.4. Teaching Staff

Analysis

2.4.1. The teaching staff involved in PBSPMS (SAR Table 3.4.1.1.) is highly qualified within the subject area and over 80% of them are active in research (Annex 2.5) and the rest have professional experience from industry. In total there are 28 teaching staff, 14 of which has a PhD. There are 5 professors or associate professors, which equals the minimum requirement. The requirements for teaching in Latvian are fulfilled. The requirements for teaching in Latvian are fulfilled since the teaching staff has sufficient knowledge of Latvian according to Annex 2.5 and Annex 2.6.

2.4.2. During the last eight-year period, there have been a relatively large number of retirements and recruitments of younger teaching staff members. (SAR Table 3.4.2.1 and Table 3.4.2.2). This has led to shift from associate professors and docent to lecturers and university teachers. The total number of teaching staff involved has increased. The younger members of the teaching staff are more professionally oriented which has strengthened the professional component of the programme.

2.4.3. N. A.

2.4.4. Among the 28 teachers (SAR, Table 3.4.1.1) 26 have relevant publications during the last six years (Annex 2.5). One has no publications, but more than five years of practical experience relevant to the content of the programme. One is an assistant with a recent BSc who has only been employed for a short time.

2.4.5. The development of the programme is discussed regularly with the involved teaching staff in meetings at the department level. As a part of this work, the content of courses is updated to reflect current trends, which is particularly important in the field of data science which is in a state of rapid transformation. These departmental discussions include the connections between courses and how they fit together to achieve the programme objectives. There are also strong connections with relevant employer representatives to ensure the validity of the professional training in the programme.

Conclusions on this set of criteria, by indicating strengths and weaknesses

The teaching staff of the programme is highly competent and to a large extent research active. They are very engaged in the development of the programme. In recent years, the recruitment of new teaching staff in replacement of retirements has led to a strengthening of the professional components of the programme.

Strengths
1. Highly competent teaching staff
2. Well functioning mechanisms for involving teaching staff in programme development
3. Successful recruitment of professionally oriented teaching staff that ensures validity of the professional skills developed in the programme

Weaknesses
No weaknesses were identified

Assessment of the requirement [7]

1 R7 - Compliance of the qualification of the academic staff and visiting professors, visiting associate professors, visiting docents, visiting lecturers and visiting assistants with the conditions for the implementation of the study programme and the requirements set out in the respective regulatory enactments.

Assessment of compliance: Fully compliant

Highly competent academic staff, clearly satisfying the requirements. 28 teaching staff active in research and/or with professional experience from industry.

2.5. Assessment of the Compliance

Requirements

1 1 - The study programme complies with the State Academic Education Standard or the Professional Higher Education Standard

Assessment of compliance: Fully compliant

The study programme “Mathematician Statistician” volume is 160CP of which 20 CP are

compulsory part covering the overall educational field, 38CP cover basic theoretical courses and information technology courses in this field, 24 CP are the field specific professional specialisation courses, 6CP for the free elective part, 40CP for restricted elective courses ,20CP for internships and 12CP for Bachelor's thesis.
Compliance with the study programme with the Professional Higher Education Standard and Cabinet Regulation No.512 is described in Annex No 3.6.

2 2 - The study programme complies with a valid professional standard or the requirements for the professional qualification (if there is no professional standard required for the relevant occupation) provided if the completion of the study programme leads to a professional qualification (if applicable)

Assessment of compliance: Partially compliant

At the point of evaluation, study programme partially complies with a valid professional standard. It will fully comply only in the case when professional qualification is changed to "Senior Data Analysis Specialist" with specialization "Statistics Mathematician" to correspond standard No PS-224. (See 2.1.2. chapter) (see at https://www.google.com/url?q=https://registri.visc.gov.lv/profizglitiba/dokumenti/standarti/2017/PS-224.pdf&sa=D&source=docs&ust=1677106515044268&usg=AOvVaw0tyUO8-rtacGwY_aB_bkmN in Latvian).
The study programme is meeting the criteria set in "Regulations of the Cabinet of Ministers on the Classifier of Professions, Basic Tasks Corresponding to the Profession and Basic Qualification Requirements No. 264" and Professional Higher Education Standard. The study programme complies with a recently made valid professional standard PS-224 and sufficiently provides the required knowledge for carrying out basic tasks for the profession.
The study programme complies with a valid professional standard, see Annex No 3.7.

3 3 - The descriptions of the study courses and the study materials have been prepared in all languages in which the study programme is implemented, and they comply with the requirements set forth in Section 561 , Paragraph two and Section 562 , Paragraph two of the Law on Higher Education Institutions.

Assessment of compliance: Fully compliant

Study course descriptions and study materials are prepared in Latvian and English languages, and they satisfy requirements set in Law on Higher Education Institutions. It must be noted that some study courses, e.g. DartZ1355 has outdated compulsory literature which should be renewed. See annex 3.10.

4 4 - The sample of the diploma to be issued for the acquisition of the study programme complies with the procedure according to which state recognised documents of higher education are issued.

Assessment of compliance: Fully compliant

The diploma issued complies with the state legislature and "Procedures by which documents certifying higher Education recognised by the State shall be issued" (Cabinet of Ministers No. 202). See annex: annex_PBSPMS_Sample of the diploma and its supplement.pdf.
However, in accordance with the above-mentioned about the awarded qualification, these amendments must also be made in the diploma.

5 5 - The academic staff of the academic study programme complies with the requirements set forth in Section 55, Paragraph one, Clause 3 of the Law on Higher Education Institutions.

Assessment of compliance: Not relevant

6 6 - Academic study programmes provided for less than 250 full-time students may be implemented and less than five professors and associated professors of the higher education institution may be involved in the implementation of the mandatory and limited elective part of these study programmes provided that the relevant opinion of the Council for Higher Education has been received in accordance with Section 55, Paragraph two of the Law on Higher Education Institutions.

Assessment of compliance: Not relevant

7 7 - At least five teaching staff members with a doctoral degree are among the academic staff of an academic doctoral study programme, at least three of which are experts approved by the Latvian Science Council in the respective field of science. At least five teaching staff members with a doctoral degree are among the academic staff of a professional doctoral study programme in arts (if applicable).

Assessment of compliance: Not relevant

8 8 - The teaching staff members involved in the implementation of the study programme are proficient in the official language in accordance with the regulations on the level of the official language knowledge and the procedures for testing official language proficiency for performing professional duties and office duties.

Assessment of compliance: Fully compliant

The academic staff has sufficient Latvian language knowledge for implementing study courses, see annex: 2.6.annex_Declarations of the state language.zip

9 9 - The teaching staff members to be involved in the implementation of the study programme have at least B2-level knowledge of a related foreign language, if the study programme or any part thereof is to be implemented in a foreign language (if applicable).

Assessment of compliance: Not relevant

10 10 - The sample of the study agreement complies with the mandatory provisions to be included in the study agreement.

Assessment of compliance: Fully compliant

Study agreements include all necessary parts set in legislation. See the annex: Standard sample of study agreement.zip.

It is advised to include information about guarantees of compensation losses (11. and 12. criteria), so that this information is easier for the students to acknowledge already from the beginning.

11 11 - The higher education institution / college has provided confirmation that students will be provided with opportunities to continue their education in another study programme or another higher education institution or college (agreement with another accredited higher education institution or college) if the implementation of the study programme is terminated.

Assessment of compliance: Fully compliant

University has a record declaration and cooperation agreement with Riga Technical University as confirmation that in case the implementation of this study programme is terminated students will be able to continue studies in UL academic bachelor study programme “Mathematics” or RTU professional bachelor programme “Financial Engineering” See annex: 2.3.Compensations.zip

12 12 - The higher education institution / college has provided confirmation that students are guaranteed compensation for losses if the study programme is not accredited or the study programme’s license is revoked due to the actions (actions or omissions) of the higher education institution or college and the student does not wish to continue studies in another study programme.

Assessment of compliance: Fully compliant

University has a rector's signed refund and compensation policy that confirms it will compensate losses to students if the study programme is not accredited or loses its license and the student does not wish to continue studies in another study programme. See annex: 2.3.annex_Compensations.zip It is advised to include this information in the study agreement.

13 13 - The joint study programmes comply with the requirements prescribed in Section 55.(1), Paragraphs one, two, and seven of the Law on Higher Education Institutions (if applicable)

Assessment of compliance: Not relevant

14 14 - Compliance with the requirements specified in other regulatory enactments that apply to the study programme being assessed (if applicable)

Assessment of compliance: Not relevant

Assessment of the requirement [8]

1 R8 - Compliance of the study programme with the requirements set forth in the Law on Higher Education Institutions and other regulatory enactments.

Assessment of compliance: Fully compliant

The requirement has been met and fulfilled, and all requirements set in different regulatory enactments are satisfied - study programme complies with State professional education standart, professional standart and Law on Higher Education Institutions.

General conclusions about the study programme, indicating the most important strengths and weaknesses of the study programme

The study programme is justified and complies with the study field. The programme is in line with the strategic goals of the University of Latvia. This study programme is well recognized by all stakeholders and should provide the labour market with highly skilled specialists. Most graduates work in the field of data science and find their first job during their studies. Therefore, many topics of bachelor's theses are related to problems to be solved in their workplaces. The content of the study courses corresponds to the objectives of the study programme and ensures the achievement of learning outcomes. Several changes have been implemented in the content of the study program (e.g. new and updated study courses) as an outcome of the feedback from students, graduates and employers. Faculty has a wide provision of the material and technical base, which provides very good opportunities for learning a profession. The legal issue with the outdated professional qualification in the description of the study program looks like a result of miscommunication between the study program management and decision-makers at the ministry level, it was resolved.

Strengths
1. The study provision is ensured by experienced and well-equipped units from UL FPMO, thus providing the best available options for mathematics statistics studies at the bachelor level.
2. The material-technical, informative and methodological base for ensuring a high-quality study process in bachelor-level physics studies is appropriate and up to date.

3. Highly competent teaching staff
4. Successful recruitment of professionally oriented teaching staff that ensures the validity of the professional skills developed in the programme

Weaknesses
1. The number of students (102 in 2021/2022) is sufficient to ensure the financial sustainability of the study program, but a negative trend in student numbers indicates potential risks to maintaining the cost-effectiveness of the study program, therefore, it remains the main risk for the profitability and financial sustainability of the study program.
2. The professional qualification in the description of the study program refers to an outdated professional standard; it should be changed to an updated version according to the new professional standard No PS-224.

Evaluation of the study programme "Mathematician Statistician"

Evaluation of the study programme:

Excellent

2.6. Recommendations for the Study Programme "Mathematician Statistician"

Short-term recommendations

1.Change the professional qualification in the description of the study program to “Senior Data Analysis Specialist” with a specialization “Statistics Mathematician” to correspond to the standard No PS-224.
2. Review descriptions of study courses and update information on literature sources.

Long-term recommendations

1.Consider the positioning of the study program in marketing activities as an option to study Data Science with a specialization in mathematics, thus benefiting from the trend in the profession choice.
2.Consider an opportunity to implement the study program in the English language to attract foreign students and raise international competitiveness.
3.Develop mechanisms in order to recruit permanent teaching staff with international experience.
4.Some effort should be made to lower the number of students that do not finish the course of studies, while keeping at the same time the high level and quality of courses and exams.

II - "Physics" ASSESSMENT

II - "Physics" ASSESSMENT

2.1. Indicators Describing the Study Programme

Analysis

2.1.1. The Academic Bachelor Study Programme Physics (ABSPP), code 43443, is fully compliant with the Study Field Physics, Material Science, Mathematics, and Statistics.

2.1.2. Upon the fulfilment of all requirements the students are conferred the Bachelor’s degree of Natural Sciences in Physics. The duration of the study programme is three years. Its goal is to develop an understanding of physical laws in the surrounding world and technology, to develop creativity, critical thinking, experimental skills, physics and mathematical modelling capabilities, by preparing students for work in research, industry, education or other fields. The aims, learning objectives and outcomes are closely interrelated and are very similar to analogous study programmes in mathematics in most European universities. To be able to enrol in ABSPP, the applicant must have obtained secondary education. If the number of candidates exceeds the number of positions, the admission is based on the results of the centralised national examinations. The teaching language is Latvian which is justified for a bachelor-level study programme. As it results from Annexes 4.9 and 4.10 all field-specific courses and more than 90% of all courses that constitute the curriculum of the Academic Bachelor's Study Programme “Physics” (code 43443), belong to the Klasius classifications 053, 054 and 058 (Physics, Mathematics and other Natural Sciences), thus we may conclude that the programme is fully compliant with the Study Field Physics, Material Science, Mathematics, and Statistics.

2.1.3. The recommendations of the previous assessment were thoroughly analysed and implemented. In particular, the learning outcomes were defined in a more structured way, the academic practice was introduced and e-training materials are now extensively used. The size of the compulsory part (Part A) has been significantly (by 12 CP) increased on behalf of the restricted choice part (Part A). Three study courses related to the acquisition of general knowledge in different thematics were introduced in Part A to ensure better preparation of students for the acquisition of specialization courses. In addition, courses have been updated based on the newest development in the field as well as feedback obtained from employers, graduates and students. Introduced changes are reasonable and might improve the motivation of students and reduce the dropout rate, however, it takes time to assess the impact.

2.1.4. Physics, as a fundamental scientific field, is taught at the bachelor, master and doctoral levels at most classical universities. Physics graduates are essential for the development, application and teaching of physics in every modern society. The statistics on the number of students (Annex 4.5) show that the enrolment and the number of students are essentially stable but it also indicates a considerable decrease in the number of graduates (and the corresponding increase in the number of drop-outs from the programme). That trend is worrying and should be reversed. More than half of final-year students combine their studies with work and practically all graduates that do not continue their studies are employed shortly after their graduation. The overall enrollment in the programme decreased from 135 in 2011 to around 100 in 2018 after which it remained stable with only minimal oscillations. Unfortunately, the number of graduates shows a decreasing trend as it dropped from an average of 30 in the first half of the decade to around 20 in the second half. The main reason is smaller enrollment, as the number of drop-outs remained stable averaging around 35 per year. Note that in the same period, the number of secondary school graduates in Latvia dropped by almost 30% and the number of pupils taking the centralized exams in physics dropped by 35% (from 866 to 570). As for the economic and social justification it has been stated above that all graduates find employment in jobs with high added value and that physics is a fundamental scientific field that should be taught at every complete university.

2.1.5. N. A.

Conclusions on this set of criteria, by specifying strengths and weaknesses

Study programme Physics (ABSPP) provides a basic course of studies in physics at the university

level. The basic structure, duration and learning outcomes are compliant with national and international standards. Graduates are in high demand in the labour market. The main threat is the decreasing number of graduates caused by a rise of students that drop out from the programme.

Strengths
1. Graduates are highly requested on the job market and can easily find good employment or continue their studies in physics and in other related fields.

Weaknesses
1. Increase in the number of students that drop out from the programme and the resulting decrease in the number of students that graduate from the programme.

2.2. The Content of Studies and Implementation Thereof

Analysis

2.2.1. The general structure of the study programme is a combination of basic courses (mathematical analysis and linear algebra, physics 1.-3., advanced physics courses, chemistry), applied courses (engineering physics, electrodynamics, academic practice and soft skills (environment protection). About two thirds of the courses are compulsory, others are elective and give students the opportunity to shape their course of studies according to personal interests and employment plans. A mandatory bachelor thesis is required for graduation. The improvements to the programme are based on the feedback from employers, student and alumni surveys, and in consultations with the programme's faculty, most of whom are active scientists and conduct research in physics. In particular, as a result of employers' recommendations, several new courses have been included or updated, e.g. Scientific Programming for Physicists, Image Processing in Physics, Machine Learning for Physicists, Autonomous Experimental Systems and Computer Networking Laboratory.
Mapping of the study courses (Annex 3.8) shows that upon completion of their studies the students will achieve main goals of the programme, namely knowledge of basic parts of physics, including classical mechanics, electromagnetism, quantum physics, thermodynamics, statistical physics, waves, optics, substance structure, atomic structure, a qualitative understanding of the development of modern physics; know in depth one of the fields of physics, such as atomic physics, spectroscopy, material physics, astronomy, and their current state. execute experiments, acquire experimental data, analyze the data, assess measurement errors, compare the results obtained with theoretical models; use mathematics to describe physical models and solve problems; apply programming languages and prepared software packages to address physical problems, processing, describing and communicating results.
Annex 4.8 shows a hierarchical arrangement of courses, General Physics Part A courses provide the basic principles of physical description by learning classical mechanics, electricity, optics. At the same time students develop experimental, mathematics and IT skills. The following courses of physics are increasingly abstract, e.g. Theoretical mechanics, Electromagnetism, Statistical physics of Quantum physics. After strengthening the students' knowledge of general physics, the proportion of Part B elective courses is increased. These courses are closely linked to research in various subjects, such as atomic physics, spectroscopy, solid-state physics, theoretical physics. Thus, the content of the courses can be immediately updated following science field developments. In experimental courses, students, in addition to developing experimental skills in university laboratories, benefit from the use of scientific equipment of institutes under the guidance of scientists. The continuity of the courses of study is represented by the prerequisites required to take a particular course. The entire course of studies covers the majority of standard physical topics and gives the students a good base either to continue their studies or to proficiently apply their skills in

the work place.

Compliance with the national education standard is documented in Annex 4.6 and is confirmed by the above analysis of the curriculum.

2.2.2. N. A.

2.2.3. Most courses are implemented in the form of introductory lectures, individual, pairs and group work, computer-class practical works, practice exercise tutorials, experimental demonstrations, laboratory work, project work, workshops, training tours to scientific institutes and businesses Courses are coherently designed, are interconnected and with a very low content overlap. E-learning is extensively used. Student mobility is encouraged, and the numbers of incoming and outgoing students are quite good (SAR Annex 2.10). Compliance with national standards is assessed in Annex 5.6. Surveys of students' opinions about the study programme are regularly taken and analysed. The results (SAR Annex 2.11) show a high level of satisfaction with the study programme ABSPP. Student centred learning and teaching principles are present in various aspects of the curriculum. Considerable number of elective courses allow the students to choose courses that best fit their interests. Active participation to research projects is encouraged, especially related to the preparation of the Bachelor thesis. In the study process student communication is promoted, addressing real physical problems and modelling. Systematic transition in the formative physics courses to student-centred learning approach is undertaken. Lectures are supplemented with frequent votes on multiple-choice tasks followed by discussions. Practical tasks, seminars, individual and group work, discussions and project work, visits to external employers and industries are widely used. Student evaluations are used to improve and actualize the teaching process. In particular, they are of central importance for the planning and implementation of updates to the general curriculum and to the contents of individual courses. Formulation of learning outcomes promote students' understanding, self-assessment and ownership of their own learning.

2.2.4. An internship is foreseen and regulated (SAR Annex 4.11). In the Bachelor 's study programme “Physics”, academic practice/internship takes place in the 4th semester of studies (“Academic practice I”) and the 5th semester (“Academic practice II”). Each practice/internship course is 2 credit points corresponding to 80 working hours in the place of practice/internship. The practice is supervised by the Director of the Bachelor of Mathematics programme, internship supervisor and an employee at the institution where the internship takes place. Each student receives a cover letter from the practice organizer indicating what type of tasks would be expected to be performed at the institution of practice. In loco the students familiarize with the institution's structure and the specific tasks involving mathematical content. The student must agree with the head of practice on one concrete problem to be solved during the practice. At the end of practice, the student prepares a report on the practice institution, problems dealt, methods and an analysis of the results. The report and a reference letter from the practice organizer are submitted to the internship supervisor. Finally the student gives a short presentation to a committee that gives a final evaluation of the practice.

The stated goals of the internship are that a student familarizes with the work organisation at the specific workplace, acquire the skills to work in a team , apply the skills acquired in studies to modern physics challenges in academic research, education or applied physics, train problem-solving skills, communication skills, IT skills, analytical and research skills as well as ethical action. These goals are in accordance with the aims of the study programme and its learning outcomes by providing a set of knowledge, skills and competences in accordance with level 6 knowledge, skills and competence of the framework structure specified in the Latvian education classification and to ensure the achievement of scientifically based wide-profile study results

Detailed regulation of the internship can be found in Annex 4.11. The internship complies with the requirements of regulatory enactments.

2.2.5. N. A.

2.2.6. The titles of bachelor theses indicate topics geared toward applications and which require integration of contents of different study courses. High final grades witness a high level of knowledge, skills and competence achieved by the students during their course of studies. The topics of bachelor's theses are in line with the research directions of the institutes involved in the implementation of the ABSPP, demonstrating close links with potential employers and their interest in attracting ABSPF students. Most theses have been written in collaboration with the UL Institutes of Solid State Physics, of Chemical Physics, the FPMO Laser Centre, the Institute of Atomic Physics and Spectroscopy, the Numeric Modelling Institute and the Astronomy Institute. Some characteristic theses titles are Raman spectroscopy of diamond crystals synthesized by CVD method, Optical studies of diphenyl sulfone and benzophenone derivatives for organic light-emitting diodes of third-generation, Influence of correlated disorder on localization phenomena in one-dimensional tight-binding models, Synthesis of gallium oxide based core-shell nanowire heterostructures, Electrocaloric effect of perovskite structure ferroelectrics at large electric fields.

Conclusions on this set of criteria, by specifying strengths and weaknesses

The contents of the academic bachelor study program “Physics (43443)” comply with national regulations and international standards. Basic courses are complemented by a wide range of elective courses and some soft skills. Student mobility is quite good for the bachelor level. The titles of final theses indicate a high connection with the study program.

Strengths
1. Good combination of basic and applied courses which results in very high employability.
2. Final thesis defence and examination contribute to the enforcement of standards and of a high level of graduates.

Weaknesses
No weaknesses were identified.

Assessment of the requirement [5] (applicable only to master's or doctoral study programmes)

1 R5 - The study programme for obtaining a master's or doctoral degree is based on the achievements and findings of the respective field of science or field of artistic creation.

Assessment of compliance: Not relevant

N/A

2.3. Resources and Provision of the Study Programme

Analysis

2.3.1. The study program is implemented by the Department of Physics of the UL FPMO in collaboration with other departments from the faculty and other UL units. The department has the necessary experience and resources to ensure a high-quality study process, it is also responsible for the implementation of masters and doctoral-level study programs in physics. The staff of departments/units involved in the implementation of the study program actively collaborates with

research institutes of the UL and two research structures of the UL FPMO, providing opportunities for students to perform academic practice in scientific laboratories and gain their first scientific work experience. Students have a chance to be actively involved in the scientific activities of institutes as part-time scientific collaborators (information obtained from interviews with students, alumni and staff). As a result, there are cases when bachelor students are involved in the preparation of scientific papers, thus demonstrating a high scientific quality of the study process which can be a good basis for further master studies.

UL library is a modern open-space type library with many study process suitable working places accessible 24 hours every day. It ensures access to a wide range of thematic literature both in printed and electronic format. Students have access to all main scientific databases (e.g. Web of Science, Scopus) as well as scientific journals (e.g. Nature, Physical Review Journals). Two computer rooms with 30 seats and shared-use portable computers with regular specialised software (e.g. COMSOL, MatLab, LabView, Mathematica, Ansys) are available for use at the FPMO building. Specialised software could be used also on students' personal computers.

Moodle platform is used to ensure an e-study environment. During the Covid-19 time, the teaching staff was forced to improve the study content in the e-study environment and practise distance learning through video calls. As a result, the amount of available/possible study resources in the e-study environment has increased. FPMO is located in a relatively new building with well-equipped classrooms to support both modern teaching methods as well as distance learning. The technical support to the study process has received significant investments (150000 euros over the last 3 years) and has been recently modernised.

2.3.2. N. A.

2.3.3. State funding (3097,21 euros per year per budget-funded student) is the primary funding source for the study program. The breakdown of the costs is well described showing that the cost-effectiveness of the study program is achieved with 94 or more budget students. According to the last available data from 2022/2021, there were 101 students enrolled in the study program of which 10 were paying for their studies. The total number of students has decreased (from ~130 to ~100) over the last ten years but is quite stable (~100) during the last few years. Currently, the study program is financially sustainable and profitable, however, the student number is slightly above the margin to maintain the cost-effectiveness of the study program. From discussions with students, it was understood that computer science (including data science) programs are more popular among graduates of high schools and potential physics students as well as study options in physics abroad. The FPMO has spent a lot of effort in the popularisation of physics studies through different outreach activities (e.g. Young Physicist School). Students are highly motivated and most of them have participated in physics olympiads during high school. Two potential opportunities to attract new students were identified. The first, the possibility of implementing a study program in English to attract foreign students which is currently not possible due to legislation. The second, developing and offering new multi-disciplinary professional bachelor study programs in collaboration with other institutions where physics is one of the core disciplines.

It should be noted that the study program is financed also from other funds, e.g. revenues received from lifelong learning and other services, and financial resources accumulated by the FPMO, UL Study Quality Improvement Fund. It ensures the continuation of the development of the study program.

Conclusions on this set of criteria, by specifying strengths and weaknesses

The study program is implemented by the Department of Physics of the UL FPMO in collaboration with other departments from the faculty and other UL units ensuring the best available teaching staff, laboratory equipment and other study resources for students. The material-technical, informative and methodological base for ensuring a high-quality study process in the bachelor level physics studies and its specialisations is appropriate and up to date, The classrooms are well equipped to support modern teaching methods as well as distance learning. The technical support has received significant investments for modernization. Available state budget funding is sufficient for the implementation and development of the study program. However, the student number is slightly above the margin to maintain the cost-effectiveness of the study program. The FPMO has spent a lot of effort in the popularisation of physics studies through different outreach activities (e.g. Young Physicist School) but talented high school graduates (potential students) tend to choose computer science (including data science) study programs or study physics abroad.

Two potential opportunities to attract new students were identified:
1. Implementation of a study program in English to attract foreign students as well as Latvians who choose to study abroad but in such case, the regulatory framework regarding the use of the Latvian language should be changed
2.Developing and offering new multi-disciplinary professional bachelor study programs in collaboration with other institutions where physics is one of the core disciplines.

Strengths
1.The study provision is ensured by experienced and well-equipped units from UL FPMO, thus providing the best available options for physics studies at the bachelor level.
2. FPMO has close collaboration with scientific institutes in the implementation of the study program, students have the option to get a practical introduction to scientific work during academic practice.
3. The material-technical, informative and methodological base for ensuring a high-quality study process in bachelor-level physics studies is appropriate and up to date.

Weaknesses
1. The number of students (101 in 2021/2022) is sufficient to ensure the financial sustainability of the study program, but it is slightly above the margin to maintain the cost-effectiveness of the study program, therefore, it remains the main risk for the profitability and financial sustainability of the study program.

Assessment of the requirement [6]

1 R6 - Compliance of the study provision, science provision (if applicable), informative provision (including library), material and technical provision and financial provision with the conditions for the implementation of the study programme and ensuring the achievement of learning outcomes

Assessment of compliance: Fully compliant

The study provision is ensured by experienced and well equipped units from UL FPMO in collaboration with scientific institutions, thus providing best available options for physics studies in the bachelor level in Latvia.

2.4. Teaching Staff

Analysis

2.4.1. The Academic Bachelor Study Programme in Physics (ABSPP) has a teaching staff that is highly qualified. All the 28 teachers of the compulsory courses have a PhD (SAR Table 4.4.1.1) and a

clear majority of the 40 members of the teaching staff is active in research (SAR 4, Annex 2.5). The number of professors and associate professors involved in the implementation of the compulsory part of the programme is 12 which is well above the minimum of 5 given in the regulation. The language requirements for Latvian bachelor programmes are fulfilled since the teaching staff has sufficient knowledge of Latvian according to Annex 2.5 and Annex 2.6.

2.4.2. Over the last eight-year period there has been a renewal of the teaching staff leading to a considerable reduction of the average age, from 51 to 46 (SAR 3.4.2). Overall, there has been an increase in the number of teaching staff that is involved which has made it possible for the teaching staff to increase their time for research. The renewal of the teaching staff has also led to a shift towards more modern teaching practices with a higher focus on student centred learning.

2.4.3. N. A.

2.4.4. Among the 40 members of the teaching staff of the programme, 37 have published during the last six years, but five of them have not published since 2017. The three exceptions are one PhD student with five years experience as research assistant, one lecturer with more than five years of experience as a work safety specialist, and one assistant professor.

2.4.5.The content of the study programme and the connections between courses are mostly discussed in meetings within the Department of Physics, but when it comes to specialisations, also the scientific institutes at UL are involved. (SAR 3.4.5.) The board of the Department of Physics takes formal decisions. Meeting with teaching staff showed high engagement in programme development.

Conclusions on this set of criteria, by indicating strengths and weaknesses

The teaching staff is highly qualified, and a vast majority is research active in relevant areas. Recent replacements and new recruitments have contributed to a decrease in the average age and an increase in the use of modern teaching methods and student centred learning. The teaching staff is very engaged in the development of the programme.

Strengths
1. Highly competent teaching staff
2. Well functioning mechanisms for involving teaching staff in programme development
3. New teaching staff is bringing a modern student centred learning approach into the programme.

Weaknesses
No weaknesses have been identified

Assessment of the requirement [7]

1 R7 - Compliance of the qualification of the academic staff and visiting professors, visiting associate professors, visiting docents, visiting lecturers and visiting assistants with the conditions for the implementation of the study programme and the requirements set out in the respective regulatory enactments.

Assessment of compliance: Fully compliant

Highly competent academic staff, clearly satisfying the requirements. 40 teaching staff out of which 12 are professors or associate professors. Almost all are research active and have recent

publications in relevant areas.

2.5. Assessment of the Compliance

Requirements

1 1 - The study programme complies with the State Academic Education Standard or the Professional Higher Education Standard

Assessment of compliance: Fully compliant

The study programme “Physics” volume is 120CP of which 88CP are compulsory part, which includes obligatory practice 2CP, 28 CP are the field specific professional specialisation courses (compulsory choice), 4CP for the free elective part, and 10CP for Bachelor’s thesis.
Compliance with the study programme with the Academic Higher Education Standard and Cabinet Regulation no. 240 is described in Annex No 4.6.

2 2 - The study programme complies with a valid professional standard or the requirements for the professional qualification (if there is no professional standard required for the relevant occupation) provided if the completion of the study programme leads to a professional qualification (if applicable)

Assessment of compliance: Not relevant

N/A

3 3 - The descriptions of the study courses and the study materials have been prepared in all languages in which the study programme is implemented, and they comply with the requirements set forth in Section 561 , Paragraph two and Section 562 , Paragraph two of the Law on Higher Education Institutions.

Assessment of compliance: Fully compliant

Study course descriptions and study materials are prepared in Latvian and English languages, and they satisfy requirements set in Law on Higher Education Institutions. See annex 4.10.

4 4 - The sample of the diploma to be issued for the acquisition of the study programme complies with the procedure according to which state recognised documents of higher education are issued.

Assessment of compliance: Fully compliant

The diploma issued complies with the state legislature and “Procedures by which documents certifying higher Education recognised by the State shall be issued” (Cabinet of Ministers No. 202). See annex: ABSPF_Sample of the diploma and its supplement.pdf.

5 5 - The academic staff of the academic study programme complies with the requirements set forth in Section 55, Paragraph one, Clause 3 of the Law on Higher Education Institutions.

Assessment of compliance: Fully compliant

There are at least 5 associate. professors or professors involved in the study programme implementation together. It is confirmed by the Head of Study Field Declaration. See annex: ABSPF_Confirmation that the academic staff complies with the requirements specified in S55 P1 C3 of the Law on Higher Edu.docx

6 6 - Academic study programmes provided for less than 250 full-time students may be implemented and less than five professors and associated professors of the higher education institution may be involved in the implementation of the mandatory and limited elective part of these study programmes provided that the relevant opinion of the Council for Higher Education has been received in accordance with Section 55, Paragraph two of the Law on Higher Education Institutions.

Assessment of compliance: Fully compliant

This criterion is met and AIP has approved the implementation of the study programme. See annex: ABSPF_Opinion of the Council of Higher Education.docx

7 7 - At least five teaching staff members with a doctoral degree are among the academic staff of an academic doctoral study programme, at least three of which are experts approved by the Latvian Science Council in the respective field of science. At least five teaching staff members with a doctoral degree are among the academic staff of a professional doctoral study programme in arts (if applicable).

Assessment of compliance: Not relevant

N/A

8 8 - The teaching staff members involved in the implementation of the study programme are proficient in the official language in accordance with the regulations on the level of the official language knowledge and the procedures for testing official language proficiency for performing professional duties and office duties.

Assessment of compliance: Fully compliant

The academic staff has sufficient Latvian language knowledge for implementing study courses, see annex: 2.6.annex_Declarations of the state language.zip

9 9 - The teaching staff members to be involved in the implementation of the study programme have at least B2-level knowledge of a related foreign language, if the study programme or any part thereof is to be implemented in a foreign language (if applicable).

Assessment of compliance: Not relevant

10 10 - The sample of the study agreement complies with the mandatory provisions to be included in the study agreement.

Assessment of compliance: Fully compliant

Study agreements include all necessary parts set in legislation. See the annex: Standard sample of study agreement.zip.
It is advised to include information about guarantees of compensation losses (11. and 12. criteria), so that this information is easier for the students to acknowledge already from the beginning.

11 11 - The higher education institution / college has provided confirmation that students will be provided with opportunities to continue their education in another study programme or another higher education institution or college (agreement with another accredited higher education institution or college) if the implementation of the study programme is terminated.

Assessment of compliance: Fully compliant

University has a record declaration and cooperation agreement with Riga Technical University as confirmation that in case the implementation of this study programme is terminated students will be able to continue studies in UL academic bachelor study programme “Chemistry” or RTU “Medical Engineering and Physics”. See annex: 2.3.Compensations.zip

12 12 - The higher education institution / college has provided confirmation that students are guaranteed compensation for losses if the study programme is not accredited or the study programme’s license is revoked due to the actions (actions or omissions) of the higher education institution or college and the student does not wish to continue studies in another study programme.

Assessment of compliance: Fully compliant

University has a rector's signed refund and compensation policy that confirms it will compensate losses to students if the study programme is not accredited or loses its licence and the student does not wish to continue studies in another study programme. See annex: 2.3.annex_Compensations.zip It is advised to include this information in the study agreement.

13 13 - The joint study programmes comply with the requirements prescribed in Section 55.(1), Paragraphs one, two, and seven of the Law on Higher Education Institutions (if applicable)

Assessment of compliance: Not relevant

N/A

14 14 - Compliance with the requirements specified in other regulatory enactments that apply to the study programme being assessed (if applicable)

Assessment of compliance: Not relevant

N/A

Assessment of the requirement [8]

1 R8 - Compliance of the study programme with the requirements set forth in the Law on Higher Education Institutions and other regulatory enactments.

Assessment of compliance: Fully compliant

The requirement has been met and fulfilled, and all requirements set in different regulatory enactments are satisfied - study programme complies with State academiceducation standart, and Law on Higher Education Institutions.

General conclusions about the study programme, indicating the most important strengths and weaknesses of the study programme

The study programme is justified and complies with the study filed. The programme is in line with strategic goals of the University of Latvia. This study programme is well recognized by all stakeholders and should provide the labour market with highly skilled specialists. This study programme has the potential to be developed and taught in Latvian and English languages, acquiring students from Latvia and other countries. The content of the study courses corresponds to the objectives of the study programme and ensures achievement of learning outcomes. Several changes have been implemented in the content of the study study program (e.g. new and updated study courses, scientific practice) as an outcome from the feedback from students, graduates and employers. Practice in collaboration with scientific institutes provides an opportunity to get to know potential employers. Faculty has a wide provision of the material and technical base, which provides very good opportunities for learning a profession.

Strengths
1.The study provision is ensured by experienced and well-equipped units from UL FPMO, thus providing the best available options for physics studies at the bachelor level.
2.FPMO has close collaboration with scientific institutes in the implementation of the study program, students have the option to get a practical introduction to scientific work during academic practice.
3. The material-technical, informative and methodological base for ensuring a high-quality study process in bachelor-level physics studies is appropriate and up to date.
4. Highly competent teaching staff
5.New teaching staff is bringing a modern student centred learning approach into the programme.

Weaknesses

1.The number of students (101 in 2021/2022) is sufficient to ensure the financial sustainability of the study program, but a negative trend in student number indicates potential risks to maintaining the cost-effectiveness of the study program, therefore, it remains the main risk for the profitability and financial sustainability of the study program.

Evaluation of the study programme "Physics"

Evaluation of the study programme:

Excellent

2.6. Recommendations for the Study Programme "Physics"

Short-term recommendations

1. The increasing number of drop-outs has multiple causes that should be analysed and then suitable measures should be introduced. In particular, the faculty should find a way to convince the students that it is in their best interest to conclude the study programme before taking full-time employment, as the medium and long-term advantages outweigh the short-time attractiveness of having a good job and income before the formal completion of their course of studies.

Long-term recommendations

1.Consider the collaboration with other UL units or universities to develop interdisciplinary practical bachelor programs where physics is the core field taking into account employers' needs.
2.Consider an opportunity to implement the study program in the English language to attract foreign students and raise international competitiveness.
3.Develop mechanisms in order to recruit permanent teaching staff with international experience.

II - "Mathematics" ASSESSMENT

II - "Mathematics" ASSESSMENT

2.1. Indicators Describing the Study Programme

Analysis

2.1.1. The Academic Bachelor Study Programme Mathematics (ABSPM), code 43460, is fully compliant with the Study Field of Physics, Material Science, Mathematics, and Statistics. As it results from Annexes 5.9 and 5.10 all core courses and more than 80% of all courses that constitute the curriculum of the Academic Bachelor Study Programme Mathematics (ABSPM), code 43460, belong to the Klasius classifications 054, 058 and 059 (Mathematics, Statistics and Natural Sciences), thus we may conclude that the programme is fully compliant with the Study Field Physics, Material Science, Mathematics, and Statistics.

2.1.2. Upon the fulfilment of all requirements the students are conferred the Bachelor’s degree of Natural Sciences in Mathematics. The duration of the study programme is three years. Its goal is to provide students with high-quality academic education in mathematical science, prepare them for further studies in Master of Mathematics or other related Master's programmes in Latvia and worldwide, find employment in industry, education or other fields, develop their abilities to

implement achievements of mathematical science in innovative solutions of scientific, technological and economic problems. The aims, learning objectives and outcomes are closely interrelated and are very similar to analogous study programmes in mathematics in most European universities. To be able to enrol in ABSPM, the applicant must have obtained secondary education. If the number of candidates exceeds the number of positions, the admission is based on the results of the centralised national examinations.

2.1.3. The recommendations from the previous assessment have been thoroughly analysed by the faculty. Almost all recommendations resulted in specific action plans that have been already implemented or are in the course of implementation. A notable exception is suggestion no. 2 (study field) regarding the establishment of stricter admission criteria. The HEI argues that such an action would be counterproductive and decrease the number of applications and consequently the quality of students. To lower the drop-out rate several actions are introduced, including the establishment of a system of programme curators as well as preparatory courses. Implemented actions demand more effort and resources from the HEI, however, are reasonable and might lead to a reduced drop-out rate.

The length of the study program was reduced from 4 years (160 CP) to 3 years (120 CP), and four specializations were introduced after the third semester. The feedback from employers and students was taken into account defining specializations as well as updating study courses. The academic practice was introduced in 2021. Introduced changes are reasonable and are in line with international standards as well as labour market requirements.

2.1.4.Mathematics is a fundamental scientific field and as such, it is taught at the bachelor, master and doctoral level at most complete universities. Mathematics graduates are indispensable in the development, application and teaching of mathematics in every modern society. The statistical data on the number of students (Annex 5.5) show a worrying downward trend that should be reversed. The official forecast by the Ministry of Economy lists the mathematical profession that will see the most significant labour shortages in the medium term. More than half of final year students combine their studies with work and, according to the information gathered in the interviews, practically all graduates that do not continue their studies are employed shortly after their graduation. The enrollment in the programme oscillates between a minimum of 51 (in 2020) and a maximum of 69 (in 2011) with a slightly decreasing trend. The number of graduates shows much bigger variation as the minimum is 2 (in 2019) and the maximum is 13 (in 2011 and 2012). In the last two years the numbers improved and are close to the median value 9. Interestingly, the number of drop-outs is also decreasing and it was 14 in 2021, dropping from 31 in 2012.

As for the socio-economic justifications, all graduates either continue their studies or find high value added jobs, Ministry of Economy lists mathematicians as professions that will have serious labor shortages in the medium term and finally, as a fundamental scientific field, mathematics ought to be taught at the university level and in the main university in the country.

2.1.5. N. A.

Conclusions on this set of criteria, by specifying strengths and weaknesses

Study programme Mathematics (ABSPM) provides a basic course of studies in mathematics at the university level. The basic structure, duration and learning outcomes are compliant with national and international standards. Graduates are in high demand in the labour market. The main threat is the decreasing number of students that enrol and graduate from the programme. Faculty is fully

aware of that problem and invests a lot of effort to reverse the trends. Many of the factors (decreasing student cohorts, public visibility of the STEM fields, competition with more 'practical' study courses, ...) are not within the faculty's reach and would require wider support (from the university, employers, state institutions) to improve the present situation.

Strengths
1. Graduates are in high demand on the job market and can easily find good employment or continue their studies in mathematics or in other related fields.

Weaknesses
1. The overall enrolment at ABSPM is relatively low. Coupled with a high dropout rate it results in a worryingly small number of graduates.

2.2. The Content of Studies and Implementation Thereof

Analysis

2.2.1. The general structure of the study programme is a combination of basic courses (mathematical logic, analysis, algebra, geometry, probability, discrete mathematics, mathematical physics), applied courses (numerical mathematics, programing, statistics, operation research) and soft skills (communication in English for mathematicians, environment protection). About two thirds of the courses are compulsory, others are elective and give students the opportunity to shape their course of studies according to personal interests and employment plans. A mandatory bachelor thesis is required for graduation. The content of the study programme is designed based on the needs of the labor market and the structure of similar programmes at other universities. Mapping of the study courses (Annex 5.8) shows that the upon completion of their studies the students will achieve main goals of the programme, namely knowledge and understanding of the axiomatic architecture of mathematics, theoretical results and algorithms, key proof techniques; . understanding of the the course materials and IT technologies; ability to solve standard problems, proves results and successfully use IT technologies.
The course mapping (Annex 5.9) shows continuity and increasing level of complexity of the courses which cover all the intended learning outcomes of the programme. Continuity of courses is central, as all courses regularly use concepts and theorems learned in previous courses as prerequisites. For example, students must master the basics of algebra and mathematical analysis before studying functional analysis and the theory of functions of complex variable. Thus, there is a cycle of four courses in mathematical analysis, two courses in algebra, three in computer programming. Basic courses can be continued by more advanced courses, like Differential Equations I and II, Equations of Mathematical Physics, Mathematical Statistics, etc. The continuity of the courses of study is represented by the prerequisites required to take a particular course. The entire course of studies covers the majority of standard mathematics topics and gives the students a good base either to continue their studies or to proficiently apply their skills in the work place.

Compliance with the national education standard is documented in Annex 5.6 and is corroborated by the above analysis of the curriculum.

2.2.2. N. A.

2.2.3. Most courses are implemented in the form of lectures (introductory, interactive, summary, problem-oriented) and tutorials. Specific courses consist of practical exercises, student seminars and individual and group project work. Courses are coherently designed, are interconnected and with a very low content overlap. E-learning is extensively used. Student mobility is encouraged, however

the incoming and outgoing numbers are very low (Annex 2.10). According to the assessment of the national Council of Higher Education “Scientists who have obtained education at bachelor's level in mathematics and statistics are required not only in Latvian universities, but also in companies such as banks, insurance, IT firms, etc. The “Information report on medium and long-term labour market forecasts” issued by the Ministry of Economy forecasts a shortage of mathematicians and statisticians on the labour market of a thousand skilled workers by 2035”. Compliance with national standards is assessed in Annex 5.6. Student centred learning and teaching principles are present in various aspects of the curriculum. Considerable number of elective courses allow the students to choose courses that best fit their interests. Active participation to research projects is encouraged, especially related to the preparation of the Bachelor thesis. Student evaluations are used to improve and actualize the teaching process. In particular, they are of central importance for the planning and implementation of updates to the general curriculum and to the contents of individual courses. Formulation of learning outcomes promote students' understanding, self-assessment and ownership of their own learning.

2.2.4. An internship is foreseen and regulated (Annex 5.11), It is frequently related to the students’ future employment. Integral to the internship is a detailed report on the work done. Alumni described their internships as a very helpful and formative experience. The practice duration is 4 weeks (4 CT) and is scheduled at the beginning of the 6th semester. The practice is supervised by the Director of the Bachelor of Mathematics programme, internship supervisor and an employee at the institution where the internship takes place. Each student receives a cover letter from the practice organizer indicating what type of tasks would be expected to be performed at the institution of practice. In loco the students familiarize with the institution's structure and the specific tasks involving mathematical content. The student must agree with the head of practice on one concrete problem to be solved during the practice. At the end of practice, the student prepares a report on the practice institution, problems dealt, methods and an analysis of the results. The report and a reference letter from the practice organizer are submitted to the internship supervisor. Finally the student gives a short presentation to a committee that gives a final evaluation of the practice.
The following titles exemplify the type of internships in the past years: Development of hydrological models, Pairing algorithm for images and descriptions, Data analysis in marketing and sales of a pharmacological company, Applications of Markov chains in credit loss analysis.

The stated goals of the internship are that the students familiarize with mathematics applications, acquire, develop and strengthen the necessary competences in the working environment, gain research skills and prepare for the Bachelor's thesis. These goals are in accordance with the aims of the study programme and its learning outcomes by providing a set of knowledge, skills and competences in accordance with level 6 knowledge, skills and competence of the framework structure specified in the Latvian education classification and to ensure the achievement of scientifically based wide-profile study results

The internship complies with the requirements of regulatory enactments.

2.2.5. N. A.

2.2.6. Most bachelor theses have a considerable applied component, which enhances the already strong connection with the job market. Some typical titles of bachelor theses are Applications of mathematical morphology operators in image processing, Exploring the basic properties of mathematical morphology operators, Modelling natural convection with the finite volume method, Time-parallel numerical methods and Topology optimisation for rod system models. Examples of

theses with purely mathematical content are rarer, e.g. Application of the upper and lower function method to the study of the solvability of second order boundary value problems.

Conclusions on this set of criteria, by specifying strengths and weaknesses

The contents of the study program complies with national regulations and international standards. Basic courses are complemented with a wide range of elective courses and some soft skills. Student mobility is very low. Internships are organised as an integral part of the study curriculum and are an important contribution to the employability of the graduates. The titles of final theses indicate high connection with the study program.

Strengths

1. Good combination of basic and applied courses which results in a very high employability.
2. Final thesis defense and examination contribute to the enforcement of standards and of a high level of graduates.

Weaknesses

1. Student mobility is very low.

Assessment of the requirement [5] (applicable only to master's or doctoral study programmes)

1 R5 - The study programme for obtaining a master's or doctoral degree is based on the achievements and findings of the respective field of science or field of artistic creation.

Assessment of compliance: Not relevant

This is bachelor level program.

2.3. Resources and Provision of the Study Programme

Analysis

2.3.1. The study program is implemented by the Department of Mathematics of the UL FPMO in collaboration with other departments from the faculty and other UL units. The department has the necessary experience and resources to ensure a high-quality study process, it is also responsible for the implementation of masters and doctoral-level study programs in mathematics. The study program is implemented mainly in the Science Building (Jelgavas 3) of the UL which has been commissioned in 2019, therefore, having appropriate planning and modern equipment for the implementation of the study program.

UL library is a modern open-space type library with many study process suitable working places accessible 24 hours every day. It ensures access to a wide range of thematic literature both in printed and electronic format. Students have access to all main scientific databases (e.g. Web of Science, Scopus) as well as scientific journals (e.g. Nature, Oxford Journals). Two computer rooms with 30 seats and shared-use portable computers with regular specialised software (e.g. Mathematica, Ansys, COMSOL, MatLab, LabView) are available for use at the FPMO building. Specialised software could be used also on students’ personal computers.

Moodle platform is used to ensure an e-study environment. During the Covid-19 time, the teaching staff was forced to improve the study content in the e-study environment and practise distance learning through video calls. As a result, the amount of available/possible study resources in the e-study environment has increased.

2.3.2. N. A.

2.3.3. The state funding (2445,17 euros per year per budget-funded student) is the primary funding source for the study program. The breakdown of the costs is well described showing that the cost-effectiveness of the study program is achieved with 52 or more budget students. According to the last available data from 2022/2021, there were 55 students enrolled in the study program of which 5 were paying for their studies. The total number of students has decreased (from 69 to 55). Currently, the study program is financially sustainable and profitable, however, the student number is only slightly above the margin to maintain the cost-effectiveness of the study program. From discussions with students, it was understood that computer science (including data science) programs are more popular among graduates of high schools and potential mathematics students as well as study options in mathematics abroad. The FPMO has spent a lot of effort in the popularisation of mathematics studies through different outreach activities. Students are highly motivated and most of them have participated in mathematics olympiads during high school. From the discussion with alumni, it was understood that most graduates successfully build their careers as data scientists. Therefore, it might be used for the marketing of the study program among high school students. Currently, study programs can be implemented only in Latvian according to Latvian legislation that limits possibilities to attract foreign students as well as those Latvians who choose to study abroad. Implementation of the study program in English might provide new opportunities to increase the number of students.

Conclusions on this set of criteria, by specifying strengths and weaknesses

The study program is implemented by the Department of Physics of the UL FPMO in collaboration with other departments from the faculty and other UL units ensuring the best available teaching staff, laboratory equipment and other study resources for students. The material-technical, informative and methodological base for ensuring a high-quality study process in bachelor-level mathematics studies is appropriate and up to date. The classrooms are well equipped to support modern teaching methods as well as distant learning. Available state budget funding is sufficient for the implementation and development of the study program. However, the student number is slightly above the margin to maintain the cost-effectiveness of the study program. The FPMO has spent a lot of effort in the popularisation of mathematics studies through different outreach activities but talented high school graduates (potential students) tend to choose computer science (including data science) study programs or study mathematics abroad.

Two potential opportunities to attract additional students to the study program were identified:
- Implementation of a study program in English to attract foreign students as well as Latvians who choose to study abroad but in such cases, the regulatory framework regarding the use of the Latvian language should be changed
- Positioning mathematics bachelor program in market activities as an option to study data science with a specialisation in mathematics

Strengths
1. The study provision is ensured by experienced and well-equipped units from UL FPMO, thus providing the best available options for mathematics studies at the bachelor level.

2. The material-technical, informative and methodological base for ensuring a high-quality study process in bachelor-level physics studies is appropriate and up to date.

Weaknesses
1. The number of students (55 in 2021/2022) is sufficient to ensure the financial sustainability of the study program, but it is slightly above the margin (52) to maintain the cost-effectiveness of the study program, therefore, it remains the main risk for the profitability and financial sustainability of the study program.

Assessment of the requirement [6]

1 R6 - Compliance of the study provision, science provision (if applicable), informative provision (including library), material and technical provision and financial provision with the conditions for the implementation of the study programme and ensuring the achievement of learning outcomes

Assessment of compliance: Fully compliant

The study provision is ensured by experienced and well equipped units from UL FPMO in collaboration with scientific institutions, thus providing best available options for mathematics studies in the bachelor level in Latvia.

2.4. Teaching Staff

Analysis

2.4.1. The teaching staff involved in the academic bachelor study programme in mathematics (ABSPM) is highly qualified within the subject area, most of them are active in research and 16 out of 27 have a PhD (SAR Table 5.4.1.1). Among the teaching staff, there are 8 professors or associate professors, exceeding the minimum of 5 given by the regulations. The remaining teaching staff are lecturers, researchers and assistants. The requirements for teaching in Latvian are fulfilled since the teaching staff has sufficient knowledge of Latvian according to Annex 2.5 and Annex 2.6.

2.4.2. During the last eight-year period, there have been a relatively large number of retirements and recruitments of younger teaching staff members. (SAR 3.4.2). This has led to a shift from associate professors and docent to lecturers and university teachers. The younger members of the teaching staff are supported to develop their competencies and skills so that the quality is maintained.

2.4.3. N. A.

2.4.4. Among the 27 members of the teaching staff involved in the programme, all but two have published during the last six years. One of the exceptions is an assistant with a recent BSc who has four years of experience as laboratory assistant and the other exception is a university teacher with only publications in Latvian.

2.4.5. The development of the programme is discussed regularly with the involved teaching staff in meetings at the department level, both informal and informal meetings.. These discussions include the connections between courses and how they fit together to achieve the programme objectives. (SAR 3.4.5) The meeting with the teaching staff of the programme showed that they are deeply involved in the discussion about programme development and these mechanisms are sufficient to ensure that courses are linked within the programme.

Conclusions on this set of criteria, by indicating strengths and weaknesses

The teaching staff involved in the programme is in general highly qualified and to a large extent active in research active in relevant areas. They are also active in the continuous discussions on the development of the programme. Recent replacements and new recruitments have led to a shift from associate professors and docents to lecturers and university teachers, but the number of professors and associate professors is still sufficiently high.

Strengths
1. Highly competent teaching staff
2. Well functioning mechanisms for involving teaching staff in programme development

Weaknesses
No weaknesses were identified

Assessment of the requirement [7]

1 R7 - Compliance of the qualification of the academic staff and visiting professors, visiting associate professors, visiting docents, visiting lecturers and visiting assistants with the conditions for the implementation of the study programme and the requirements set out in the respective regulatory enactments.

Assessment of compliance: Fully compliant

Highly competent academic staff, clearly satisfying the requirements. 27 teaching staff, 16 of which have a PhD. All but two have recent publications in relevant areas.

2.5. Assessment of the Compliance

Requirements

1 1 - The study programme complies with the State Academic Education Standard or the Professional Higher Education Standard

Assessment of compliance: Fully compliant

The study programme “Mathematics” volume is 120CP of which 86CP are compulsory part, which includes obligatory practice in mathematics 4CP and 10CP for Bachelor thesis, 32 CP are the compulsory choice courses of which 24CP are specialisation study courses and 8CP are free compulsory choice courses, 2CP for the free elective part.
Compliance with the study programme with the Academic Higher Education Standard and Cabinet Regulations No. 240 is described in Annex No 5.6.

2 2 - The study programme complies with a valid professional standard or the requirements for the professional qualification (if there is no professional standard required for the relevant occupation) provided if the completion of the study programme leads to a professional qualification (if applicable)

Assessment of compliance: Not relevant

3 3 - The descriptions of the study courses and the study materials have been prepared in all languages in which the study programme is implemented, and they comply with the requirements set forth in Section 561 , Paragraph two and Section 562 , Paragraph two of the Law on Higher Education Institutions.

Assessment of compliance: Fully compliant

Study course descriptions and study materials are prepared in Latvian and English languages, and they satisfy requirements set in Law on Higher Education Institutions. See annex 5.10.

4 4 - The sample of the diploma to be issued for the acquisition of the study programme complies with the procedure according to which state recognised documents of higher education are issued.

Assessment of compliance: Fully compliant

The diploma issued complies with the state legislature and “Procedures by which documents certifying higher Education recognised by the State shall be issued” (Cabinet of Ministers No. 202). See annex: ABSPM_Sample of the diploma and its supplement.pdf.

5 5 - The academic staff of the academic study programme complies with the requirements set forth in Section 55, Paragraph one, Clause 3 of the Law on Higher Education Institutions.

Assessment of compliance: Fully compliant

There are at least 5 asoc. professors or professors involved in the study programme implementation together. It is confirmed by Head of Study Field Declaration. See annex: ABSPM_Confirmation that the academic staff complies with the requirements specified in S55 P1 C3 of the Law on Higher Edu.docx

6 6 - Academic study programmes provided for less than 250 full-time students may be implemented and less than five professors and associated professors of the higher education institution may be involved in the implementation of the mandatory and limited elective part of these study programmes provided that the relevant opinion of the Council for Higher Education has been received in accordance with Section 55, Paragraph two of the Law on Higher Education Institutions.

Assessment of compliance: Fully compliant

This criterion is met and AIP has approved the implementation of the study programme. See annex: Opinion of the Council of Higher Education.docx

7 7 - At least five teaching staff members with a doctoral degree are among the academic staff of an academic doctoral study programme, at least three of which are experts approved by the Latvian Science Council in the respective field of science. At least five teaching staff members with a doctoral degree are among the academic staff of a professional doctoral study programme in arts (if applicable).

Assessment of compliance: Not relevant

8 8 - The teaching staff members involved in the implementation of the study programme are proficient in the official language in accordance with the regulations on the level of the official language knowledge and the procedures for testing official language proficiency for performing professional duties and office duties.

Assessment of compliance: Fully compliant

The academic staff has sufficient Latvian language knowledge for implementing study courses, see annex: 2.6.annex_Declarations of the state language.zip

9 9 - The teaching staff members to be involved in the implementation of the study programme have at least B2-level knowledge of a related foreign language, if the study programme or any part thereof is to be implemented in a foreign language (if applicable).

Assessment of compliance: Not relevant

10 10 - The sample of the study agreement complies with the mandatory provisions to be included in the study agreement.

Assessment of compliance: Fully compliant

Study agreements include all necessary parts set in legislation. See the annex: Standard sample of study agreement.zip.
It is advised to include information about guarantees of compensation losses (11. and 12. criteria), so that this information is easier for the students to acknowledge already from the beginning.

11 11 - The higher education institution / college has provided confirmation that students will be provided with opportunities to continue their education in another study programme or another higher education institution or college (agreement with another accredited higher education institution or college) if the implementation of the study programme is terminated.

Assessment of compliance: Fully compliant

University has a record declaration and cooperation agreement with Riga Technical University as confirmation that in case the implementation of this study programme is terminated students will be able to continue studies in RTU professional bachelor study programme “Financial Engineering”. See annex: 2.3.Compensations.zip

12 12 - The higher education institution / college has provided confirmation that students are guaranteed compensation for losses if the study programme is not accredited or the study programme’s license is revoked due to the actions (actions or omissions) of the higher education institution or college and the student does not wish to continue studies in another study programme.

Assessment of compliance: Fully compliant

University has a rector's signed refund and compensation policy that confirms it will compensate losses to students if the study programme is not accredited or loses its licence and the student does not wish to continue studies in another study programme. See annex: 2.3.annex_Compensations.zip It is advised to include this information in the study agreement.

13 13 - The joint study programmes comply with the requirements prescribed in Section 55.(1), Paragraphs one, two, and seven of the Law on Higher Education Institutions (if applicable)

Assessment of compliance: Not relevant

14 14 - Compliance with the requirements specified in other regulatory enactments that apply to the study programme being assessed (if applicable)

Assessment of compliance: Not relevant

Assessment of the requirement [8]

1 R8 - Compliance of the study programme with the requirements set forth in the Law on Higher Education Institutions and other regulatory enactments.

Assessment of compliance: Fully compliant

The requirement has been met and fulfilled, and all requirements set in different regulatory enactments are satisfied - study programme complies with State academiceducation standart, and Law on Higher Education Institutions.

General conclusions about the study programme, indicating the most important strengths

and weaknesses of the study programme

The study programme is justified and complies with the study filed. The programme is in line with strategic goals of the University of Latvia. This study programme is well recognized by all stakeholders and should provide the labour market with highly skilled specialists. Most graduates work in the field of data science and finds the first job during studies. This study programme has the potential to be developed and taught in Latvian and English languages, acquiring students from Latvia and other countries. The content of the study courses corresponds to the objectives of the study programme and ensures achievement of learning outcomes. Several changes have been implemented in the content of the study study program (e.g. new and updated study courses) as an outcome from the feedback from students, graduates and employers. Faculty has a wide provision of the material and technical base, which provides very good opportunities for learning a profession. To further promote internationalization and offer more opportunities for students and staff, experts suggest to review the option to implement this programme in English language.

Strengths

1. The study provision is ensured by experienced and well-equipped units from UL FPMO, thus providing the best available options for mathematics studies in the bachelor level.
2. The material-technical, informative and methodological base for ensuring a high-quality study process in bachelor-level physics studies is appropriate and up to date.
2. Highly competent teaching staff.

Weaknesses

1. The number of students (55 in 2021/2022) is sufficient to ensure the financial sustainability of the study program, but it is slightly above the margin (52) to maintain the cost-effectiveness of the study program, therefore, it remains the main risk for the profitability and financial sustainability of the study program.

Evaluation of the study programme "Mathematics"

Evaluation of the study programme:

Excellent

2.6. Recommendations for the Study Programme "Mathematics"

Short-term recommendations

Long-term recommendations

1.Consider the positioning of the study program in marketing activities as an option to study Data Science with a specialization in mathematics, thus benefiting from the trend in the profession choice.
2.Consider an opportunity to implement the study program in the English language to attract foreign students and raise international competitiveness.
3.Develop mechanisms in order to recruit permanent teaching staff with international experience.

4.Increase in the number and quality of students should be the main priority for the long-term survival and development of the study programme. It requires a coordinated and sustained effort to increase the visibility of the study programme (both among the high-school students and among the general population), and the general awareness of the excellent career opportunities in academia, research and development, and attractive employment opportunities in IT, finance and high-tech jobs. This cannot be achieved by the faculty alone, but requires a combined effort of the University, prospective employers and relevant state institutions.
5.Although mobility is an important aspect of higher education, it is more topical and easier to organise at the master level. For outgoing students the most important factors are adequate financing and flexibility in the preparation of learning agreements. For incoming students the main problem is the language barrier.

II - "Physics" ASSESSMENT

II - "Physics" ASSESSMENT

2.1. Indicators Describing the Study Programme

Analysis

2.1.1. The Academic Master Study Programme Physics (AMSPP), code 45443 is fully compliant with the Study Field Physics, Material Science, Mathematics, and Statistics, which is reasonably justified in Annex 6.4 "Compatibility of the joint study program with the requirements of the law of Higher education" and Annex 6.6 "Compliance of the Academic Master's Study Programme "Physics" with the State Education Standard".

2.1.2. The Master's degree of Natural Sciences in Physics is given to students that fulfil the requirements at the end of the two-year full time Academic Master Study Programme Physics (45443). The programme, which is a joint programme between LU and DU, has two implementations, one in Latvian and one in English. The goal of the programme is "to prepare highly qualified and internationally competitive master-level physics specialists for the labour market, providing an opportunity to specialise in sub-disciplines of physics specific to Latvia with high research and innovation potential and stimulating the acquisition of interdisciplinary competence during studies." There is a clear alignment between aims, objectives and learning outcomes. The admission requirements allow for other backgrounds than a bachelor's degree in physics or mathematics if additional requirements for courses in physics and mathematics are satisfied. The implementation of the programme in English which is justified because of the intended international recruitment in addition to the national recruitment.

2.1.3. The program is new since 2021 with the first students admitted in 2022, but it builds on previous master programs at LU and UD. The recommendations from the licensing of the programs have been analysed and most of them have already been fully implemented. Two of them cannot be evaluated yet since the start of the programme is too recent, and they need to be monitored in the next accreditation. The major changes compared to the previous programme have been made to give more focus on specialisations and to offer the programme in English as well as in Latvian. The English option will clearly make the programme more attractive for incoming exchange students.

2.1.4. The new programme does not have enough data, but if we also look at the previous programme, we can see that there is a decrease in the number of students with 47 graduates 2017-2021 compared to 84 graduates 2011-2015. Since most of the students enrolled in the

programme comes from ABSPP, there is a correlation between the number of students in these two programmes. The statistics on student enrolment in Annex 6.5 does not include information about in which of the two universities the students have been enrolled.
The development of the new programme is in part a response to the dropping number of students with the idea that the focus on specialisations and offering the programme in English will increase the attractivity of the programme. This is in itself one of the justifications for the new study programme. There is also evidence for a growing demand for graduates from master programmes in STEM fields in general as can be seen from SAR 3.1.3. A further justification is the fact that this will be the only study programme in Latvia leading to a MSc degree in Physics.

2.1.5. The University of Latvia and the University of Daugavpils have made a mutual agreement (AMSPP Other annexes, “UL and DU Agreement about AMSPP.docx”) for the implementation and the development of AMSPP. There are strategic reasons from both sides that have led to this agreement. The joint programme allows the two universities to use each other’s expertise in sub-disciplines of physics to offer more and deeper specialisations to their students. In the view of decreasing numbers of students and international competition, it is an advantage to join forces and create an internationally competitive programme. The quality assurance system for the joint programme is not clearly specified in the SAR which makes it hard to evaluate.

Conclusions on this set of criteria, by specifying strengths and weaknesses

The Academic Master Study Programme Physics (AMSPP) is a newly developed joint programme between University of Latvia and University of Daugavpils that builds on previous master programmes and where the joined forces will allow for more specialisations. Part of the reason for introducing the new programme is also to meet the challenges of decreasing number of students. Offering the programme also in English is an important step towards increasing the number of incoming students.

Strengths

1. The collective competence at LU and UD allows for many specialisations
2. The implementation of the programme in English can attract international students

Weaknesses

1. The low number of students in recent years (13-23 new students per year in the old programme 2017-2021).
2. Vague description of the quality assurance system for the joint program.

2.2. The Content of Studies and Implementation Thereof

Analysis

2.2.1. The curriculum and course content is thoughtful, interconnected and complementary, as well as relevant to the industry. The planning of the academic master's study program and the succession of courses indicate a targeted opportunity for graduates of the bachelor's study program "Physics" to continue their education in physics at the master's level. The study program meets the goal of the program to prepare highly educated specialists for work in the field of physics in general. Table 6.6, provided in the appendix, indicates the compliance of the study program with regulations No. 512 "Regulations on state standard second-level professional higher education". SAR section 3.2.1 provides a detailed analysis regarding the relevance of the study program, linking of

courses/modules, compliance with program objectives and industry trends, compliance with national legislation. Interviews of students, lecturers and graduates fully confirm this.
The relevance of the studies is confirmed by the declared specialization opportunities (Astrophysics, Atomic, molecular and optical physics, Physics of solids and materials, Physics of continuous environment, Physics of technology, Theoretical physics), which are not offered in other universities in the country, the high scientific level of implementation is confirmed by access to internationally recognized staff, high level laboratories and other resources.
The compliance of the program with the national standard is given in Appendix 6.6, the compliance of the courses with the objectives of the program is presented in Appendix 6.8. Interviews of students, program management and lecturers confirm compliance.

The compliance of the academic study program with the professional qualification requirements is not applicable.

2.2.2. The relevance of the academic master's study program "Physics" to the field of study is determined by its content. Physics precisely and uniquely corresponds only to the field of study "Physics, material science, mathematics and statistics". This study program is currently the only academic master's study program in Latvia that is directly related to physics. The admission requirements are designed in such a way that graduates of physics bachelor's programs, as well as those who have obtained bachelor's education in related fields, can continue their studies in physics in the master's study program, thus generally obtaining interdisciplinary education, for which there is a growing demand. According to paragraph 58 of the Law on Universities, the study program for obtaining a master's degree must end with a final examination, which includes the development and defence of the master's thesis. SAR 3.2.2 mentioned arguments for the high evaluation of master's level studies - academic practice is implemented in the interaction of the industry and academic staff, representatives of the industry participate in the development and evaluation of practice works, while in most cases the master's theses are developed this year. the scientific topic of the relevant academic staff, therefore the master's degree is based on scientific achievements and knowledge in the field of creativity. Master's study programs end with a master's thesis. Exams in study courses are oral, written and combined. In the period since 2011, 144 master's students have graduated from this program (Appendix 6.5). Therefore, the commission recognized their achieved results as appropriate for awarding the degree. The above confirms that the awarding of the degree is based on achievements and knowledge in the relevant field of science.

2.2.3. In paragraph 3.2.3 of the SAR the study implementation methods are clearly described - they are both oral, written and combined study and assessment methods. Methods of acquiring and strengthening knowledge are also described, which contribute to the variety and versatility of learning the course content. Practitioners, professionals from various institutions are invited to teach individual lectures in study courses in order to promote the unity of theory and practice. Practical tasks, seminars, individual, pair and group work, discussions and project development, study tours to industry organisations are widely used. Employers are involved in the implementation and development of study courses. In order to foster the development of students' research competence, students have the opportunity to analyse and study in depth problems of interest to them in the field in successive courses. Senior students are involved in peer teaching-learning. Student interviews confirm that the study implementation methods are focused on the student and really help to learn the content of the study courses in a comprehensive manner. Methods such as solving industry problems, situation modelling, flipped classrooms are used. Student interviews confirm that since the master's study program in Physics is shared with Daugavpils University, distance learning is widely used, which facilitates students' access to the study process.
It can be seen from the SAR that student-centred learning and teaching principles are considered:

"In order to foster the development of students' research competence, students have the opportunity to analyze and study in depth problems of interest to them in the field in successive courses" (e.g. "Research Laboratory Works I and II", "Numerical Simulation of Physical Processes", "Academic Practice of Physic's Master", "Master Thesis in Physics I" and "Master Thesis in Physics II"). Senior students are involved in peer teaching-learning. In the seminars, students' speaking, presentation and discussion skills are promoted. This is particularly evident in the courses "Current Topics in Physics and Astronomy I and II", "Numerical Simulation of Physical Processes". In addition, the SAR clause mentions: "The student-centred approach is followed when updating study programs and their study courses, with special attention paid to the meaningful formulation of study outcomes, thus promoting dialogue between lecturers and students on study content, forms of organization and methods. Correctly formulated learning outcomes, in turn, promote students' understanding and ownership of their own learning, self-assessment and understanding of the assessment received. In the study process, lecturers use methods, forms of examination and assessment criteria that are appropriate to the aim of the study and the planned study outcomes."
In SAR section 3.2.3, much attention is paid to the realization of studies in two remote cities - Riga and Daugavpils.
Possibilities for remote and hybrid study courses are used. Connecting students remotely using modern IT methods, for example using MS Teams, is a well-proven solution in the last two years. Special attention is paid to the availability of study materials and provision of consultations in remote mode. An opportunity is provided for the implementation of study courses according to a "compressed time schedule" - for example, the study course is completed within 1 month, reducing the time students need to be in another city. The conduct of individual study courses (for example, practice and development of a master's thesis) can be equally provided both at LU and DU.

2.2.4 Both student interviews and SAR paragraph 3.2.4 analysis confirm that in the academic master's study program Physics, internship is implemented in the amount of 6 credit points (9 ECTS). Internships are organised in the structural units of the LU / DU natural sciences, as well as in other organisations where fundamental or applied research is carried out (LU Institute of Physics, LU Institute of Atomic Physics and Spectroscopy, LU Institute of Chemical Physics, Institute of Solid State Physics (CFI), DU Institute of Life Sciences Technology department) or Science Intensive Manufacturing (from SAR, paragraph 3.2.4). All of them are high-level physics-related research centres where students can achieve internship goals. Since the research units are part of UL or UD, students have access to these internships, where the achievable results related to the study process are realised. However, the involvement of Daugavpils University students in full studies, in particular internship, is partly related to the change of residence; in distance studies, the quality of the studies may also vary. It takes time to evaluate this aspect; currently, after licensing, there is a small number of students from Daugavpils. Appendix 6.11 confirms the compliance of practice with regulatory enactments. They also provide internships for foreign students, as confirmed by an interview with the head of the Institute of Solid State Physics.

2.2.5. N. A.

2.2.6. The subtle description of the SAR paragraph 3.2.6 and the interviews of the students, graduated and lecturers confirm that the topics of the final theses are fully relevant to the study field and correspond to the study program. The topicality and compliance of the final theses is also evidenced by the high ratings of them (average ratings of the theses are equal to or higher than 8), which is directly facilitated by the implementation of the student`s works mainly in high -level research institutions. Table 6.2.5.1 shows that supervisors are evenly distributed and can fully indulge in work with students. Topics of final theses such as "Investigation of electromagnetically excited liquid metal flow for aluminum transport and degassing in a linear channel", "Synthesis,

properties and applications of bismuth and antimony chalcogenide/carbon nanotube heterostructures for flexible thermoelectric devices", "Development of novel 1D ZNO/PDA core-shell nanostructures with improved structural, electronic, optical and sensing properties, Quantitative analysis of europium ion distribution and properties in glass ceramics", "Calculation of cobalt and iron containing perovskite materials using the AOLK method with hybrid density functionals", "High-resolution spectroscopic studies and electronic structure analysis of the A~b complex of the Cs2 molecule", "High-resolution spectroscopy of pulsating stars near the AMZ peak" shows the involvement of high-level work supervisors and the capabilities of scientific laboratories.

Conclusions on this set of criteria, by specifying strengths and weaknesses

The content of studies in the academic master's study program corresponds to the sector and meets the goals of the program and national legislation. The awarding of the master's degree follows principles based on student achievement; studies are student-oriented, promoting the availability of versatile knowledge. Students are given wide specialization options in the field of physics. Student internships are implemented in high-level scientific institutions or scientific companies that promote high-quality final theses. The application of the student-centred approach in the implementation of the joint study program provides opportunities to choose suitable internship sites, implement individual courses in the form of modules, and apply innovative teaching methods, such as distance learning, etc. The topics of the final theses are relevant to the field of study, and the high average grades indicate a high quality of the study process as a whole.

Strengths
1. The content of the study program is fully in line with the objectives of the program, allows the planned results to be achieved and meets national legislation.
2. The implementation of the study program is versatile, in close connection with scientific institutions and allows the development of high-quality final theses.

Weaknesses
1. Remotely taught Daugavpils students may vary in their knowledge of the content of the program.

Assessment of the requirement [5] (applicable only to master's or doctoral study programmes)

1 R5 - The study programme for obtaining a master's or doctoral degree is based on the achievements and findings of the respective field of science or field of artistic creation.

Assessment of compliance: Fully compliant

The study program for obtaining an academic master's degree is based on physics achievements and findings, studies and practice are organised in accordance with normative acts.

2.3. Resources and Provision of the Study Programme

Analysis

2.3.1. The study program is implemented jointly by two universities (the University of Latvia and Daugavpils University). Such consolidation of resources ensures master-level studies in physics in the two largest cities of Latvia - Riga and Daugavpils. The Department of Physics of the UL FPMO responsible for the implementation of the study program together with partner departments and institutions has the necessary experience and resources to ensure a high-quality study process, it is also responsible for the implementation of bachelor and doctoral level study programs in physics.

Six different departments/units with relevant expertise and laboratory provision are responsible for the implementation of six different specialisations of the study program. The staff of departments/units involved in the implementation of the study program actively collaborates with six research institutes of the UL, two research structures of the UL FPMO and one research centre of the DU, thus ensuring synergy between the study process and science. In total, 66 teaching staff members with relevant expertise and good or even excellent scientific track record are involved in the implementation of 67 study courses. Students have a chance and are actively involved in the scientific activities of these institutes as part- or full-time scientific collaborators (information obtained from interviews with students, alumni and staff). Research results of master thesis are often published in peer-reviewed journals, thus demonstrating a high scientific quality of the study process which can be a good basis for further doctoral studies.

UL library is a modern open-space type library with many study process suitable working places accessible 24 hours every day. It ensures access to a wide range of thematic literature both in printed and electronic format. Students have access to all main scientific databases (e.g. Web of Science, Scopus) as well as scientific journals (e.g. Nature, Physical Review Journals). Two computer rooms with 30 seats and shared-use portable computers with regular specialised software (e.g. COMSOL, MatLab, LabView, Mathematica, Ansys) are available for use at the FPMO building. Specialised software could be used also on students' personal computers.

Moodle platform is used to ensure an e-study environment. During the Covid-19 time, the teaching staff was forced to improve the study content in the e-study environment and practise distance learning through video calls. As a result, the amount of available/possible study resources in the e-study environment has increased. FPMO is located in a relatively new building with well-equipped classrooms to support both modern teaching methods as well as distance learning.

The Department of Physics of the UL FPMO has the necessary prerequisites for the implementation of the study program in English. All teaching staff has English knowledge at B2 or higher level, the majority (~77%) in C1 or C2. English is the main professional language in physics in which most actual professional literature is written, the library provides necessary access to books (in both paper and electronic formats) as well as scientific papers. During the interviews, the teaching staff confirmed the readiness to start the implementation of the study program in English.

All students have equal rights to access resources used for the implementation of the joint study program in both universities. They have access to information resources in both libraries as well as e-study platforms. However, from interviews with students, it was understood that all study courses have been implemented by the UL so far and UL students haven't had a need to access resources in the DU. There are only a few students who have been enrolled in DU and they have a chance to participate in the study process remotely. It is too early to evaluate the collaboration between the UL and the DU in the implementation of the joint study program but it should remain as important accept to be assessed by the next accreditation.

2.3.2. N. A.

2.3.3. State funding (4645,81 euros per year per budget-funded student) is the primary funding source for the study program. The breakdown of the costs is well described showing that the cost-effectiveness of the study program is achieved with 23 or more students. According to the last available data from 2022/2021, there were 26 budget-funded students in the master-level physics program at the UL and a slightly negative trend in the total number of students could be observed during the last ten years, thus identifying a potential threat to the financial sustainability of the

study program. From the discussion with the study field and program managers, it was understood that several actions were taken to improve the attractiveness of the study program to potential students - a joint study program between UL and DU which allows the study process in English, implementation of specialisations as well as new study courses. Currently, most of the new students in the master-level study program are graduates of the bachelor-level program. However, it is planned to start the implementation of the study process in English in the next study year to attract foreign students. It requires several years to see the outcome of the implemented improvements. Meanwhile, the relatively small number of new students remains the main risk for the profitability and financial sustainability of the study program.

It should be noted that the study program is financed also from other funds, e.g. revenues received from lifelong learning and other services, and financial resources accumulated by the FPMO, UL Study Quality Improvement Fund. It ensures the continuation of the development of the study program despite the relatively low number of students.

Conclusions on this set of criteria, by specifying strengths and weaknesses

The study program implemented jointly by UL and DU ensures the best available teaching staff, laboratory equipment and other study resources for students in the two largest Latvian cities - Riga and Daugavpils. The study provision is ensured by UL and DU units involved also in the implementation of bachelor and doctoral level studies. The material-technical, informative and methodological base for ensuring a high-quality study process in master-level physics studies and its specialisations is appropriate, up to date and sufficient for implementation in both Latvian and English languages. The classrooms are well equipped to support modern teaching methods as well as distant learning. Available state budget funding is sufficient for the implementation and development of the study program. However, the relatively small number of new students remains the main risk for the profitability and financial sustainability of the study program. Several actions were taken to improve the attractiveness of the study program to potential students - a joint study program between UL and DU which allows the study process in English, implementation of specialisations as well as new study courses, but it requires several years to see the outcome of the implemented improvements. All students have equal rights to access resources used for the implementation of the joint study program in both universities but it is too early to evaluate the success of this cooperation because there were no cases available when the study process for UL students was ensured by the DU.

Strengths
1. The study provision is ensured by experienced and well-equipped units from UL and DU, thus providing the best available options for physics studies at the master level in the two largest Latvian cities - Riga and Daugavpils.
2. Scientific institutes are involved in the implementation of the study program providing highly qualified teaching staff, laboratory equipment, as well as employment to students and graduates.
3. The material-technical, informative and methodological base for ensuring a high-quality study process in master-level physics studies and its specialisations is appropriate and up to date.

Weaknesses
1. The relatively small number (26 in 2021/2022) of students remains the main risk for the profitability and financial sustainability of the study program.
2. The small number of students (26 in 2021/2022) increases the possibility that some courses or specialisations are not available if the minimum number (5) of students is not reached.

Assessment of the requirement [6]

1 R6 - Compliance of the study provision, science provision (if applicable), informative provision (including library), material and technical provision and financial provision with the conditions for the implementation of the study programme and ensuring the achievement of learning outcomes

Assessment of compliance: Fully compliant

The study provision is ensured by experienced and well-equipped units from UL and DU in collaboration with scientific institutions, thus providing the best available options for physics studies at the master level in the two largest Latvian cities - Riga and Daugavpils.

2.4. Teaching Staff

Analysis

2.4.1. The teaching staff that is planned to be involved in the academic master study programme in Physics (AMSPP) is very highly qualified with a large number of professors (9) and associate professors (6). This number clearly exceeds the minimum of five given by the regulations. In addition, there will be researchers from the scientific research institutes at LU who will take part in the teaching of some courses. Overall, there will be 58 teaching staff involved in the implementation of the programme. Apart from the professors and associate professors, there are 15 docents, one acting lecturer and 27 university teachers. (SAR Table 6.4.1.2) The information in the SAR is not sufficient to determine how many of them are from LU and how many are from DU. The teaching staff has sufficient language skills to fulfil the requirements for teaching in Latvian and English according to Annex 2.5 and Annex 2.6.

2.4.2. Compared to 2012, the number of teaching staff will increase by more than a factor of two when the new program is implemented. (Table 6.4.2.2) This increase is made possible by involving more specialised researchers in the teaching, and in this way spreading the teaching over a larger number of individuals. This has the potential to increase the quality in terms of offering more advanced courses and courses that are updated to the state of the art in each specialisation. This is also in line with the strategic development of the new programme. Retirements and new recruitments have led to a decrease in the average age of the teaching staff from 51 to 47.

2.4.3. N. A.

2.4.4. The 15 professors and associate professors all have publications from the last six years. The remaining teaching staff 43 are not specified in the SAR. Thus the criterion is not possible to verify without more precise information on the teaching staff.

2.4.5. The new programme has been developed in a process that has involved discussions between teachers and researchers at different levels at both universities. There have been broad discussions on the department level but also discussions within specialisations. This has led to a clear structure with a common core in the A part with lots of opportunities of specialisations in the B part. Meeting with teaching staff showed high engagement in the development process of the new programme. From SAR 3.4.5 it is clear that the responsibility for the cooperation between the teaching staff between the two universitites is owned by the study programme director. However, it is not clear how this cooperation will take place in practice

Conclusions on this set of criteria, by indicating strengths and weaknesses

The joint programme will have a large number of teaching staff allowing for more specialisations. The teaching staff that is mentioned in SAR Table 6.4.1.1 are all highly qualified. The lack of information on the remaining teaching staff makes it hard to make conclusions about the overall quality. The new progamme is very promising and the process that has led to its development has involved teaching staff and researchers from both universities.

Strengths

1. Highly competent teaching staff (15 professors and associate professors)
Well functioning mechanisms for involving teaching staff in programme development
2. Large number of teaching staff allows for offering more advanced courses

Weaknesses

1. The remaining 43 members of the teaching staff are not specified in the SAR.
2. The mechanisms for cooperation between teaching staff from the two universities can be made more precise.

Assessment of the requirement [7]

1 R7 - Compliance of the qualification of the academic staff and visiting professors, visiting associate professors, visiting docents, visiting lecturers and visiting assistants with the conditions for the implementation of the study programme and the requirements set out in the respective regulatory enactments.

Assessment of compliance: Fully compliant

Highly competent academic staff, clearly satisfying the requirements. 58 teaching staff, out of which 15 are professors or associate professors.

2.5. Assessment of the Compliance

Requirements

1 1 - The study programme complies with the State Academic Education Standard or the Professional Higher Education Standard

Assessment of compliance: Fully compliant

The joint masters study programme “Physics” volume is 80CP of which 46CP are compulsory part including 20CP for Master thesis and 6CP for obligatory academic practice, 32 CP are the compulsory choice courses, and 2CP for the free elective part.
Compliance with the study programme with the AcademicHigher Education Standard and Cabinet Regulations no. 240 is described in Annex No 6.6.

2 2 - The study programme complies with a valid professional standard or the requirements for the professional qualification (if there is no professional standard required for the relevant occupation) provided if the completion of the study programme leads to a professional qualification (if applicable)

Assessment of compliance: Not relevant

3 3 - The descriptions of the study courses and the study materials have been prepared in all languages in which the study programme is implemented, and they comply with the requirements set forth in Section 561 , Paragraph two and Section 562 , Paragraph two of the Law on Higher Education Institutions.

Assessment of compliance: Fully compliant

Study course descriptions and study materials are prepared in Latvian and English languages, and they satisfy requirements set in Law on Higher Education Institutions. See annex 6.10.

4 4 - The sample of the diploma to be issued for the acquisition of the study programme complies with the procedure according to which state recognised documents of higher education are issued.

Assessment of compliance: Fully compliant

The diploma issued complies with the state legislature and “Procedures by which documents certifying higher Education recognised by the State shall be issued” (Cabinet of Ministers No. 202). See annex: AMSPF_Sample of the diploma and its supplement.pdf.

5 5 - The academic staff of the academic study programme complies with the requirements set forth in Section 55, Paragraph one, Clause 3 of the Law on Higher Education Institutions.

Assessment of compliance: Fully compliant

There are at least 5 associate professors or professors involved in the study programme implementation together. It is confirmed by the Head of Study Field Declaration. See annex: AMSPF_Confirmation that the academic staff complies with the requirements specified in S55 P1 C3 of the Law on Higher Edu.docx

6 6 - Academic study programmes provided for less than 250 full-time students may be implemented and less than five professors and associated professors of the higher education institution may be involved in the implementation of the mandatory and limited elective part of these study programmes provided that the relevant opinion of the Council for Higher Education has been received in accordance with Section 55, Paragraph two of the Law on Higher Education Institutions.

Assessment of compliance: Fully compliant

This criterion is met and AIP has approved the implementation of the study programme. See annex: AMSPF_Opinion of the Council of Higher Education.docx

7 7 - At least five teaching staff members with a doctoral degree are among the academic staff of an academic doctoral study programme, at least three of which are experts approved by the Latvian Science Council in the respective field of science. At least five teaching staff members with a doctoral degree are among the academic staff of a professional doctoral study programme in arts (if applicable).

Assessment of compliance: Not relevant

8 8 - The teaching staff members involved in the implementation of the study programme are proficient in the official language in accordance with the regulations on the level of the official language knowledge and the procedures for testing official language proficiency for performing professional duties and office duties.

Assessment of compliance: Fully compliant

The academic staff has sufficient Latvian language knowledge for implementing study courses, see annex: 2.6.annex_Declarations of the state language.zip

9 9 - The teaching staff members to be involved in the implementation of the study programme have at least B2-level knowledge of a related foreign language, if the study programme or any part thereof is to be implemented in a foreign language (if applicable).

Assessment of compliance: Fully compliant

The academic staff has sufficient foreign language knowledge for implementing study courses, see annex: 2.7.Declarations on the respective foreign language skills.zip

10 10 - The sample of the study agreement complies with the mandatory provisions to be included in the study agreement.

Assessment of compliance: Fully compliant

Study agreements include all necessary parts set in legislation. See the annex: Standard sample of study agreement.zip.
It is advised to include information about guarantees of compensation losses (11. and 12. criteria), so that this information is easier for the students to acknowledge already from the beginning.

11 11 - The higher education institution / college has provided confirmation that students will be provided with opportunities to continue their education in another study programme or another higher education institution or college (agreement with another accredited higher education institution or college) if the implementation of the study programme is terminated.

Assessment of compliance: Fully compliant

University has a record declaration and cooperation agreement with Riga Technical University and University of Daugavpils as confirmation that in case the implementation of this study programme is terminated students will be able to continue studies in RTU professional master study programme “Medical Engineering and Physics”. See annex: 2.3.Compensations.zip

12 12 - The higher education institution / college has provided confirmation that students are guaranteed compensation for losses if the study programme is not accredited or the study programme’s license is revoked due to the actions (actions or omissions) of the higher education institution or college and the student does not wish to continue studies in another study programme.

Assessment of compliance: Fully compliant

University has a rector's signed refund and compensation policy that confirms it will compensate losses to students if the study programme is not accredited or loses its licence and the student does not wish to continue studies in another study programme. See annex: 2.3.annex_Compensations.zip It is advised to include this information in the study agreement.

13 13 - The joint study programmes comply with the requirements prescribed in Section 55.(1), Paragraphs one, two, and seven of the Law on Higher Education Institutions (if applicable)

Assessment of compliance: Fully compliant

This programme fully satisfies requirements fully described - it is formed by the parts of study programmes of the same level for both partners, there are unified requirements in respect of the implementation of the joint study programme, the final examinations, the awarding of degrees to be acquired in studies; the parts of the joint study programme together form a unified content and consecutive joint study programme.

14 14 - Compliance with the requirements specified in other regulatory enactments that apply to the study programme being assessed (if applicable)

Assessment of compliance: Not relevant

Assessment of the requirement [8]

1 R8 - Compliance of the study programme with the requirements set forth in the Law on Higher Education Institutions and other regulatory enactments.

Assessment of compliance: Fully compliant

The requirement has been met and fulfilled, and all requirements set in different regulatory enactments are satisfied - study programme complies with State academic education standart, and Law on Higher Education Institutions.

General conclusions about the study programme, indicating the most important strengths and weaknesses of the study programme

The study programme is justified and complies with the study field. The programme is in line with the strategic goals of the University of Latvia. This study programme is well recognized by all stakeholders and should provide the labour market with highly skilled specialists. This study programme has the potential to be developed and taught in Latvian and English languages, acquiring students from Latvia and other countries. The content of the study courses corresponds to the objectives of the study programme and ensures the achievement of learning outcomes. Several changes have been implemented in the content of the study program (e.g. specialisations and new/updated study courses) as an outcome of the feedback from students, graduates and employers. Faculty has a wide provision of the material and technical base, which provides very good opportunities for learning a profession. Since this programme is joined together with the University of Daugavpils, a strong level of cooperation is important to ensure the quality of the programme on both sides.

Strengths
1. The study provision is ensured by experienced and well-equipped units from UL and DU, thus providing the best available options for physics studies at the master level in the two largest Latvian cities - Riga and Daugavpils.
2. Scientific institutes are involved in the implementation of the study program providing highly qualified teaching staff, laboratory equipment, as well as employment to students and graduates.
3. The material-technical, informative and methodological base for ensuring a high-quality study process in master-level physics studies and its specialisations is appropriate and up to date.
4. Highly competent teaching staff
5. The collective competence at LU and UD allows for many specialisations
6. The implementation of the programme in English can attract international students

Weaknesses
1. The relatively small number (26 in 2021/2022) of students remains the main risk for the profitability and financial sustainability of the study program.
2. The small number of students (26 in 2021/2022) increases the possibility that some courses or specialisations are not available if the minimum number (5) of students is not reached.

Evaluation of the study programme "Physics"

Evaluation of the study programme:

Excellent

2.6. Recommendations for the Study Programme "Physics"

Short-term recommendations

1.Specify the remaining 43 teaching staff to make it possible to assess overall qualifications of teaching staff.

Make the mechanisms for future cooperation between teaching staff from the two universities more precise.

Long-term recommendations

1.Evaluate the impact of the implemented changes in the new study program on the number of students, adapt specialisations according to the needs of employers if needed.
2.Consider an opportunity to implement the study program in the English language to attract foreign students and raise international competitiveness.
3.Develop mechanisms in order to recruit permanent teaching staff with international experience.

II - "Mathematics and Data Science" ASSESSMENT

II - "Mathematics and Data Science" ASSESSMENT

2.1. Indicators Describing the Study Programme

Analysis

2.1.1. The Academic Master Study Programme Mathematics and Data Science (AMSPMDS), code 45460 is fully compliant with the Study Field Physics, Material Science, Mathematics, and Statistics. As it results from Annexes 7.9 and 7.10 all core courses and about 80% of all courses (depending on the module) that constitute the curriculum of the Academic Master's degree programme "Mathematics and Data Science" (code 45460), belong to the Klasius classifications 054, 058 and 059 (Mathematics, Statistics and Natural Sciences), which proves that the programme is fully compliant with the Study Field Physics, Material Science, Mathematics, and Statistics.

2.1.2. Upon the fulfilment of all requirements the students are conferred the Master’s degree of Natural Sciences in Mathematics. The duration of the study programme is two years. The goals of the program are to provide innovative and technology-oriented higher education, prepare top-level specialists with broad competences in mathematics and data science to work in industry, finance, data management, statistics and high-technology companies, as well as in universities, institutes and research centres in Latvia and abroad. Admission requirement is a bachelor's degree in mathematics or a bachelor's degree or a level 2 vocational higher education in science, computer science, engineering or economics complemented with an assessment of mathematical subjects. In case of competition, admission ratings are based on weighted average marks and the final test mark (see regulations for further details). Within the broad scientific field of Mathematics there is a relatively clear distinction between pure mathematics and applied mathematics (although almost every part of the former has topics that could be considered as applied). Nevertheless, the study of pure mathematics is essential for the basic research and development of the field. This justifies the establishment of a sub-programme in pure mathematics as an indispensable component in the education of future researchers and the development of the field on the national level. The remaining two sub-programmes cover two areas of applied mathematics - mathematical statistics and technology (or industrial) mathematics - that have just a small overlap and are very different regarding the type of employment after graduation. In fact, mathematical statisticians are in high request in insurance companies, banks and other financial institutions, marketing companies and other areas that require deep understanding of sophisticated probabilistic and statistical methodology. On the other hand, industrial mathematics is geared toward applications in technology, ranging from numerical simulations, algorithms development, cryptography and

informatics security, etc.

Annex 7.6 contains a detailed description of the aims and learning outcomes of the programme and the individual sub-programmes. A comparison of the common and specific curricula of each sub-programme shows that the aims and learning outcomes are covered by the compulsory and elective courses offered.

2.1.3. The recommendations from the previous assessment have been thoroughly analysed and all recommendations resulted in specific action plans that have been already implemented or are in the course of implementation. This in particular covers the availability of teaching materials in e-format, whose production was also boosted by the needs that arose during the pandemics. There is also notable improvement in the participation of foreign faculty in the didactics. Admission criteria have been adapted, the introduction of three sub-programmes will help the students to choose an optimal set of courses and decrease the drop-out rate.

2.1.4. The dynamics of the numbers of enrolled students and graduates shows a worrying trend that is also fully acknowledged and analysed in the institutional self-evaluation. In the first half of the past decade, the program had around 50 students and 15-20 graduates each year, a good result on all accounts for that type of programme. However, in the last years these numbers have more than halved to only 16 students and 5 graduates in the year 2021. According to the self-evaluation the causes are internal (perception that the programme is too theoretical, migration of bachelors toward master studies in programming and economics) and external (drop in the national student population, general drive toward other types of employment). An attempt to mitigate internal causes resulted in the reform of the master programme that has now more applied courses and inclusion of data science in the title and contents of the master programme. On the other hand, one should take into account that AMSPMDS is the only place in Latvia where high-level mathematicians are trained. Thus, a sub-programme in pure mathematics should be maintained in spite of small numbers in order to ensure a reproduction of the top knowledge base and scientific research in the basic field of Mathematics. According to the official data, jobs related to mathematics, statistics and actuary science will be in high demand in the short and medium term. The lack of mathematics professionals is witnessed by the fact that the professions Statistician mathematician and Mathematician are among professions in which significant shortages are forecasted and in which foreign nationals may be invited to work in Latvia.

2.1.5. N. A.

Conclusions on this set of criteria, by specifying strengths and weaknesses

Study programme Mathematics and Data Science (AMSPMDS) is the only master's programme in mathematical sciences in Latvia. The structure, duration and learning outcomes of the programme are compliant with national and international standards. Graduates are in high demand in the labour market. The main threat is the decreasing number of students that enrol and graduate from the programme. To cope with this problem the study programme was recently reformed and complemented with more applied courses and the possibility to choose between three sub-programmes.

Strengths
1. Graduates are in high demand on the job market and can easily find good employment in mathematics or in other related fields.

Weaknesses
1. The overall enrolment at AMSPMDS has almost halved in recent years and so has the number of graduates.

2.2. The Content of Studies and Implementation Thereof

Analysis

2.2.1. The study programme is divided into three sub-programmes: Data Science, Technology mathematics and Pure mathematics. Five compulsory courses for a total of 20CP are common for all sub-programme. In addition, for each sub-programme, there are four specific compulsory courses with 14CP. Finally, the number of courses (22CP) is determined by a choice of a module within the sub-programme. A master's thesis (20CP) is required for graduation. A comparison of the course contents shows relatively big overlaps between certain bachelor and master courses (Algebra 2/Applied algebra, Introduction to abstract algebra/Abstract algebra, Discrete mathematics/Graphs, networks, Introduction to topology/Topology, etc.). English translations of course plans are occasionally inadequate, which can be a problem for incoming mobility.
According to the institution, the content of the study programme was designed in close cooperation with employers and industry and by taking into account trends in the labour market and similar programmes at foreign universities. Sub-programme Data science is geared toward needs of the IT sector, users of big data, statistical analyses, and also in the financial and actuarial sectors. Sub-programme Technology mathematics is based on the specific demands of the latest technology, computing techniques and engineering industries. The main motivation for the sub-programme in Pure mathematics is to provide the only master's degree in pure mathematics in Latvia, thereby raising researchers professors in the field of mathematics.

General structure of the programme comprises mandatory part A courses: 20 CP, mandatory part A courses of the sub-programme: 14 CP, limited-choice Part B courses: 22 CP, free-choice Part C courses and academic practice: 2 CP each, and Master's thesis: 20 CP. Mandatory Part A courses constitute the basis for all other courses, e.g. for the Data Science Subprogramme Mate5131 Modern statistics and data science is the basis for Mate5143 Statistical learning, DatZ6056 Deep Learning, Mate5327 Statistical Modelling, Mate5135 Bayesian statistics, Mate5008 Supplementary Chapters of Probability and Statistics, Mate5136 Time series and signal analysis, Mate5039 Nonparametric Statistics, Mate5318 Stochastic Processes, Mate5040 Asymptotic Statistics, Mate5132 Stochastic Differential Equations with Applications, which are also strongly interconnected. Similarly, Mate5121 Nonlinear optimization is the basis for Technology Mathemaitcs subprogramme courses Mate5156 Graphs, networks and discrete optimization algorithms and Mate5145 Advanced mathematical methods with Python, R and Matlab are the basis for Mate5150 Industrial mathematical modelling
Mate5144 Dynamical systems, Mate5138 Numerical Methods for Partial, Differential Equations, Mate5151 Systems and control Mate5127 Methods of functional analysis for differential and integral equations, Mate5132 Stochastic Differential Equations with Applications, Mate5149 Analytic methods for partial differential equations, Mate5038 Ordinary Differential Equations and Modelling and other courses.
Finally, the basic theoretical courses Mate5120 Theory of Functions and Functional Analysis, Mate5157 Category Theory, Mate5010 Measure and Integral, Mate5141 Number theory are the basis for other courses Mate5146 Harmonic Analysis Mate5147 Ill-posed problems, Mate5158 Optimal control theory, Mate5155 Approximation theory, Mate5149 Analytic methods for partial differential equations, DatZ5034 Quantum Computers, Mate5033 Combinatorics, DatZ6015 Applied cryptography, DatZ5039 Mathematical Fundaments of Theoretical Computer Science, Mate5071 Automata and Theory of Algorithms for the Pure Mathematics subprogramme

Study courses are firmly related with the objectives of the programme and meet the needs of the labor market. Data Science subprogramme has a core part with courses Statistical learning, Deep learning, Statistical modelling and Bayesian statistics. It is then split into two modules Statistics and Data Analyst with specific courses, e.g. Random processes, Nonparametric statistics, Time series and signal analysis, and respectively Selected chapters about data warehousing, Big Data technologies, Business intelligence tools and data visualization, High performance computing in data science and modelling. Similarly, Technology Mathematics subprogramme has base courses Industrial Mathematical Modelling, Dynamical Systems, Numerical Methods for Partial Differential Equations and Theory and Control of Systems. It has Applied Mathematics module with specific courses Data-driven numerical algorithms, Mathematical foundations of neural networks,"Numerical methods for integral equations etc.,
and Numerical Mathematics module with courses Methods of functional analysis for differential and integral equations, Analytical methods for partial differential equations etc. Finally, Pure Mathematics subprogramme has specializations in Topology, Algebra and Discrete Mathematics and Modern Elementary Mathematics and Mathematical Didactics. It has core mathematical courses and specific courses that reflect scientific direction of each specialization. All courses are detailed in Annex 7.9.

Compliance with the State Education Standard is documented in Annex 7.6.

2.2.2. According to the programme curriculum (Annex 7.9), the awarding of the degree is based on the courses, which are relevant to the chosen sub-programme/module, and on the successful defence of a master thesis, which requires an in-depth analysis of a given topic/problem. The academic master's program gives the opportunity to specialise in one of three sub-programs: Data science, Technological mathematics, Pure mathematics (SAR 3.1.1). According to paragraph 58 of the Law on Universities, the study program for obtaining a master's degree must end with a final examination, which includes the development and defence of the master's thesis. SAR 3.2.2 mentioned arguments for the high evaluation of master's level studies - academic practice is implemented in the interaction of industry and academic staff, representatives of industry participate in the development and evaluation of practice works, while in most cases master's theses are developed in the scientific topic of the relevant academic staff, thus the master's degree is based on scientific branches in achievements and findings in the field of creativity. According to the programme curriculum (Annex 7.9), the awarding of the degree is based on the courses, which are relevant for the chosen sub-programme/module, and on the successful defence of a master thesis, that requires an in-depth analysis of a given topic/problem. Exams in study courses are oral, written and combined. In the period since 2011, 126 master's students have graduated from this program (Appendix 7.5). Therefore, the commission recognized their achieved results as appropriate for awarding the degree. The above confirms that the awarding of the degree is based on achievements and knowledge in the relevant field of science.

2.2.3. Most courses are implemented in the form of lectures (introductory, interactive, summary, problem-oriented) and seminars. Specific courses consist of practical exercises, student seminars and individual and group project work. A more experienced lecturer usually gives lectures, while practical work also involves young lecturers and PhD students. E-learning is extensively used. Student mobility is extremely low for a master-level programme with only one outgoing and two incoming students in the period 2013-2022 (Annex 2.10). The student-centred approach is visible in the use of extensive student surveys as a way to assess students' opinions and suggestions on the curriculum and the individual courses. Compliance with national standards is assessed in Annex 5.6.

New specialisations will be introduced in the study year of 2023/2024, therefore, it is impossible to evaluate their implementation at this moment. However, positive feedback was received from employers, graduates and students during interviews on planned changes in the study program. The Data Science specialisation could attack more interests and ensure a larger number of students.

2.2.4. An internship is foreseen and regulated (Annex 5.11), In the interviews, the graduates praised the utility of internships as an occasion to experience a real working environment and enhance the employability of the students. The practice duration is 2 weeks (2 CT) or 80 hours and is scheduled at the beginning of the 2nd semester. The practice is supervised by the Director of the Bachelor of Mathematics programme, the internship supervisor at the department and a supervising employee at the institution where the internship takes place. Each student receives a cover letter from the practice organizer indicating what type of tasks would be expected to be performed at the institution of practice. In loco, the students familiarize themselves with the institution's structure and the specific tasks involving mathematical content. The student must agree with the head of practice on one concrete problem to be solved during the practice. At the end of practice, the student prepares a report on the practice institution, problems dealt with, methods and an analysis of the results. The report and a reference letter from the practice organizer are submitted to the internship supervisor. Finally, the student gives a short presentation to a committee that gives a final evaluation of the practice.

The stated goals of the internship are that the students to become acquainted with the place of practice/internship and its organization, to apply the knowledge and skills acquired in studies to practical problems in applied mathematics or academic research, to train problem-solving skills, communication skills, IT skills, to develop the competence related to analytical and research skills, as well as ethical action and to prepare students for the development of master's thesis. These goals are in accordance with the aims of the study programme and its learning outcomes by providing a set of knowledge, skills and competencies specified in the Latvian education classification and ensuring the achievement of scientifically based wide-profile study results. It is provided that for students in the English flow of the programme, the programme director will find appropriate places of practice in more international institutions and firms, where a large part of the communication is already in English and employees from abroad are also involved. Alternatively, the practice can be implemented in any Latvian institution or firm by agreeing in advance that the communication of job tasks is in English.

A detailed description of the procedures can be found in Annex III.3.2, Academic master's study programme Mathematics and Data Science regulations of practice internship. The internship complies with the listed requirements.

2.2.5. N. A.

2.2.6. The titles of master theses indicate topics geared toward applications and which require integration of contents of different study courses. High final grades witness a high level of knowledge, skills and competence achieved by the students during their course of studies. Based on the titles of bachelor theses one can conclude that roughly half of them discuss topics in statistics and/or data science. Typical titles include Real-time series analysis for forecasting and anomaly detection and Two sample empirical likelihood method for weakly dependent data. Other examples belong to industrial applications, e.g. Mathematical model of biomass thermal decomposition,
Methods of parameter estimation for diffusion processes, and to purely mathematical problems like Investigation of peace-wise linear difference equation systems and Methods of parameter estimation for diffusion processes.

Conclusions on this set of criteria, by specifying strengths and weaknesses

The content of the study program complies with national regulations and international standards. Courses are divided into compulsory for all sub-programmes, compulsory for the specific programme and compulsory for a module, so that there is only a small choice of completely elective courses. Student mobility is very low. The titles of final theses indicate strong connection with the study program.

Strengths
1. Master graduates are in very high demand in the job market and easily find employment.
2. The level of the master thesis and the requirements for its defence contribute to the enforcement of standards and of a high level of graduates.

Weaknesses
1. Student mobility is very low.
2. Notable overlap between some courses on the bachelor and master level.

Assessment of the requirement [5] (applicable only to master's or doctoral study programmes)

1 R5 - The study programme for obtaining a master's or doctoral degree is based on the achievements and findings of the respective field of science or field of artistic creation.

Assessment of compliance: Fully compliant

The study program for obtaining an academic master's degree is based on mathematics achievements and findings, studies and practice are organised in accordance with normative acts.

2.3. Resources and Provision of the Study Programme

Analysis

2.3.1.The study program is implemented by the Department of Mathematics of the UL FPMO in collaboration with other departments from the faculty and other UL units, including some courses provided by the lecturers from the Computer Science Faculty. The department has the necessary experience and resources to ensure a high-quality study process, it is also responsible for the implementation of bachelor and doctoral-level study programs in mathematics. UL Institute of Mathematics and Computer Science is also involved in the implementation of the study program, and supervision of the master thesis. The study program is implemented mainly in the Science Building (Jelgavas 3) of the UL which has been commissioned in 2019, therefore, having appropriate planning and modern equipment for the implementation of the study program.

The department has the necessary resources to ensure the qualitative implementation of newly introduced specialisations which are primarily based on the current program content. In the case of Data Science specialisation, relevant expertise is outsourced from the Faculty of Computer Science.

UL library is a modern open-space type library with many study process suitable working places accessible 24 hours every day. It ensures access to a wide range of thematic literature both in printed and electronic format. Students have access to all main scientific databases (e.g. Web of Science, Scopus) as well as scientific journals (e.g. Nature, Oxford Journals). Two computer rooms with 30 seats and shared-use portable computers with regular specialised software (e.g. Mathematica, Ansys, COMSOL, MatLab, LabView) are available for use at the FPMO building.

Specialised software could be used also on students' personal computers.

Moodle platform is used to ensure an e-study environment. During the Covid-19 time, the teaching staff was forced to improve the study content in the e-study environment and practise distance learning through video calls. As a result, the amount of available/possible study resources in the e-study environment has increased.

The Department of Mathematics of the UL FPMO has the necessary prerequisites for the implementation of the study program in English. The teaching staff has sufficient English skills as well as motivation to teach in English as was understood from the interviews with academic staff. English is the main professional language in mathematics in which most actual professional literature is written, the library provides necessary access to books (in both paper and electronic formats) as well as scientific papers.

2.3.2. N. A.

2.3.3. State funding (3667,75 euros per year per budget-funded student) is the primary funding source for the study program. The breakdown of the costs is well described showing that the cost-effectiveness of the study program is achieved with 18 or more budget students. According to the last available data from 2022/2021, there were 16 students enrolled in the old master's study program. The total number of students has decreased (from ~50 to 16) in the last ten years. It was the main motivator to restructure the master-level program by implementing specialisations among which there is also data science. Students, alumni and employers positively evaluated the proposed changes, agreeing that they might attract more students. It is too early to evaluate if the proposed changes will increase the number of students, thus ensuring the financial sustainability and profitability of the program. It should be mentioned that it is planned to implement a study program in both languages Latvian and English, thus potentially attracting students from abroad.

Conclusions on this set of criteria, by specifying strengths and weaknesses

The study program is implemented by the Department of Physics of the UL FPMO in collaboration with other departments from the faculty and other UL units ensuring the best available teaching staff, laboratory equipment and other study resources for students. The material-technical, informative and methodological base for ensuring a high-quality study process in master-level mathematics studies and its specialisations in both Latvian and English languages is appropriate and up to date. The classrooms are well equipped to support modern teaching methods as well as distant learning. Available state budget funding is sufficient for the implementation and development of the study program. Proper action was taken to improve the study program (e.g. including data science specialisation) and make it more attractive for potential students, positive feedback and interest have been received from students, alumni and employers. However, it wasn't possible to evaluate the implementation results of the newly introduced specialisation because the first enrollment is planned for the academic year 2023/2024. Therefore, the assessment of the effect of the implemented changes should be performed during the next accreditation.

Strengths
1. The study provision is ensured by experienced and well-equipped units from UL FPMO, thus providing the best available options for mathematics studies at the master level.
2. Good link and balance are ensured with both the industry and scientific sectors in the implementation of the study program; lecturers representing industry and scientific institutions are involved in the study process.

3. The material-technical, informative and methodological base for ensuring a high-quality study process in bachelor-level physics studies is appropriate and up to date.

Weaknesses
1. The number of students has decreased significantly (from ~50 to 16) during the last ten years; proper actions were implemented to improve the attractiveness of the study program; but it remains a risk for the financial sustainability and profitability of the study program.

Assessment of the requirement [6]

1 R6 - Compliance of the study provision, science provision (if applicable), informative provision (including library), material and technical provision and financial provision with the conditions for the implementation of the study programme and ensuring the achievement of learning outcomes

Assessment of compliance: Fully compliant

The study provision is ensured by experienced and well equipped units from UL FPMO in collaboration with scientific institutions, thus providing best available options for mathematics studies at the master level in Latvia.

2.4. Teaching Staff

Analysis

2.4.1. The new programme is planned to be implemented with a large number of highly qualified teaching staff from mathematics and computer science. Twelve of the 33 members of the teaching staff are professors and two are associate professors, 25 of them have a PhD, and all but two are active in research. (SAR Table 7.4.1.1 and Annex 2.5). The number of professors and associate professors exceeds the minimum of five given by the regulations. The teaching staff has sufficient language skills to fulfil the requirements for teaching in Latvian and English according to Annex 2.5 and Annex 2.6.

2.4.2. Compared to the situation in the old program in 2013/14, the number of teaching staff involved has doubled. This is partly due to the involvement of teaching staff from the Faculty of Computer Science and from the Laboratory of Statistical Research and Data Analysis. There have been a number of retirements, and these have been replaced by younger faculty, some of which have been recruited back from abroad. These changes will overall increase the quality of the study programme in terms of being very much in line with current trends in mathematics and data science.

2.4.3. N. A.

2.4.4. Among the 33 members of the teaching staff (SAR Table 7.4.1.1), 28 have published research in relevant areas in the last six years. The exceptions are one university teacher teaching statistics with no publications in statistics, two PhD students with no publications, one docent teaching Basic Latvian with no publications except two in Latvian, and one university teacher with no publications since 2016, but with five years of practical experience as senior financial analyst.

2.4.5. Since the new programme involves teaching staff also from computer science, there have been discussions over the department borders. There is a plan for regular meetings involving discussions on connections between courses and how they fit together to achieve the programme objectives. Employer representatives are also asked to contribute in the development in order to

ensure the validity of the content of the programme.

Conclusions on this set of criteria, by indicating strengths and weaknesses

The teaching staff involved in the programme is in general highly qualified and to a large extent active in research active in relevant areas. The involvement of the Faculty of Computer Science and the Laboratory of Statistical Research and Data Analysis has made it possible to create a credible focus on Data Science in the program. The teaching staff are also active in the continuous discussions on the development of the programme even across the department borders.

Strengths
1.Highly competent teaching staff
2. Well functioning mechanisms for involving teaching staff in programme development

Weaknesses
No weaknesses have been identified.

Assessment of the requirement [7]

1 R7 - Compliance of the qualification of the academic staff and visiting professors, visiting associate professors, visiting docents, visiting lecturers and visiting assistants with the conditions for the implementation of the study programme and the requirements set out in the respective regulatory enactments.

Assessment of compliance: Fully compliant

Highly competent academic staff, clearly satisfying the requirements. Of the 33 members of the teaching staff, 25 have a PhD and all but two are active in research in relevant areas.

2.5. Assessment of the Compliance

Requirements

1 1 - The study programme complies with the State Academic Education Standard or the Professional Higher Education Standard

Assessment of compliance: Fully compliant

The masters study programme “Mathematics and Data Science” volume is 80CP of which 56CP are compulsory parts including 20CP for Master thesis, 22 CP are the restricted elective part courses, and 2CP for the free elective part.
Compliance with the study programme with the Academic Higher Education Standard and Cabinet Regulations No.240 is described in Annex No 7.6.

2 2 - The study programme complies with a valid professional standard or the requirements for the professional qualification (if there is no professional standard required for the relevant occupation) provided if the completion of the study programme leads to a professional qualification (if applicable)

Assessment of compliance: Not relevant

N/A

3 3 - The descriptions of the study courses and the study materials have been prepared in all languages in which the study programme is implemented, and they comply with the requirements set forth in Section 561 , Paragraph two and Section 562 , Paragraph two of the Law on Higher Education Institutions.

Assessment of compliance: Fully compliant

Study course descriptions and study materials are prepared in Latvian and English languages, and they satisfy requirements set in Law on Higher Education Institutions. See annex 7.10.

4 4 - The sample of the diploma to be issued for the acquisition of the study programme complies with the procedure according to which state recognised documents of higher education are issued.

Assessment of compliance: Fully compliant

The diploma issued complies with the state legislature and “Procedures by which documents certifying higher Education recognised by the State shall be issued” (Cabinet of Ministers No. 202). See annex: MSPMDZ_Sample of the diploma and its supplement.pdf.

5 5 - The academic staff of the academic study programme complies with the requirements set forth in Section 55, Paragraph one, Clause 3 of the Law on Higher Education Institutions.

Assessment of compliance: Fully compliant

There are at least 5 associate professors or professors involved in the study programme implementation together. It is confirmed by the Head of Study Field Declaration. See annex: MSPMDZ_Confirmation that the academic staff complies with the requirements specified in S55 P1 C3 of the Law on Higher.docx

6 6 - Academic study programmes provided for less than 250 full-time students may be implemented and less than five professors and associated professors of the higher education institution may be involved in the implementation of the mandatory and limited elective part of these study programmes provided that the relevant opinion of the Council for Higher Education has been received in accordance with Section 55, Paragraph two of the Law on Higher Education Institutions.

Assessment of compliance: Fully compliant

This criterion is met and AIP has approved the implementation of the study programme. See annex: MSPMDZ_Opinion of the Council of Higher Education.docx

7 7 - At least five teaching staff members with a doctoral degree are among the academic staff of an academic doctoral study programme, at least three of which are experts approved by the Latvian Science Council in the respective field of science. At least five teaching staff members with a doctoral degree are among the academic staff of a professional doctoral study programme in arts (if applicable).

Assessment of compliance: Not relevant

N/A

8 8 - The teaching staff members involved in the implementation of the study programme are proficient in the official language in accordance with the regulations on the level of the official language knowledge and the procedures for testing official language proficiency for performing professional duties and office duties.

Assessment of compliance: Fully compliant

The academic staff has sufficient Latvian language knowledge for implementing study courses, see annex: 2.6.annex_Declarations of the state language.zip

9 9 - The teaching staff members to be involved in the implementation of the study programme have at least B2-level knowledge of a related foreign language, if the study programme or any part thereof is to be implemented in a foreign language (if applicable).

Assessment of compliance: Fully compliant

The academic staff has sufficient foreign language knowledge for implementing study courses, see annex: 2.7.Declarations on the respective foreign language skills.zip

10 10 - The sample of the study agreement complies with the mandatory provisions to be included in the study agreement.

Assessment of compliance: Fully compliant

Study agreements include all necessary parts set in legislation. See the annex: Standard sample of study agreement.zip.
It is advised to include information about guarantees of compensation losses (11. and 12. criteria), so that this information is easier for the students to acknowledge already from the beginning.

11 11 - The higher education institution / college has provided confirmation that students will be provided with opportunities to continue their education in another study programme or another higher education institution or college (agreement with another accredited higher education institution or college) if the implementation of the study programme is terminated.

Assessment of compliance: Fully compliant

University has a record declaration and cooperation agreement with Riga Technical University as confirmation that in case the implementation of this study programme is terminated students will be able to continue studies in RTU academic master study programme “Financial Engineering Mathematics”. See annex: 2.3.Compensations.zip

12 12 - The higher education institution / college has provided confirmation that students are guaranteed compensation for losses if the study programme is not accredited or the study programme’s license is revoked due to the actions (actions or omissions) of the higher education institution or college and the student does not wish to continue studies in another study programme.

Assessment of compliance: Fully compliant

University has a rector's signed refund and compensation policy that confirms it will compensate losses to students if the study programme is not accredited or loses its licence and the student does not wish to continue studies in another study programme. See annex: 2.3.annex_Compensations.zip It is advised to include this information in the study agreement.

13 13 - The joint study programmes comply with the requirements prescribed in Section 55.(1), Paragraphs one, two, and seven of the Law on Higher Education Institutions (if applicable)

Assessment of compliance: Not relevant

N/A

14 14 - Compliance with the requirements specified in other regulatory enactments that apply to the study programme being assessed (if applicable)

Assessment of compliance: Not relevant

N/A

Assessment of the requirement [8]

1 R8 - Compliance of the study programme with the requirements set forth in the Law on Higher Education Institutions and other regulatory enactments.

Assessment of compliance: Fully compliant

The requirement has been met and fulfilled, and all requirements set in different regulatory

enactments are satisfied - study programme complies with State academic education standart, and Law on Higher Education Institutions.

General conclusions about the study programme, indicating the most important strengths and weaknesses of the study programme

The study programme is justified and complies with the study field. The programme is in line with the strategic goals of the University of Latvia. This study programme is well recognized by all stakeholders and should provide the labour market with highly skilled specialists. This study programme has the potential to be developed and taught in Latvian and English languages, acquiring students from Latvia and other countries. The content of the study courses corresponds to the objectives of the study programme and ensures the achievement of learning outcomes. Several changes have been implemented in the content of the study program (e.g. specialisations and new/updated study courses) as an outcome of the feedback from students, graduates and employers. The introduction of the specialisation of data science could attract more students because most graduates already work as data scientists. However, it is too early to evaluate the introduced changes as real implementation will start in the study year 2023/2024. Faculty has a wide provision of the material and technical base, which provides very good opportunities for learning a profession.

Strengths
1. The study provision is ensured by experienced and well-equipped units from UL FPMO, thus providing the best available options for mathematics studies at the master level.
2. Good link and balance are ensured with both the industry and scientific sectors in the implementation of the study program; lecturers representing industry and scientific institutions are involved in the study process.
3. The material-technical, informative and methodological base for ensuring a high-quality study process in bachelor-level physics studies is appropriate and up to date.
4. Highly competent teaching staff

Weaknesses
1. The number of students has decreased significantly (from ~50 to 16) during the last ten years; proper actions were
implemented to improve the attractiveness of the study program; but it remains a risk for the financial sustainability and profitability of the study program.

Evaluation of the study programme "Mathematics and Data Science"

Evaluation of the study programme:

Excellent

2.6. Recommendations for the Study Programme "Mathematics and Data Science"

Short-term recommendations

Long-term recommendations

1.Evaluate the impact of the implemented changes in the new study program on the number of students, adapt specialisations according to the needs of employers if needed.

2.Consider an opportunity to implement the study program in the English language to attract foreign students and raise international competitiveness.
3.Develop mechanisms in order to recruit permanent teaching staff with international experience.
4.The main source of master students in mathematics are graduates of academic and professional bachelor studies in mathematics and related fields (computer science, economics, physics). We recommend trying to attract students from all the potential sources in order to increase enrolment in the program. At the same time some institutional support will be necessary in order to preserve the sub-programme in pure mathematics that is indispensable for the future development of mathematical sciences in Latvia.
5.The curriculum should allow for a higher degree of choice in elective courses at least at the module, maybe even on the sub-programme level. The overlap in the content with bachelor level courses should be reviewed and reduced whenever possible. A serious effort should be invested in the increase of student mobility. Ideally, a master graduate should be mathematically bilingual, and this can be achieved through outgoing mobility and by taking a number of courses that are taught in English.

II - "Particle Physics and Accelerator Technologies" ASSESSMENT

II - "Particle Physics and Accelerator Technologies" ASSESSMENT

2.1. Indicators Describing the Study Programme

Analysis

2.1.1. The Doctoral Study Programme Particle Physics and Accelerator Technologies (DSPPPAT), code 51443 is fully compliant with the Study Field Physics, Material Science, Mathematics, and Statistics, which is reasonably justified in Annex 8.4 ("annex_DSPDFPT_Compatibility of the joint study program with the requirements of the law of Higher educ..docx") and Annex 8.7 ("Correspondence of the doctoral study programme to the specific normative regulation.docx"). .
2.1.2. The degree Doctor of Science in Physics and Astronomy or the degree Doctor of Science in Mechanical Engineering and Mechanics is given to students that fulfil the requirements at the end of the four-year programme. The goal of the programme is “to provide the students with an opportunity to undertake scientific research and obtain a doctoral degree in high-energy particle physics and accelerator technologies in Latvia and to prepare world-class scientists with highly sought-after skills and competencies.” The aims, learning objectives and outcomes are aligned and justified. The admission requirements are Master of Natural Sciences or Master of Engineering, or comparable. This is necessary because of the dual nature of the programme. The programme is implemented in Latvian and English which is justified since the programme is serving the needs not only for Latvia.

2.1.3. The programme is new since 2021. There were recommendations in the licensing. The short-term recommendations have all been fully implemented. The long-term recommendations about establishing research laboratories and about developing an appropriate academic master study programme are still under consideration. Remaining long-term recommendations are already implemented.

2.1.4. The programme is developed as a part of a national strategy for participation in CERN. A full membership in CERN will require a national commitment in the research area. In addition, graduates from the programme will have competencies and skills that will be highly attractive at the labour

market also outside of the research environment at CERN. So far, only seven students have been admitted, which makes it impossible to analyse dynamics.

2.1.5. The programme is developed by the University of Latvia and Riga Technical University. This is the first joint programme between these two universities. Since the programme involves both particle physics from the natural sciences and accelerator technology from engineering science, it is essential to have both universities represented, contributing with their respective expertise. Other Baltic universities have also been involved through the CERN Baltic Group. The quality assurance aspects of the joint study programme and the processes related to quality assurance are not clearly described in SAR 3.1.5, which prevents a thorough analysis of the criteria at this point.

Conclusions on this set of criteria, by specifying strengths and weaknesses

The doctoral study programme Particle Physics and Accelerator Technologies (DSPPPAT) is a highly specialised programme which is part of a strategic development for Latvia to become a full member of CERN. The strong connection with researchers at CERN is essential for this development. The development of the programme is a successful collaboration between LU and RTU where each of the universities can contribute with their strengths.

Strengths
1. The strong connection with CERN
2. The programme is a successful collaboration between leading universities in Latvia making use of their respective strong sides

Weaknesses
1. The quality assurance system of the joint study programme is not clearly outlined.

2.2. The Content of Studies and Implementation Thereof

Analysis

2.2.1. The doctoral study program "Particle Physics and Accelerator Technologies" prepares internationally competitive researchers for work in universities and research laboratories, as well as a highly qualified and innovative workforce in general; provides otherwise unavailable opportunities in Latvia for research work in high-energy physics and accelerator technologies, thus providing a counterbalance to the outflow of intellectual potential from the country; grows Latvia's scientific capacity in high-energy physics and accelerator technology research, as well as natural science and engineering capacity in general (SAR, program parameters; SAR, section 3.2.1). The content of the study courses (appendices 8.9 - annex_DSPDFPT_study courses plan.pdf and 8.10 - annex_DSPDFPT_Descriptions of the study courses.docx) is mutually compatible and complementary, meets the goals of the program and ensures the achievement of study results (appendix 8.8 - Mapping of study courses). Graduates of the program are suitable for work in scientific institutions of all levels and, most importantly for Latvian society, in the field of medicine, where oncology in general and radiology in particular are determined as one of Latvia's priorities (Public Health Guidelines for 2021-2027, Sabiedrības veselības pamatnostādnes 2021.–2027. gadam (likumi.lv)). The content of the program complies with the specific normative regulation of the industry (SAR, appendix "Correspondence of the doctoral study program to the specific normative regulation.docx").

2.2.2. SAR section 3.2.2 provides justification for the award of a doctorate degree, based on achievements and findings in the science of high-energy particle physics. During the program,

students come into contact with top level researchers from all over the world. In this program, students will submit doctoral theses that will be evaluated according to the highest standards, and the quality of the submitted work will be at least equal to the doctoral theses developed by students from other countries conducting research at CERN (SAR - section 3.2.2).
2.2.3. Study implementation methods, applied techniques and types are described in SAR section 3.2.3 - they include both oral, written and combined study and evaluation methods. In order for students to achieve their study results - acquire and strengthen knowledge, skills and develop competence - the study process is dominated by methods in which student activity is important. In the study process, methods are used that promote student communication in performing study tasks, solving real industry problems, and modelling situations. During the study process, the lecturers use methods, test forms and assessment criteria appropriate to the purpose of the study and the planned study results. During the study process, students receive support and feedback from lecturers. The evaluation criteria for the posting of grades have been made public in advance. The student-centred approach is followed by updating study courses, formulating study results, promoting dialogue about study content, organisational forms and methods. By observing the study principles of student-centred education, student mobility is promoted (recognition of study results), students are involved in research initiated by academic staff and social activities in society. The results of student surveys are evaluated and taken into account in the improvement of the study process. Since the Doctoral Study Program Particle Physics and Accelerator Technologies (DSPPPAT) is a joint program with RTU, and students spend considerable time at CERN, distance learning methods are widely used, and independent work is organised, for which UL has all the necessary technologies and tools. Students have access to a full-fledged material, informative, scientific base for the provision of studies, which is described in detail in SAR sections 3.3.1-3.3.3 and which is confirmed by interviews of students and professors.

2.2.4. N. A.

2.2.5. SAR section 3.2.5 provides information on the procedure for defending a doctoral thesis. Since the study program is new, no information is yet available about the realisation of the defence of doctoral theses. Students' opportunities to defend their doctoral theses are described in detail in section 3.2.5 of the SAR - it is established that students can defend their doctoral thesis in the existing doctoral councils according to the student's affiliation (RTU or UL), support for the development of doctoral theses is established both in CERN and in Latvia, and the pre-defense deadline and defense procedures in the relevant doctoral council is established.

2.2.6. Since the Doctoral Study Program Particle Physics and Accelerator Technologies (DSPPPAT) study program is in its first year of operation, the topics of the final theses are not yet available.

Conclusions on this set of criteria, by specifying strengths and weaknesses

The doctoral study program "Particle Physics and Accelerator Technologies" prepares internationally competitive researchers for work in universities and research laboratories, as well as a highly qualified and innovative workforce in general. The content of the study courses is mutually compatible and complementary, meets the goals of the program and ensures the achievement of study results. Graduates of the program are suitable for work in scientific institutions of all levels and, most importantly for Latvian society, in the field of medicine. The study program for obtaining a doctor's degree is based on achievements in the relevant field of science - a doctoral thesis. The internship takes place at CERN - one of the largest high-level science centers in the world. However, some deficiencies have been identified that should be eliminated: study course descriptions are misleading and must be improved, study courses are not up to date with respect to used literature,

partner universities do not provide all the courses at the level of doctoral studies, some of the used literature sources are not in the language of the study program.

Strengths
1. Impressive study program setting, content and provision.
2. Students have access to the highest level of professors and working environment.

Weaknesses
1. For now, in the first year of studies, there is little statistical information for analysis and recommendations on the implementation, success and demand of studies
2. Study course descriptions are misleading and must be improved
3. Study courses are not up to date with respect to used literature
4. Partner universities do not provide all the courses at the level of doctoral studies
5. Some of the used literature sources are not in the language of the study program

Assessment of the requirement [5] (applicable only to master's or doctoral study programmes)

1 R5 - The study programme for obtaining a master's or doctoral degree is based on the achievements and findings of the respective field of science or field of artistic creation.

Assessment of compliance: Fully compliant

The study program for obtaining a doctor's degree is based on achievements in the relevant field of science - a doctoral thesis.

2.3. Resources and Provision of the Study Programme

Analysis

2.3.1. The study program is implemented jointly by two universities (the University of Latvia and Riga Technical University) in close collaboration with the CERN Baltic Group as well as support from the CERN. The Department of Physics of the FPMO responsible for the implementation of the study program (especially its specialisation in particle physics) from the UL side together with partner departments and institutions has the necessary experience and resources to ensure a high-quality study process, it has relevant experience in the implementation and management of a doctoral study program in physics. Doctoral students have access to laboratories and equipment of both the largest universities in Latvia, as well as CERN facilities and resources to perform research for their doctoral thesis. During the visit, 3 of 4 students participated in the meeting remotely from the CERN. Each student has a chance to spend at least 1 year at the CERN, work there in an international team as well as have a supervisor from the CERN.

UL library is a modern open-space type library with many study process suitable working places accessible 24 hours every day. It ensures access to a wide range of thematic literature both in printed and electronic format. Students have access to all main scientific databases (e.g. Web of Science, Scopus) as well as scientific journals (e.g. Nature, Physical Review Journals). Two computer rooms with 30 seats and shared-use portable computers with regular specialised software (e.g. COMSOL, MatLab, LabView, Mathematica, Ansys) are available for use at the FPMO building. Specialised software could be used also on students’ personal computers. Besides, students also have access to the RTU library as well as CERN Document Server.

UL Moodle platform is used to ensure an e-study environment for UL-hosted courses. A similar e-

study environment is also provided for RTU-hosted courses. Lectures are often held in the hybrid mode because some students or teaching staff aren't located in Latvia. ULScience Building (Jelgavas 3) has been commissioned in 2019, therefore, having appropriate planning and modern equipment for the implementation of the study program hybrid mode and supporting remote teaching.

The study program is already implemented mostly in English due to frequent English-speaking guest lecturers as well as international students (currently, one). All relevant literature (scientific publications) are in English and are available to students through the databases provided by UL and RTU libraries as well as the CERN Document Server. In order to increase the international competitiveness of the study program, it should be implemented only in English. There is no reason or practical justification to ensure its implementation in Latvian.

2.3.2. Collaboration agreement with the CERN ensures necessary scientific expertise and equipment support to perform research for their doctoral thesis. Each student is ensured financial support to visit the CERN facilities and perform research there. The research topic has been discussed in advance in collaboration with a relevant expert from the CERN which supports students with scientific expertise. Students have a chance to work on state-of-the-art scientific topics in particle physics and accelerator technologies in competitive international teams using the most advanced infrastructure in Europe.

2.3.3. State funding (9300 euros per year per budget-funded student) is the primary funding source for the study program. The breakdown of the costs is well described showing that the cost-effectiveness of the study program is achieved with 19 or more students (20 budget places are expected). In 2022/2021, six budget students were enrolled and a similar number of students was enrolled this year, thus having 10+ students in 2 years - keeping the path to achieve the required number of students to ensure the financial sustainability of the study program.
Currently, study courses are offered even for one student, thus ensuring a student-centred approach. It is also backed by the teaching staff's enthusiasm and willingness to devote time to a single student in the study course. However, such an approach might not be cost-effective in the long term perspective. The potential solution might be a closer collaboration with other similar study programs in Europe to provide joint courses. From the discussion with the study program management, it was understood that a joint master-level study program in particle physics and accelerator technologies is under development in collaboration between five universities in the Baltic states. It might serve as a basis for a larger number of potential doctoral students and possible collaboration in joint study courses at the doctoral level.

Conclusions on this set of criteria, by specifying strengths and weaknesses

The study program implemented jointly by UL and RTU in collaboration with the CBG and CERN ensures the best available teaching staff, laboratory equipment and other study resources for students. The study provision is ensured by UL units involved also in the implementation of doctoral-level studies in physics, thus having relevant experience. The material-technical (including access to the CERN facilities and resources), informative and methodological base for ensuring a high-quality study process in the doctoral level particle physics and accelerator technologies studies is appropriate and up to date. Collaboration with the CERM and access to its research facilities are crucial for the implementation of the study program. The classrooms are well equipped to support modern teaching methods as well as distant learning. Available state budget funding is sufficient for the implementation and development of the study program. However, the relatively small number of students remains the main risk for the profitability and financial sustainability of the study program. It is planned to develop a joint master-level study program in particle physics and accelerator

technologies between 5 universities in the Baltic states that might serve as a basis for a larger number of potential doctoral students. There are no restrictions in the study program implementation in English, therefore, providing the possibility to attract students from abroad (especially Baltic region and EU). The study program is already implemented mostly in English due to frequent English-speaking guest lecturers as well as all relevant literature (scientific publications) are in English. In order to increase the international competitiveness of the study program, it should be implemented only in English. There is no reason or practical justification to ensure its implementation in Latvian.

Strengths
1.The study provision is ensured by experienced and well-equipped units from UL and RTU, thus providing the best available options for particle physics and accelerator technologies studies at the doctoral level in Latvia.
2.The study program is implemented in collaboration with the CERM Baltic Group and with support from the CERN; students have access to the CERN facilities and resources.
3. The material-technical, informative and methodological base for ensuring a high-quality study process in doctoral-level physics studies is appropriate and up to date.
4.Programs can be implemented in English as well as remote/hybrid study forms are practised, thus fulfilling prerequisites to attract students from abroad.

Weaknesses
1. The relatively small number of students (6 in 2021/2022) remains the main risk for the profitability and financial sustainability of the study program.
2.Collaboration with the CERN and access to its facilities are crucial for the implementation of the study program; the sustainability of the study program depends on Latvia’s CERN member status.

Assessment of the requirement [6]

1 R6 - Compliance of the study provision, science provision (if applicable), informative provision (including library), material and technical provision and financial provision with the conditions for the implementation of the study programme and ensuring the achievement of learning outcomes

Assessment of compliance: Fully compliant

The study provision is ensured by experienced and well-equipped units from UL and RTU in collaboration with the CBG and with support from the CERN, thus providing the best available options for particle physics and accelerator technologies studies at the doctoral level in Latvia.

2.4. Teaching Staff

Analysis

2.4.1. The twelve members of the teaching staff involved in the programme are highly qualified researchers from LU, RTU and CERN. There are five professors from LU and seven professors from RTU involved in the implementation of the programme. They all have PhD and they are active in research (SAR 3.4.3). Ten of them are LSC experts, two of them in two subjects and one in three subjects. (SAR 3.4.3) The language skills among the teaching staff are sufficient for teaching in Latvian and English according to regulations according to Annex 2.5 and Annex 2.6. (CVs from the teaching staff from RTU are not provided.).

2.4.2. The programme is new, so it is not possible to analyze changes in the composition of the teaching staff.

2.4.3. The teaching staff involved is highly active in relevant research projects (SAR § 3.4.4) and they have an impressive scientific output in terms of publications. This high level of scientific research is essential for a successful implementation of the doctoral programme. Examples of such projects are “Peak quark and Higgs bozonal studies in the CMS experiment, developing crystal scintilators, CMS sub-detectors and particle accelerators for business use, in cooperation with CERN” with Elīna Pajuste as Scientific Head and “SEQUOIA: Single-Electron Quantum Optics for Interferometers and Applications” with Vjačeslavs Kaščejevs as leading researcher.

2.4.4. The teaching staff from LU has been very productive in research. They all have multiple publications during the last six years (Appendix 2.5, Google Scholar). Two examples of high impact publications are given by

* V. Kashcheyevs, J. D. Fletcher, N. Johnson, E. Locane, P. See, J. P. Griffiths, I. Farrer, D. A. Ritchie, P. W. Brouwer, M. Kataoka. Continuous-variable tomography of solitary electrons. Nature Communications, 10, 5298 (2019)
* I. Khlusov, Y. Dekhtyar, et al., Nanoscale electrical potential and roughness of a calcium phosphate surface promotes the osteogenic phenotype of stromal cells, Materials, Vol. 11, P. 2-25, 2018

2.4.5. The programme has been developed by a working group in collaboration between teaching staff and researchers at LU, RTU and CERN. The council of the programme continuously monitors quality and linking of courses is part of this. (SAR 3.4.5) There are discussions between lecturers of the different courses so that there is not too much overlap. (Meeting with academic staff) The collaboration between the teachers has been very egalitarian so far. (Meeting with academic staff). The programme council and the programme a working group both include teaching staff from LU and from RTU. These groups are set up in way to promote collaboration between teaching staff from both universities in the implementation and in the further development if the programme.

Conclusions on this set of criteria, by indicating strengths and weaknesses

The development of the programme has been possible due to the unique competences of the involved academic staff. Collaboration between LU, RTU and CERN has been working very well. The teaching staff is very active in research projects in relevant areas.

Strengths
1. Highly competent teaching staff

Weaknesses
No weaknesses have been identified.

Assessment of the requirement [7]

1 R7 - Compliance of the qualification of the academic staff and visiting professors, visiting associate professors, visiting docents, visiting lecturers and visiting assistants with the conditions for the implementation of the study programme and the requirements set out in the respective regulatory enactments.

Assessment of compliance: Fully compliant

Highly competent academic staff, clearly satisfying the requirements. There are five professors from LU and seven professors from RTU involved in the implementation of the programme. They all have a PhD and they are active in relevant research projects.

2.5. Assessment of the Compliance

Requirements

1 1 - The study programme complies with the State Academic Education Standard or the Professional Higher Education Standard

Assessment of compliance: Not relevant

N/A

2 2 - The study programme complies with a valid professional standard or the requirements for the professional qualification (if there is no professional standard required for the relevant occupation) provided if the completion of the study programme leads to a professional qualification (if applicable)

Assessment of compliance: Not relevant

N/A

3 3 - The descriptions of the study courses and the study materials have been prepared in all languages in which the study programme is implemented, and they comply with the requirements set forth in Section 561 , Paragraph two and Section 562 , Paragraph two of the Law on Higher Education Institutions.

Assessment of compliance: Fully compliant

Study course descriptions and study materials are prepared in Latvian and English languages, and they satisfy requirements set in Law on Higher Education Institutions. See annex 8.10.

4 4 - The sample of the diploma to be issued for the acquisition of the study programme complies with the procedure according to which state recognised documents of higher education are issued.

Assessment of compliance: Fully compliant

The diploma issued complies with the state legislature and “Procedures by which documents certifying higher Education recognised by the State shall be issued” (Cabinet of Ministers No. 202). See annex: DSPDFPT_Sample of the diploma.pdf.

5 5 - The academic staff of the academic study programme complies with the requirements set forth in Section 55, Paragraph one, Clause 3 of the Law on Higher Education Institutions.

Assessment of compliance: Fully compliant

There are at least 5 associate. professors or professors involved in the study programme implementation together. It is confirmed by the Head of Study Field Declaration. See annex: AMSPF_Confirmation that the academic staff complies with the requirements specified in S55 P1 C3 of the Law on Higher Edu.docx

6 6 - Academic study programmes provided for less than 250 full-time students may be implemented and less than five professors and associated professors of the higher education institution may be involved in the implementation of the mandatory and limited elective part of these study programmes provided that the relevant opinion of the Council for Higher Education has been received in accordance with Section 55, Paragraph two of the Law on Higher Education Institutions.

Assessment of compliance: Fully compliant

This criterion is met and AIP has approved the implementation of the study programme. See annex: DSPDFPT_Opinion of the Council of Higher Education.docx

7 7 - At least five teaching staff members with a doctoral degree are among the academic staff of an academic doctoral study programme, at least three of which are experts approved by the Latvian Science Council in the respective field of science. At least five teaching staff members with a doctoral degree are among the academic staff of a professional doctoral study programme in arts (if applicable).

Assessment of compliance: Fully compliant

This criterion is fulfilled completely, three academic staff with doctoral degrees are approved by Latvian Science Council as experts in respective fields of science.
See annex: DSPDFPT_Confirmation that the academic staff of the doctoral programme complies with the requirements.docx

8 8 - The teaching staff members involved in the implementation of the study programme are proficient in the official language in accordance with the regulations on the level of the official language knowledge and the procedures for testing official language proficiency for performing professional duties and office duties.

Assessment of compliance: Fully compliant

The academic staff has sufficient Latvian language knowledge for implementing study courses, see annex: 2.6.annex_Declarations of the state language.zip

9 9 - The teaching staff members to be involved in the implementation of the study programme have at least B2-level knowledge of a related foreign language, if the study programme or any part thereof is to be implemented in a foreign language (if applicable).

Assessment of compliance: Fully compliant

The academic staff has sufficient foreign language knowledge for implementing study courses, see annex: 2.7.Declarations on the respective foreign language skills.zip

10 10 - The sample of the study agreement complies with the mandatory provisions to be included in the study agreement.

Assessment of compliance: Fully compliant

Study agreements include all necessary parts set in legislation. See the annex: Standard sample of study agreement.zip.
It is advised to include information about guarantees of compensation losses (11. and 12. criteria), so that this information is easier for the students to acknowledge already from the beginning.

11 11 - The higher education institution / college has provided confirmation that students will be provided with opportunities to continue their education in another study programme or another higher education institution or college (agreement with another accredited higher education institution or college) if the implementation of the study programme is terminated.

Assessment of compliance: Fully compliant

University has cooperation agreement with Riga Technical University as confirmation that in case the implementation of this study programme is terminated students will be able to continue studies in similar UL and RTU doctoral study programmes “Mechanical Engineering and Mechanics” (RTU), “Chemistry, Materials Science and Technology” (RTU), Natural Sciences (Physics, Astronomy and Mechanics) (UL). See annex: 2.3.Compensations.zip

12 12 - The higher education institution / college has provided confirmation that students are guaranteed compensation for losses if the study programme is not accredited or the study programme’s license is revoked due to the actions (actions or omissions) of the higher education institution or college and the student does not wish to continue studies in another study programme.

Assessment of compliance: Fully compliant

University has a rector's signed pledge that confirms it will compensate losses to students if the study programme is not accredited or loses its licence and the student does not wish to continue studies in another study programme. See annex: 2.3.annex_Compensations.zip It is advised to include this information in the study agreement.

13 13 - The joint study programmes comply with the requirements prescribed in Section 55.(1), Paragraphs one, two, and seven of the Law on Higher Education Institutions (if applicable)

Assessment of compliance: Fully compliant

This programme fully satisfies requirements fully described - it is formed by the parts of study programmes of the same level for both partners, there are unified requirements in respect of the implementation of the joint study programme, the final examinations, the awarding of degrees to be acquired in studies and vocational qualifications; the parts of the joint study programme together form a unified content and consecutive joint study programme.

14 14 - Compliance with the requirements specified in other regulatory enactments that apply to the study programme being assessed (if applicable)

Assessment of compliance: Not relevant

N/A

Assessment of the requirement [8]

1 R8 - Compliance of the study programme with the requirements set forth in the Law on Higher Education Institutions and other regulatory enactments.

Assessment of compliance: Fully compliant

The requirement has been met and fulfilled, and all requirements set in different regulatory enactments are satisfied - study programme complies with Law on Higher Education Institutions.

General conclusions about the study programme, indicating the most important strengths and weaknesses of the study programme

The study programme is justified and complies with the study field. The programme is in line with the strategic goals of the University of Latvia as well as the agreement between Latvia and the CERN. This study programme is well recognized by all stakeholders and should ensure this field with highly skilled specialists. This study programme has the potential to be developed and taught primarily (or only) in the English language, thus acquiring students from other countries. There is no reason or practical justification to maintain it in the Latvian language as it will only limit its international competitiveness. The content of the study courses corresponds to the objectives of the study programme and ensures the achievement of learning outcomes. Faculty has a wide provision of the material and technical base, which provides very good opportunities for learning a profession. However, its implementation is not possible without collaboration with the CERN and access to its infrastructure for scientific experiments. Cooperation with CERN Baltic Group as well as support from the CERN ensures necessary teaching staff expertise.

Strengths
1. The study provision is ensured by experienced and well-equipped units from UL and RTU, thus providing the best available options for particle physics and accelerator technologies studies at the doctoral level in Latvia.
2. The study program is implemented in collaboration with the CERN Baltic Group and with support

from the CERN; students have access to the CERN facilities and resources.
3. The material-technical, informative and methodological base for ensuring a high-quality study process in doctoral-level physics studies is appropriate and up to date.
4. Programs can be (or should be) implemented in English as well as remote/hybrid study forms are practised, thus fulfilling prerequisites to attract students from abroad.
5. Highly competent teaching staff.

Weaknesses
1. The relatively small number of students (6 in 2021/2022) remains the main risk for the profitability and financial sustainability of the study program.
2. Collaboration with the CERN and access to its facilities are crucial for the implementation of the study program; the sustainability of the study program depends on Latvia's CERN member status.
3. For now, in the first year of studies, there is little statistical information for analysis and recommendations on the implementation, success and demand of studies
4. Study course descriptions are misleading and must be improved
5. Study courses are not up to date with respect to used literature
6. Partner universities do not provide all the courses at the level of doctoral studies
7. Some of the used literature sources are not in the language of the study program

Evaluation of the study programme "Particle Physics and Accelerator Technologies"

Evaluation of the study programme:

Excellent

2.6. Recommendations for the Study Programme "Particle Physics and Accelerator Technologies"

Short-term recommendations

1. Collaboration with the CERN and access to its facilities are crucial for the implementation of the study program; the sustainability of the study program depends on Latvia's CERN member status. Therefore, it is recommended to develop and implement a plan for the demonstration of clear benefits as well as the return on investment from participation in the CERN to justify the Latvian investment in it.

Long-term recommendations

1. Evaluate opportunities to attract more foreign students, especially from Estonia and Lithuania, to reach the margin of 20 students in the program to ensure the cost-effectiveness of the study program.
2. Develop mechanisms to recruit permanent teaching staff with international experience.
3. Collaboration with the CERN and access to its facilities are crucial for the implementation of the study program; the sustainability of the study program depends on Latvia's CERN member status. Therefore, it is recommended to evaluate the outcomes regularly to ensure planned impact and clearly demonstrate it to society as well as decision-makers in Latvia's CERM member status.

III - Assessment of the Requirements for the Study Field and the Relevant Study Programmes

III - Assessment of the Requirements for the Study Field and the Relevant Study Programmes

Assessment of the Requirements for the Study Field

Requirements	Requirement Evaluation			Comment
R1 - Pursuant to Section 5, Paragraph 2.1 of the Law on Higher Education Institutions, the higher education institution/ college shall ensure continuous improvement, development, and efficient performance of the study field whilst implementing its internal quality assurance system:	Fully compliant			There is full compliance with the Law on Higher Education.
R2 - Compliance of scientific research and artistic creation with the level of development of scientific research and artistic creation (if applicable)	Fully compliant			High performance of scientific and teaching staff, high level of students involved in different research activities.
R3 - The cooperation implemented within the study field with various Latvian and foreign organizations ensures the achievement of the aims of the study field.	Fully compliant			Good cooperation with local industry companies in providing internships and scientific cooperation; international cooperation within Erasmus+ and other international projects at a good level. However there is a difficulty to attract permanent teaching staff with international experience.
R4 - Elimination of deficiencies and shortcomings identified in the previous assessment of the study field, if any, or implementation of the recommendations provided.	Fully compliant			Most of the recommendations have been fully implemented and acknowledged. It was not possible to evaluate some of the recommendations from licencing of programmes due to them still being in the process of implementing.

Assessment of the Requirements for the Relevant Study Programmes of the Study Field

No.	Study programme	R5	R6	R7	R8	Evaluation of the study programme (excellent, good, average, poor)
1	Mathematician Statistician (42460)	Not relevant	Fully compliant	Fully compliant	Fully compliant	Excellent
2	Physics (43443)	Not relevant	Fully compliant	Fully compliant	Fully compliant	Excellent
3	Mathematics (43460)	Not relevant	Fully compliant	Fully compliant	Fully compliant	Excellent
4	Physics (45443)	Fully compliant	Fully compliant	Fully compliant	Fully compliant	Excellent
5	Mathematics and Data Science (45460)	Fully compliant	Fully compliant	Fully compliant	Fully compliant	Excellent
6	Particle Physics and Accelerator Technologies (51443)	Fully compliant	Fully compliant	Fully compliant	Fully compliant	Excellent

The Dissenting Opinions of the Experts

There were no dissenting opinions of the experts.