Implementation description of the study program “Particle physics and acceleration technologies”

1. Description of the problem

Justification for creation of the PhD study program ‘Particle physics and accelerator technologies” is to strengthen particle physics and accelerator technology community in Latvia. Following tasks have been identified:

1. To prepare field experts in order to boost knowledge intensive industries in Latvian economy
2. To educate scientific staff for doing high level and globally competitive scientific research
3. To enable above mentioned scientific personnel to transfer obtained knowledge to economy
4. To continue Latvia’s accession to CERN and fulfil obligations agreed between CERN and Latvian government officials to strengthen particle physics and accelerator technology community in Latvia by creating this study program.

Since the begging of 21st century, when Salaspils nuclear reactor was closed, Latvia lacks experts and innovative research in the field of particle physics due to nonexistence of material and technical basis for of particle physics research, applications and studies.

Particle physics is one of the strongest innovation drivers in the world, whose indirect technology transfer is a significant source of innovation for every national economy [1]. Low-tech sectors are mostly dominating in the Latvian manufacturing industry. The share of the high technology sector in the structure of manufacturing during the period from 1997 by 2011 has increased by only 1% [2].

Particle physics is one of the areas for contributing to the 3rd objective of the Smart Specialization Strategy (RIS3) [3], which aims to educate highly qualified physicists and engineers, who can develop and promote innovation in the fields of smart energy and material, smart technology and engineering disciplines. In order to achieve the goals mentioned in the Smart Specialization Strategy, it is necessary to develop the areas of specialization, that require the implementation of knowledge-intensive educational programs that will prepare graduates for the specialization areas mentioned above. Particle physics and accelerator technology study program is aimed at preparing new specialists for the fields with high innovation potential, focused on particle physics, basic engineering processes, programming guidelines, large data concepts and particle detection techniques. The new specialists will specialize in one or more of the above-mentioned fields within their promotion work. As the example of CERN has shown, technology transfer from particle physics can also add high value technology in classical industries such as the food industry and material science, production, innovative diagnostic and therapeutic methods, computing and imaging techniques are the way how scientific achievements can contribute to the benefits of society [4].

The above-mentioned sectors are just a part of the target groups, the development of which will be facilitated by specialists trained in the program. In the event of non-implementation of the program, new specialists will not be trained in competitive sectors that would promote the growth of innovative industries in Latvia. The program will indirectly contribute to the decline of talent students' outflow to other countries as it will offer an attractive alternative - a competitive study program with world-class teaching staff (also CERN and Baltic leading specialists will be attracted) and the opportunity to study at CERN.

References:

1. http://www.hep.ucl.ac.uk/~markl/pp2020/KnowledgeExchangeDocument.pdf
2. http://polsis.mk.gov.lv/api/file/file26002.doc
3. http://polsis.mk.gov.lv/api/file/file34401.doc
4. https://cds.cern.ch/record/1567258/files/esc-e-106.pdf
5. http://baltasam.org/images/pdf_2012/resolution_31ba.pdf

2. Proposed solution

The Government of Latvia has confirmed its willingness and practical readiness to move towards a knowledge-intensive economy. The achievement of this goal is not possible without promoting the development of excellence in strong, internationally competitive research in Latvia. One of the most effective ways of achieving this goal is to develop research and educate high-level specialists in cooperation with the largest European and global research centres.

A crucial step for public policy is the willingness of the Latvian government to join the European Nuclear Research Organization CERN. To join this organization, Latvia must demonstrate its capacity in three areas: political will, a community of high energy and particle physics researchers and a developed innovative industry.

The application by Latvia to become an associated member of the CERN, with the right to become a full member state soon, has not been furthered. The CERN Council invited the Latvian government and researchers to strengthen the high energy particle physics community in Latvia. For this purpose, CERN has demonstrated its willingness to assist in attracting and engaging in various research projects.

That's why this is the right time to create a high-energy particle physics and accelerator technology study program using CERN support[1]. The CERN Baltic Group, in which eight universities and research institutes from all three Baltic countries participate, was established in spring 2018. Baltic Particle Physics / Accelerator Technology Specialists support the development of this study program and are ready to support it. The Baltic CERN Group delegated its mandate to Mr M. Auzins, who delegated the T. Torims and K. Kravalis to take the joint establishment and implementation of the study program in RTU and the University of Latvia with the RTU High Energy Particle Physics and Accelerator Technology Centre as the focal point for the establishment of the study program. Latvia in CERN Baltic group is represented by Riga Technical University, University of Latvia and Riga Stradins University. The CERN Latvia Group, which will be established by the National CERN Contact Point of Latvia, will also be involved in the working group for the creation of this study program in order to obtain

The CERN Baltic Group has expressed a wish to create master and doctoral programs in high energy in physics, particle physics and accelerator technologies. The universities and research institutes in the group have been nominated its competent experts who are ready to participate in the development of this program.

The program is planned to be developed together with the University of Latvia as a joint study program of both universities with RTU as a responsible partner and project applicant, attracting experts from the University of Latvia based on an employment contract. It is planned to conclude an agreement between the two universities about the creation of study program. It is planned to engage the specialists of the CERN Baltic group for higher education to create the program. The focus of the

programs are Latvian and Baltic students, potentially offering it for students outside the Baltic region. This will strengthen the creation of a united Baltic educational space [2], which will strengthen a united scientific community in the Baltics.

Graduates of the study program will acquire knowledge of high energy particle physics and accelerator technologies. The study programs in these attractive fields of science and engineering are a very well defined and proactive step towards increasing the number of students in advanced science study programs in Latvia and the Baltics.

The program will attract highly qualified academic staff from CERN and leading European universities to create excellence in study and compete successfully with European study programs.

Students will be offered research practice and specific thematic training opportunities in the European Organization for Nuclear Research CERN [3] in this study program. Similarly, the feasibility of studying at CERN thematic training courses, such as accelerators school, will be evaluated [4].

As the basis for the programs already existing study courses for doctoral studies at the Riga Technical University [5] and the University of Latvia [6] will be chosen, which will be improved on a detailed level and will be oriented towards the study program direction to ensure the continuity of the acquired knowledge. Part of specific courses will be created from scratch. Also, the possibilities of using the existing study courses in other leading Baltic universities will be examined, as well as launching a common goal - to create a joint study program for the Baltic Particle Physics and Accelerator Technologies. This will allow maintaining a sufficient number of students and will offer the opportunity to select the most capable students for these difficult topics for successful studies.

References:

1. https://indico.cern.ch/event/707741/
2. http://baltasam.org/images/pdf_2012/resolution_31ba.pdf
3. http://www.izm.gov.lv/images/starptautiska_sad/CERN/CERN_ligums.pdf
4. https://cas.web.cern.ch/
5. https://info.rtu.lv/rtupub/disc2/list
6. https://www.lu.lv/gribustudet/katalogs/kursu-katalogs/?user_phpfileexecutor_pi1%5Bcourse_id%5D=2FIZ7024

3. Solution rationale

The new doctoral program will promote resource sharing and closer co-operation between the leading Latvian universities (RTU and UL) - the program will be created jointly using already existing competences in higher education institutions. RTU has long and strong traditions and ability to realize technologically oriented study programs and scientific research. LU has significant scientific and academic resources for the implementation of fundamental studies and research. The students of this study program must acquire knowledge in both fields, so the common use of above mentioned resources in both universities will be improved. Also, the experience of the Baltic neighbours and possibilities for adapting the study courses to the needs of the study program to be developed will be analysed. The emphasis here will be not

only to attract the lecturers, but also students not only from Latvia but also from all Baltic countries as well as from other countries. This is especially important in the context of the Baltic students - these are young Baltic scientists who will be able to lay the foundation for a unified Baltic scientific (and study) space.

Innovative training methods will be used in the new program - an e-courses for training and lectures modules for remote studies will be developed that will provide an opportunity to hold lectures online and instruct students to conduct student training with the help of additional online or contact colloquia. It is also planned to develop a self-learning auxiliary course for various background knowledge for field students. Also, the scientific infrastructure and its load for students' scientific research will be identified.

The selected steps and activities are ranked sequentially, with the goal of creating a new doctoral program. The two universities that comprise the curriculum have long-standing traditions and successful study practice. There is also a significant administrative, academic and scientific capacity that will enable the establishment of a high-quality study program. Experts recognized by their industry have been identified, which will form a working group for the development of study program in particle physics and accelerator technologies. The working group will meet once a month, or more often as needed. The team will invite experts from the leading Baltic universities, CERN and industry to identify the necessary skills for graduates. Expert group also will determine the range of skills acquired in the program, the composition of the study courses, analyse the existing study courses and the possibilities to apply them to the implementation of the program being developed. Sufficient funding is provided for experience exchange trips to Baltic universities and research institutes and CERN. Also, expert visits to the RTU and the University of Latvia during the development and approval of the program are foreseen.

To create the program, it is planned to attract following experts from the universities implementing the program - RTU and the University of Latvia and the leading Baltic universities:

RTU:

- Academician Dr. habil. sc. ing. Leonīds Ribickis
- Asoc. Prof. Toms Torims
- Prof Jurijs Dehtjars
- Prof. Aleksejs Kataševs
- Dr.Sc.Ing. Kalvis Kravalis
- M.Sc. Viesturs Veckalns

UL:

- Prof. Dr. Phil. Mārcis Auziņš
- Dr. Phys. Guntars Kitenbergs
- Asoc. Prof. Dr. Phil. Vjačeslavs Kasčejevs

Tallinn University of Technology

- Prof. Dr. Phil. Jaan Kalda
- Asoc. Prof., Dr. Sc. Ing. Fjodor Sergejev

Vilnius University:

- Dr. Phil. Aurelijus Rinkevicius
- Dr. Phil. Andrius Juodagalvis

University of Tartu

- Dr. Phil. Stefan Groote
- Dr. Phil. Laur Järv

Kaunas Technical University

- Prof. Sigitas Tamulevičius
- Assoc. prof. Kristina Ukvalbergienė
- Prof. Leonas Balaševičius

National Institute of Chemical Physics and Biophysics (NICPB), Tallin

Dr. Phys. Andi Hektor

CERN:

- Dr. Maurizio Vretenar
- Dr. Christoph Schaefer

Industry representative:

- Dr. Vladimir Gostillo - Chairman of the Board of SIA "Baltic Scientific Instruments"

The topic of the study program is coherent with several RTU research projects in the technological direction - in the development of innovative materials and computer science.

1. KC-PI-2017/54 - Large data stream processing capability in service. Funding: 27777 EUR (BaSeCaaS) - https://www.rtu.lv/lv/universitate/projekti/atvert?project_number=3548%2F2018
2. 1.1.1.1/16/A/203 - Multilayer silicon nanoconductor with improved dielectric layers – Funding: 648 605,05 EUR - https://www.rtu.lv/lv/universitate/projekti/atvert?project_number=2601%2F2017
3. 1.1.1.1/16/A/073 - High-performance, erosion-resistant multi-functional coatings for composite structures of aircraft (PEROMACS). Funding: 200 000 EUR
4. 1.1.1.2/VIAA/1/16/167 - Thin films with nanoparticles for ionizing radiation dosimetry. Funding: 133,805.88 EUR - http://bini.rtu.lv/content/uploads/Projekta-apraksts_LV_Marina.pdf

RTU is claiming leadership in science in Latvia in such fields as energy and electrical engineering, electronics and telecommunications, computer systems and information technology, chemistry and chemistry technology, biomechanics and biomaterial technology, material science and materials design, textile and clothing technology, heat, gas and water engineering, engineering and geomatics, mechatronics and robotics, automotive, railway and aviation transport, machine building, as well as business management and transport logistics. This is also confirmed by the prevailing number of RTU professors in the Latvian Academy of Sciences. - https://projekti.rtu.lv/external/rtu-projektu-publicitate/Infrastrukt%C5%ABras-att%C4%ABst%C4%ABbas-project=index_files/RTU%20Strategy%20un%20Attistibas%20programma%202014 .2020% 20th anniversary.pdf

LU Strategy 2020 describes the development of the following directions: 1. Higher education: natural sciences, mathematics and information technologies; engineering sciences; environment protection; health protection; education; humanities and art; social sciences, commerce and law; social protection; labor protection and safety. 2. Research: humanitarian and educational sciences; social sciences and law; sciences; medical and life sciences.

Based on these principles of research selection, UL has defined following priority research directions for the years 2016-2020.: 1. Innovative information technologies. 2. Atomic Physics, Optical Technology and Medical Physics. 3. Mathematical methods. 4. Nano and quantum technologies, innovative materials. 5. Climate change and the sustainable use of natural resources. 6. Biomedicine, pharmacy. 7. Regenerative medicine, biobank. 8. Ecology and biodiversity. 9. Public health, quality of life and nation's sustainability. 10. Critical Thinking, Innovation, Competitiveness and Globalization. 11. Letonica, diaspora and intercultural communication. 12. Man and technology, quality of education.

https://www.lu.lv/fileadmin/user_upload/lu_portal/zinas/2018/julijs/LUstrat_Kopsavilk_250517.pdf

Publications of RTU scientists are available in the RTU Scientific Publications Register- https://www.rtu.lv/lv/zinatne/publikacijas/rtu-zinatnisko-publikaciju-datubaze. RTU annual reports contain data on the number of publications per year. In 2017 RTU scientists published 1659 publications indexed in the leading industry databases IEEE Xplore, Chemical Abstracts and Engineering Village, as well as in the databases of Springer, ELSEVIER and De Gruyter Open publishing houses and EBSCO and ProQuest informational company’s databases. In the reference year there are 728, ISI Web of Knowledge indexed publications in citation databases, while SCOPUS has indexed 900 RTU publications. In 2017 RTU scientists have prepared 9 scientific monographs. - https://www.rtu.lv/writable/public_files/RTU_zdp_2017_web.pdf

Other Annual Reports available here: https://www.rtu.lv/lv/zinatne/zinatniskas-darbibas-parskati

Publications of the University of Latvia are available at the University of Latvia's Scientific Publications Register - https://www.biblioteka.lu.lv/e-resursi/lokalas-db/publikaciju-datubaze/

UL Annual Reports Available: https://dspace.lu.lv/dspace/handle/7/589

In 2017, employees of the structural units of the University of Latvia, as authors or co-authors, have prepared 1747 diverse types of scientific publications, including monographs, chapter monographs, articles in local and international scientific journals, and conference outlet collections. 59% of all publications were in the exact sciences, life sciences and medicine, 27% - humanities, and 14% - in social sciences. In Scopus and the Web of Science database in 2017, 579 LU staff members were included, of which 357 were articles in international scientific journals. 55% of the articles in the WoS and Scopus databases have been produced in co-authorship with foreign co-authors, while 76% (270) articles have been published in scientific journals with a quotation index above the average industry. The proportion of such articles in applied sciences, life sciences and medicine were 82%, in the humanities - 45%, in social sciences - 27%. In the local and international conferences materials in 2017, 771 publications have been published. In total, 39 individual authors or collective monographs, 3 textbooks, 46 articles and scientific journals have been published. In local and international conferences, in 2017, 771 publications have been published. A total of 39 individual authors or collective monographs, 3 textbooks, 46 articles and scientific journals have been published. https://dspace.lu.lv/dspace/handle/7/38408.

The scientific infrastructure of the RTU and the University of Latvia will be available for the development of the study program for students, from which the following infrastructure objects will be released, which is particularly consistent with the expected research topics:

1. RTU DITF cloud computing platform - for computing and data processing https://www.rtu.lv/universitate/masu-medijiem/zinas/atvert/rtu-ditf-izmanto-makondatosanu-eraf-un-ek-projektos-12892
2. 2. RTU IEEI Institute of Industrial Energetics and Electrical Engineering, RTU Faculty of Power and Electrical Engineering, Latvenergo Creative Laboratory for Prototyping of Equipment -https://www.rtu.lv/lv/studijas/arpusstudijas/latvenergo-radosa-laboratorija
3. RTU Institute of Biomedical Engineering and Nanotechnology - Laboratory of Nanodosimetry for weak electron emission spectroscopy
4. Materials Physics Laboratory of Solid State and Materials Physics, RTU Institute of Technical Physics
5. For rapid prototyping of the RTU design factory's technical infrastructure
6. Mathematical Modeling of Infrastructure and Research Instruction of the Institute of Mathematics and Computer Science of the University of Latvia http://www.lumii.lv/resource/show/15
7. UL Laser Center Infrastructure https://www.lu.lv/en/about-us/structure/ul-centres/lazeru-centrs/
8. Laboratory of Radiation Chemistry at the Institute of Chemical Physics at the University of Latvia for the main research areas - radiation processes in solids, material radiation stability, magnetic field effects on radiolysis-stimulated processes, and the development of new materials and technologies for fusion facilities, as well as sterilization of medical devices, sterilizers and electronic integrated circuits; An electron accelerator laboratory with the main direction of research - on the simultaneous effects of magnetic fields and ionizing radiation at various temperatures http://www.kfi.lu.lv/petijumi.html#4
9. Laboratory of Magnetic Hydrodynamics Laboratory of the Institute of Physics at UL Institute for Modeling Liquid Metals in Applications of Particle Physics for neutron fission or exotic isotope generation purposes

4. Competences of the academical staff

The teaching staff will get the certificate in required C1 level of the English language after the correspondent course at RTU Riga Business School in the frames of SAM 8.2.2. project.

5. Implementation capacity

A work group for the creation of the study program will be set up, the task of which will be to select and designate the objectives of the study program, the requirements for students' skills and competences, the composition of the study courses and the volume of the courses. The work group will also be responsible for keeping track of the timetable, to meet the deadlines for development, licensing, approval and accreditation of the study program. The work group will be formed from the experts of the University of Latvia and RTU mentioned in the application, as well as other experts of these institutions will be involved when necessary.

Work group will also implement the licensing, approbation and accreditation of the study program.

All experts involved in study program creation are planned to be employed on the basis of employment contracts. The work of foreign experts, which will not exceed the workload of 0.3, is planned to be paid from the indirect costs of the project.

The following experts will be involved in the implementation of the project:

RTU:

Academician Dr. Habil sc ing. Leonids Ribickis. Latvian Academy of Sciences Academician since 2007. LAS Corresponding member from 2001 by 2007. Rector at Riga Technical University. Has substantial experience in managing industrial enterprises. Scientific experience in RTU and foreign scientific institutions. Scientific work: Electrical engineering sub branch of the energy sector. Pedagogical activity - doctoral thesis, master's thesis supervisor, reviewer, lectures in several study subjects. Considerable experience in the implementation and management of scientific projects. He received several awards in science.

Asoc. Prof.. Dr. Sc. Ing. Toms Torims. Deputy Director of RTU High-Energy Particle Physics and Accelerator Technology Centre. Toms Torims has master degrees in mechanical engineering (2001) and in social science (2003). He holds a PhD degree in engineering sciences from Riga Technical University - RTU (2006).

He started his professional career in 1994 as a Technologist in a ship repair enterprise. Subsequently, he became an Engineer and the Managing Director of the ship repair company. He continued his career as a Senior Officer in the Ministry of Agriculture of the Republic of Latvia and is currently working as Maritime Security Inspector in the European Commission based in Brussels. In 2006 he joined RTU academic staff as an Assistant and continued as a Researcher, Lead Researcher and Head of the Material Processing Department.

Dr. Torims is elected Full Professor in RTU, where he is continuing research and teaching activities. He is author of some 50 scientific articles and co-author of 5 university textbooks. Prof. Torims participated and managed number of national and international scientific research projects.

Since 2017 Prof Torims is working in CERN as Scientific Associate in Directorate for Accelerators and Technology.

Current research interests: particle accelerator technologies, advanced production technologies, additive manufacturing, and in-situ renovation technologies.

Prof. Torims is member of: EUROMECH, American Society of Mechanical Engineers (ASME), Danube Adria Association for Automation & Manufacturing (DAAAM – Austria), and Association Française de Mechanique (AFM). Member of the Future Circular Colider International Collaboration Board (CERN), Switzerland, Member of the Royal Belgian Institute of Marine Engineers, Corresponding Member of the International Academy of Engineering – Central European Branch, Professor Founder of DAAAM International Doctoral School

Dr. hab. phys , academician, Prof. Jurijs Dehtjars/Yuri Dekhtyar
Scientific work: radiation physics for medical technologies; nano-dosimetry; nanotechnology for medicine purposes. Director of the BSc and MSc teaching Programs in Medical Engineering and Physics. Pedagogical activity – supervision and reviewing of PhD (about 20), MSs and BSc students' theses and engineer projects. Delivering of courses related to medical physical technologies. Received several honors in science and teaching. Latvian State Prize winner. Participated and led international and national projects.

Dr. phys. Prof. Alexey Katashev
Scientific work: Radiation physics for medical technologies; nano-dosimetry; radiation therapy technologies; biometrics. Pedagogical activity - supervision and reviewing of PhD, MSs and BSc students' theses and engineer projects. Delivering of courses related to medical physical technologies. Received several awards for technology transfer. Participated and led international and national projects.

Dr.Sc.Ing. Kalvis Kravalis - RTU Assistant Professor, LU FI Leading Researcher. Deputy Director of RTU High-Energy Particle Physics and Accelerator Technology Centre. Deputy Director responsible for Production processes at the Institute of Physics at UL. Pedagogical work experience in RTU since 2009. Participated in the implementation and management of several scientific projects. Scientific activity - liquid metal equipment for high energy systems.

M.Sc. Viesturs Veckalns - RTU doctoral student specializing in high-energy particle physics - is currently a participant in the CMS experiment and deals with the analysis of this experiment data. The theme of the doctoral thesis is the top quarks. Has been participating the CMS experiment since 2014. It is planned to defend the PhD thesis at the beginning of the next year.

UL:

Professor Mārcis Auziņš. Specialist in quantum physics. Currently Director of Doctoral Studies in the University of Latvia in Physics, Astronomy and Mechanics. Lecturing quantum physics. More than one hundred scientific articles and several hundred conference theses author. Oxford University Press and Cambridge University Press have published monographs related to quantum physics. Worked as a visiting professor and visiting researcher in many world universities in the USA, Canada, Britain, Germany, Israel and elsewhere. He has been visiting professor at the University of California, Berkeley, several times.

Dr. Phys. Guntars Kitenbergs. **Fakultātes nodaļas vadītājs**. Fizikas,matemātikas un optometrijas fakultāte Fizikas nodaļa. V**adošais pētnieks** Fizikas,matemātikas un optometrijas fakultāte Fizikas nodaļa Teorētiskās fizikas katedrā.

Associate Professor Vyacheslav Kascheev. Area of research is the use of quantum physics for the creation of new devices at the level of individual electrons and atoms. Vyacheslav Kashcheyev is known as the author of a precise single-electron source, the quantum-well pump. His research has been included four times in the annual list of the most significant scientific achievements of the Latvian Academy of Sciences. Vyacheslav Kascheyev is the co-author of more than 40 publications, quoted above 800 times. V. Kashechev's theoretical group cooperates with leading experimental laboratories in Germany, the UK, France, Australia and elsewhere, jointly implementing the European framework program FP7, Horizon 2020 and EMPIR quantum technology research projects.

Tallinn University of Technology:

Prof. Dr. Phil Jaan Kalda - Professor at Tallinn University of Technology. President of the European Physics Olympiad, regular supervisor and reviewer of PhD works. Scientific activity - in the field of physics - modelling of nonlinear systems, quantum mechanics. Has received several awards in science. Participated in the implementation and management of several scientific projects.

Asoc. Prof. , Dr. Sc Ing. Fyodor Sergeyev - Professor at Tallinn University of Technology. Vice dean of the Department of Engineering at the study work. Director of the study program. Scientific research direction - material science. Participated in the implementation and management of several scientific projects. Regular PhD works supervisor.

Vilnius University:

Dr. Phil. Aurelijus Rinkevicius - Lithuanian representative to CERN User council and other activities at CERN. Main research interests - particle physics. Has gained experience in several worlds leading research institutions. Defended his PhD on Higgs boson thematic.

Dr. Phil. Andrius Juodagalvis. Senior researcher, leader of the project on cooperation with CERN, funded by Lithuanian Academy of Sciences. Main research interests - Elementary particle physics and Nuclear physics and its applications. Participated in many scientific research projects. Since 2015, a representative of Vilnius University in CMS Gas Electron Multiplier (GEM) group. Since 2017, is a contact person to CMS AlCaDB group

Tartu University:

Dr. Phil. Stefan Groote - University of Tartu, Faculty of Science and Technology, Institute of Physics, Senior Research Fellow in Theoretical Physics, associated member of the COMPASS collaboration. Lecturer of several courses relevant to particle physics thematic in Tartu university. Is supervising several PhD works, has

valuable research experience in particle physics. Field of research - Physics and Technical Physics; SPECIALITY: spin in QCD perturbation theory, correlation functions and summation rules, lattice-QCD gauge theories, determination of parameters of the standard model by stochastic methods

Dr. Phil. Laur Järv - Assistant Director, Institute of Physics. Senior staff member in a number of research projects, Best lecturer award" in materials science, University of Tartu (2017). Lecturer of several courses relevant to particle physics thematic in Tartu university. Is supervising several PhD works, has valuable research experience in particle physics.

Kaunas Technical University:

Prof. Sigitas Tamulevičius - Doctor Habilitus (Materials Science), Kaunas University of Technology, Director of the Institute of Materials Science and Professor of the Physics Department, Kaunas University of Technology (KTU), Member of the Lithuanian Academy of Sciences. Field of Interests: Condensed matter physics, thin films, vacuum and plasma technologies, optical spectroscopy, surface and interface phenomena, micro and nanotechnologies, electronics, photonics, biomaterials, bio sensing. Editor-in-Chief of "Materials Science (Medžiagotyra)", ISSN1392-1320. Member of Advisory Board of „Materials Research Express" (IOPScience). Member of Editorial Board „American Journal of Nanomaterials" (Science and Education Publishing). Is supervising several PhD works, has valuable research experience in material physics.

Leonas Balaševičius - Vice-Rector for Research and Innovations of Kaunas University of Technology

2017-2018 - Head of Doctoral School of Kaunas University of Technology, 2007-2017 Director of Research Affairs Department of Kaunas University of Technology. Research interests - Parameters identification, simulation and optimization of technological processes. Doctor of Science Degree in Informatics Engineering

National Institute of Chemical Physics and Biophysics (NICPB), Tallin

Andi Hektor - senior researcher with research interests in high energy and astroparticle physics. The vice-deputy of the CMS Tallinn team in 2010 - 2103. the vice-deputy of the CMS Tallinn team. Visiting lecturer in the Helsinki and Tartu University ('High energy astrophysics'). . Is supervising several PhD works, has valuable research experience in particle physics. . Is supervising several PhD works, has valuable research experience in particle physics.

CERN:

Maurizio Vretenar - Senior Physicist – Accelerator development. Responsible for the Radio-frequency systems of CERN linear accelerators (2000-2012)
Project Leader for the Linac4 accelerator construction (2007-2017). Deputy Group Leader for Radio Frequency (2012-2014). Coordinator of the EuCARD2 and ARIES European Projects (2013-present)
Adviser for International Relations for the Accelerator and Technology Sector of CERN (2017-pres.). Has gained excellent managerial skills gained through organizing multi-million-euro projects.
Lecturer on Linear Accelerators at the « CERN Accelerator School », from 2000 to 2015. ▪ Member of the INFN Machine Advisory Committee (Italy).
Elected Member of the Committee of the Accelerator Group of the European Physical Society.

Christoph Schaefer - CERN Staff member. Head of Safety of the CMS experiment 2003 – 2014. Deputy Group leader of PH-CMM and PH-CMX groups.
Since 2014 senior adviser for relations with European associate and non-member states. Has gained skills in supervising the development and review of bachelor and master and PhD theses and
managerial skills gained through organizing and supervising programming internships. Responsible person for I am in charge of the budget and workforce planning of the International Relations sector,
organizing the CERN 60 years' anniversary VIP event, organizing all CERN Open Days at the CMS experiment. Has 700+ publications (mainly from the L3 and CMS collaboration). Also, is a Swiss certified expert in radiation protection.

Industry representative:

Dr. Vladimir Gostillo - Chairman of the Board of SIA "Baltic Scientific Instruments"

Project implementers confirm that they have the necessary infrastructure for the implementation of the doctoral study program, including buildings, premises, scientific and technical basis for carrying out the research part of research within the boundaries of university research directions.

6. Study program activities implementation time in the project: 30 months

7. Project activities and results to be achieved related to the study program

No.	Project activity	Description of the project activity (<2000 characters for each activity>)	Result	Numerical result		Partners involved**
				Amount	Unit	
1.	Development and licensing of study program implemented	Within the framework of the project a new Doctoral study program "Particle physics and accelerator technologies" will be developed.	New doctoral study program “Particle physics and accelerator technologies” licensed	1	Study program developed and licensed	
1.1	Development and licensing of study program	During the project realization period a new doctoral study program "Particle physics and accelerator technologies" will be developed, licensed and implemented.	Doctoral study program "Particle physics and accelerator technologies" is licensed	1	Study program license	
1.1.1.	Creation of work group to determine necessary skills, structure and development plan for the study program	The development of the study program will begin with the creation of a working group and the preparation of its work plan. The development of new study programs will start with the study of the current situation and the analysis of world experience, including similar study programs abroad. The labour market demand will be explored by involving the local employers of the industry in a working group. An action plan with the necessary activities for the establishment of the study program will be developed.	The existing situation is analysed, the most important requirements to the new program, its goal and tasks are formulated.	1	Report	
1.1.2.	Development of the description, structure and realization plan of the new program and study courses	Formulation of the objectives, tasks and results of the new program, description of the program implementation, study course mapping and preparation of other documents for licensing. Within the framework of this activity, it is planned to develop descriptions for new study courses of at least 65 credit points.	The content and materials of the study program are developed. Description and teaching materials of the new study courses are developed.	1	A set of documents for licensing	

1.1.3.	Visit of the members of the working group to the program for the Baltic institutions of higher learning and CERN	It is planned to exchange experience in work group missions to the Baltic universities and CERN, where the experience of the universities and scientific institutes will be assessed in the studies of particle physics and accelerator technology. The business trips are planned to the following institutions: Tallinn University of Technology, Vilnius University, Tartu University, National Institute of Chemical Physics and Biophysics, Kaunas Technical University, CERN.	There have been 5 study program development work group business trips. In total, 15 business units (persons) have been funded.	5 15	Missions; Persons	
1.1.4.	Curriculum descriptions of the study program	Descriptions of study courses necessary for realization of the whole study program are developed. Within the framework of this activity, it is planned to develop descriptions for new study courses of at least 65 credits.	A set of study course descriptions	1	A set of documents	
1.2.	Licensing of the new study program	The official approval of the new study program and its documentation at the level of Institute, Faculty and University. Submission of the necessary package of documents for licensing.	The new study program is licensed.	1	Study programs licence	
2.	Approbation of the new study program	Approbation of the study program developed during the 1st activity. Before the beginning of the program realisation the teaching materials should be developed – plans of the lectures, presentations, assignments, tests, description of the laboratory and practical works. Discussions and events for the exchange with experience will take place during the program pilot realisation. Seminar will involve at least one of the foreign experts; business trip will be organised for the experience exchange. At the end of each semester questionnaire of the students and teaching staff is organised to summarise all the results for the improvement of the program and self-assessment report for further accreditation.	Study program approbation realised	1	Report of the process and outcomes of approbation	
2.1.	Development of teaching materials for the creation of new study courses	It is planned to adapt or develop the following courses of compulsory study, partial choice and free choice courses (to be specified in the study program development working group) on the following topics: 1. Mathematics - Statistics and Group Theory	Methodological materials for study courses	1	List of developed study course materials	

		2. Quantum field theory - standard model and beyond it 3. Particle accelerator basics and technologies 4. Particle detector technologies 5. High-energy particle accelerator applications 6. The course of the experimental part of particle accelerator technology 7. Cosmology 8. Nuclear Physics 9. Physics of condensed matter 10. Particle detectors 11. Programming and numerical methods 12. Radiation safety 13. Large volumes of data 14. Nuclear Medicine Technology 15. Particle interaction with the substance and the human body 16. Advanced physical technology and medical equipment 17. Methods for measuring the properties of medical materials 18. Radiation safety achievements and trends				
2.2.	Approbation of the study program	Beginning of the pilot realisation of the developed program in accordance with the documentation, new courses and teaching materials.	Pilot realisation of the program	1	Report on the outcomes of approbation	
2.3.	Experience exchange activities for the study program work group on the results of the study program approbation.	It is planned to exchange experience through work group missions to the Baltic universities and to CERN, where the effectiveness of the newly created study program training and knowledge acquired by students will be evaluated. The missions would be to the following institutions: Tallinn University of Technology, Vilnius University, Tartu University, National Institute of Chemical Physics and Biophysics, Kaunas Technical University, CERN.	There have been 2 study program development work group visits abroad. In total, 6 persons have been funded.	2 6	Visits; Persons	
2.4.	Questionnaire of the participants of the activity	Questionnaire of the program realisation participants – students and teaching staff – is organised to improve quality of the developed study program. The	Feedback about the developed program	1	Report	

		activity includes development of the questionnaire and further analysis of the results.				
2.5.	Experience exchange seminar about the developing study program	Organisation of the seminar in experience exchange among the developers and involved teaching staff and invited experts from the abroad.	Obtained feedback recommendations from the foreign experts about the development and realisation of the study program.	1	Seminar summary	
3.	Accreditation of the corresponding study direction at EQAR Agency	Self-assessment report and all necessary documentation are completed and submitted for the accreditation at EQAR Agency	The study direction is accredited.	1	Accreditation sheet	
3.1.	Formation of the working team and planning	Working team for self-assessment report is formed as well as the work of the team is planned. The team will include the specialists – experts and senior experts – who have an experience in the development of study programs as well as accreditation documentation preparation. The plan of the work and the documents for the accreditation will be approved.	Working team is formed.	1	List of participants	
3.2.	Preparation of self-assessment report and its submission for accreditation/ accreditation	Self-assessment report is completed and officially approved at RTU in accordance with the description of the study program, its approbation feedback results. All the necessary documents are ready. The report is submitted to EQAR agency for the accreditation of the study direction.	Finished self-assessment report.	1	Self-assessment report	
3.3	Accreditation of the corresponding study direction at EQAR Agency	During the activity the interaction with the EQAR Agency is performed, Agency's expert visits at the university is coordinated. The activity finishes with the received EQAR Agency's expert group's common assessment report un submission of it the Study quality commission.	Received EQAR Agency's expert group's common assessment report un submitted to the Study quality commission.	1	EQAR Agency's expert group's common assessment report	
4.	International publicity of the new study program developed within the frames of the project	International publicity activities are carried out accordingly to the project's communication and publicity plan.	Completed international publicity activities.	1	publicity activities report	
5.	Support of the project realisation and	During the period of the project realisation all activities are coordinated and managed, timely submitting all the necessary deliverables. Coordinator	Finished realization of the project, events and processes.	1	Realized project	

	coordination of the activities	permanently supports the communication with the central management of the project for its feedback with the participants in order to minimize occurrence of the implementation risks.					

8. Study program implementation schedule

Project activity No.	2018				2019				2020				2021				2022				2023			
	1.	2.	3.	4.	1.	2.	3.	4.	1.	2.	3.	4.	1.	2.	3.	4.	1.	2.	3.	4.	1.	2.	3.	4.
1.											X	X	X											
1.1.											X	X												
1.2.													X											
2.														X	X	X	X	X						
2.1.														X	X	X	X	X						
2.2.															X	X	X	X						
2.3.																X	X							
2.4.																X		X						
2.5.																	X							
3.																	X	X	X	X				
3.1.																	X							
3.2.																	X	X						
3.3.																			X	X				
4.													X	X	X	X	X	X	X	X				
5.											X	X	X	X	X	X	X	X	X	X				

9. Summary of the study program development project budget

Kods	Title of the cost item*	Izmaksu veids (tiešās/ netiešās)	Daudzums	Mērvienība ***	Projekta darbības Nr.	Izmaksas		KOPĀ		t.sk. PVN
						attiecināmās	neattiecināmās	EUR	%	
1.	**Project costs according to the flat rate**	**netiešās**			1., 2., 3.	7 950.50	0.00	**7 950.50**	**7.96**	**0.00**
2.	**Project management costs**	**tiešās**				**4 632.69**	**0.00**	**4 632.69**	**4.64**	**0.00**
2.1.	***Remuneration costs of the project management staff***	***tiešās***				***4 632.69***	***0.00***	**4 632.69**	**4.64**	*0.00*
2.1.1.	*Remuneration costs of the project management staff (on basis of an employment contract)*	tiešās				***3 733.33***	***0.00***	**3 733.33**	**3.74**	*0.00*
2.1.1.1.	expert, project content manager	tiešās	***2400***	***stundas***	5.	***1 866.67***	***0.00***	**1 866.67**	**1.87**	*0.00*
2.1.1.1.	expert, project administrative manager	tiešās	***2400***	***stundas***	5.	***1 866.67***	***0.00***	**1 866.67**	**1.87**	*0.00*
2.1.2.	*Project management costs in the case of company / service contract*	tiešās				***0.00***	***0.00***	**0.00**	**0.00**	*0.00*
2.1.3.	*Employer taxes*	tiešās	***2***	***darbinieki***	5.	***899.36***	***0.00***	**899.36**	**0.90**	*0.00*
2.2.	***Other project management costs***	***tiešās***				***0.00***	***0.00***	**0.00**	**0.00**	***0.00***
2.2.1.	*Costs of purchasing or renting equipment for the newly created workplaces (office furniture and equipment, computer software and licenses)*	tiešās				***0.00***	***0.00***	**0.00**	**0.00**	***0.00***
2.2.2.	*Costs of domestic business trips and work travels*	tiešās				***0.00***	***0.00***	**0.00**	**0.00**	***0.00***
2.2.3.	*Transport costs*	tiešās				***0.00***	***0.00***	**0.00**	**0.00**	***0.00***
2.2.4.	*Costs of foreign business trips RTU*	tiešās					***0.00***	**0.00**	**0.00**	***0.00***
3.	**Project implementation staff costs**	**tiešās**				**71 339.14**	**0.00**	**71 339.14**	**71.39**	**0.00**
3.1.	***Remuneration costs of the project implementation staff***	***tiešās***				**61 139.14**	**0.00**	**61 139.14**	**61.18**	***0.00***
3.1.1.	*Remuneration costs of the project implementation staff (on basis of an employment contract)*	tiešās	3705	stundas	1., 2., 3.	***49 270.00***	***0.00***	**49 270.00**	**49.31**	0.00
3.1.1.1.1.	senior expert, professor, RTU	tiešās	***535***	stundas		***9 095.00***	***0.00***	**9 095.00**	**9.10**	0.00
3.1.1.1.2.	vecākais eksperts, profesors, LU	tiešās	*405*	stundas		***6 885.00***	***0.00***	**6 885.00**	**6.89**	0.00
3.1.1.2.1.	senior expert, assoc. professor RTU	tiešās	***535***	stundas		***7 490.00***	***0.00***	**7 490.00**	**7.50**	0.00
3.1.1.2.2.	vecākais eksperts, asoc. Profesors LU	tiešās	*405*	stundas		***5 670.00***	***0.00***	**5 670.00**	**5.67**	0.00
3.1.1.3.1.	expert, assit. professor, RTU	tiešās	***535***	stundas		***6 420.00***	***0.00***	**6 420.00**	**6.42**	0.00
3.1.1.3.2.	eksperts, docents, LU	tiešās	*405*	stundas		***4 860.00***	***0.00***	**4 860.00**	**4.86**	0.00
3.1.1.4.1.	expert, lecturer RTU	tiešās	*480*	stundas		***4 800.00***	***0.00***	**4 800.00**	**4.80**	0.00
3.1.1.4.2.	eksperts, lektors LU	tiešās	*405*	stundas		***4 050.00***	***0.00***	**4 050.00**	**4.05**	0.00
3.1.3.	*Employer taxes*	tiešās	18	darbinieki	1., 2., 3.	***11 869.14***	***0.00***	**11 869.14**	**11.88**	0.00
3.2.	***Other project implementation staff costs***	***tiešās***				**10 200.00**	**0.00**	**10 200.00**	**10.21**	***0.00***
3.2.1.	*Costs of purchasing or renting equipment for the newly created workplaces (office furniture and equipment, computer software and licenses)*	tiešās				***0.00***	***0.00***	**0.00**	**0.00**	***0.00***
3.2.2.	*Costs of domestic business trips and work travels*	tiešās				***0.00***	***0.00***	**0.00**	**0.00**	***0.00***
3.2.3.	*Transport costs*	tiešās				***0.00***	***0.00***	**0.00**	**0.00**	***0.00***
3.2.4.	*Costs of foreign business trips*	tiešās	***21***	***komandējumi***	***1., 2.***	***10 200.00***	***0.00***	**10 200.00**	**10.21**	***0.00***
3.2.4.1.	Business trip to Tallinn Technical University and National Institute Of Chemical Physics and Biophysics, Estonia for 2 RTU experts	tiešās	***2***	***komandējums***		***500.00***	***0.00***	**500.00**	**0.50**	***0.00***
3.2.4.2.	Business trip to University of Tartu, Estonia for 2 RTU experts	tiešās	***2***	***komandējums***		***500.00***	***0.00***	**500.00**	**0.50**	***0.00***
3.2.4.3.	Business trip to Vilnius University, Lithuania for 2 RTU experts	tiešās	***2***	***komandējums***		***500.00***	***0.00***	**500.00**	**0.50**	***0.00***
3.2.4.4.	Business trip to Kaunas University of Technology, Lithuania for 2 RTU experts	tiešās	***2***	***komandējums***		***500.00***	***0.00***	**500.00**	**0.50**	***0.00***
3.2.4.5.	Business trip to CERN, Switzerland for 2 RTU experts	tiešās	***6***	***komandējums***		***4 800.00***	***0.00***	**4 800.00**	**4.80**	***0.00***
3.2.4.6.	Business trip to Tallinn Technical University and National Institute Of Chemical Physics and Biophysics, Estonia for LU experts	tiešās	***1***	***komandējums***		***250.00***	***0.00***	**250.00**	**0.25**	***0.00***
3.2.4.7.	Business trip to University of Tartu, Estonia for 1 LU expert	tiešās	***1***	***komandējums***		***250.00***	***0.00***	**250.00**	**0.25**	***0.00***
3.2.4.8.	Business trip to Vilnius University, Lithuania for 1 LU expert	tiešās	***1***	***komandējums***		***250.00***	***0.00***	**250.00**	**0.25**	***0.00***
3.2.4.9.	Business trip to Kaunas University of Technology, Lithuania for 1 LU expert	tiešās	***1***	***komandējums***		***250.00***	***0.00***	**250.00**	**0.25**	***0.00***
3.2.4.10.	Business trip to CERN, Switzerland for 1 LU expert	tiešās	***3***	***komandējums***		***2 400.00***	***0.00***	**2 400.00**	**2.40**	***0.00***
10.	**Cost of project information and publicity measures**	**tiešās**				**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
13.	**Other project implementation costs**	**tiešās**				**16 006.00**	**0.00**	**16 006.00**	**16.02**	**1 820.23**
13.1.	*Costs of services*	tiešās				***0.00***	***0.00***	**0.00**	**0.00**	**0.00**
13.2.	*Costs related to the organization and implementation of discussions and experience exchange activities*	tiešās	3	***semināŗs***	2.5.	***1 800.00***	***0.00***	**1 800.00**	**1.80**	**312.40**
13.3.	*Costs of licencing of study programmes*	tiešās	1	***licencēšana***	1.2.	***4 894.00***	***0.00***	**4 894.00**	**4.90**	**370.19**
13.4.	*Costs of accreditation of the study direction in the EQAR Agency*	*tiešās*	1	***akreditācija***	3.3.	***6 312.00***	***0.00***	**6 312.00**	**6.32**	**616.98**
13.5.	*Costs of accreditation of the study programme in an international professional organisation (if applicable)*	*tiešās*				***0.00***	***0.00***	**0.00**	**0.00**	**0.00**
13.6.	*Costs of participation in international professional organisations*	*tiešās*				***0.00***	***0.00***	**0.00**	**0.00**	**0.00**
13.7.	*International publicity costs of the new study programme developed within the scope of the project*	tiešās	1	***audiovizuālo materiālu izstrāde***	4.	***3 000.00***	***0.00***	**3 000.00**	**3.00**	**520.66**
	TOTAL					**99 928.34**	**0.00**	**99 928.34**	**100.00**	**1 820.23**