Latvian Science Council

Consensus Review of Project Proposal

Project title: VPP-IZM-CERN-2022/1-0001 High-energy particle physics research at the CMS experiment and the development of advanced accelerator technologies in collaboration with CERN

1.	**Scientific quality of the project**	4.5
1.1	scientific quality, credibility and novelty of the research	The proposal covers both High Energy particle physics aspects and Accelerator aspects. Regarding the first field, in the absence of signals that would indicate the presence of new physics in the form of new particles, precision studies of known physics have assumed a central role. Particularly QCD-related measurements of the t-quark (the measurement of the t and anti-t mass difference (PhD-1) or the search of non-SM leptonic decays of the t-quark (PhD-3)) are sensitive probes for the breaking of fundamental symmetries (CPT, lepton flavor universality), and while the focus of the LHC experiments is increasingly strong in this area, the proposed searches are novel and unique. At the same time, also continued searches for new physics at the highest energies, and in concert, a deepened understanding of the SM Higgs particle, are essential, and are very sensitively implemented via searches for a high-mass Higgs boson (PhD-2). These approaches are complementary in their goals but follow common underlying search strategies, thus ensuring excellent potential for mutual benefit among the four PhD students and also for the foreseen MSc student, and who will find a very knowledgeable work environment. The close involvement of all participants also in a detector construction project (MTD, the focus of PhD-4) is crucial in providing hands-on real-life experience to the students who might otherwise exclusively work on data analysis, without becoming aware of the potential effect of the data acquisition methodology and devices on the quality of the data on which they will carry out their work. With respect to Accelerator developments, the two areas that have been selected are very topical. Additive manufacturing is by now an established technology, but in the field of accelerator developments, and in particular in the field of RF cavities, this approach is the subject of very active research, and it is thus a very germane topic for a PhD student and a MSc student, with impacts on technological and precision engineering firms in Latvia, should the students decide to pursue a non-academic career after graduation. The second focus is on optimizing ion-based hadron therapy infrastructures. Given that the current radiotherapy approaches are based on either protons or, in the most advanced systems (of which there are only a handful worldwide), Carbon ions, accelerator and medical research on a wide range of alternate ions is a clear priority, and a PhD in this area has very large career and societal potential. In both areas, the research is very well embedded in a wider context of world-leading experts, either in form of the CMS experiment, or in the form of the accelerator research consortia NIMMS, I.FAST or HITRIplus. Overall, the proposal promises to meet the goals of strengthening the scientific community and the research capacity in Latvia in the fields of high-energy particle physics and accelerator technologies, as well as to promote the

1.2	scientific quality of the selected research strategy, methodological solutions, and success in achieving the set goals	scientific collaboration between Latvian research institutions and CERN. The projects build upon established research collaboration between the involved groups with the CMS collaboration as well as with Accelerator Technology groups at CERN. While the expert panel recognizes the high interest and value of the proposed research, the panel would have found useful, for a full appreciation of the scientific quality of the proposal, a more detailed description of previous results obtained by the team in the contest of their previous research collaboration as well as more details about the role and future contributions of the Latvian team in the context of the large groups they collaborate with.	
1.3	the project's capacity to increase knowledge or technological insights		
1.4	the contribution of cooperation partners (if applicable), their scientific capacity and planned cooperation quality		
2.	**Impact of project results**		4.5
2.1	planned transfer of knowledge and skills obtained in further activity and in the development of scientific capacity	Two specific goals of this proposal are far-reaching: to facilitate Latvia's aim to become a Full Member State of CERN in the near future (building on the present status of Associate Member State of CERN); and to federate and strengthen ties between a number of Latvian research institutes. An auxiliary goal is that of building interdisciplinary bridges between HEP, Accelerator technologies and other fields of physics (and beyond). If successful, this impact is at a high level and greatly strengthens the interconnectedness of the Latvian physics community with activities at CERN and more globally. In turn, such ties will facilitate common EU projects, bolster the opportunities for involved students to form the nucleus of future research teams also outside of Latvia, and should strengthen the competitiveness of Latvian entities in which the former students, exposed to highly relevant technologies such as big data, data mining, or complex detector and accelerator technologies, will be able to spread their acquired expertise. In the context of accelerator research, there is a clear potential both for continued involvement of Latvia within the existing NIMMS, I.FAST or HITRIplus consortia, or as part of very likely subsequent EU-level research projects. Furthermore, medical applications in the form of hadron therapy focusing on alternate ions than carbon could well result in a unique dedicated treatment and research centre in which Latvia - through their involvement in these projects - would be well placed to play an important role. While the proposed project promises to have high impact in terms of generating opportunities in academic research and applications for industries, the expert panel would have appreciated some discussion of plans on how to foster contacts with commercial parties, and generally more detailed discussion of the expected research impact.	
2.2	opportunities for developing future research, including contribution to the preparation of new projects for submission to calls within the European Union research and innovation framework programme "Horizon 2020" and other research and innovation support programmes and technological initiatives		
2.3	the knowledge created as a result of the research is important for the development of the corresponding field, national economy and society		
2.4	sustainability of the obtained knowledge and a qualitative plan for its dissemination, including envisaged scientific publications and activities for informing society		
2.5	implementation of the research fosters strengthening scientific personnel, including the scientific capacity of university students		
3.	**Project implementation possibilities and security**		4.5
3.1	quality of the research work plan and its compliance with the set goal. The planned resources are appropriate and sufficient in order to achieve the goal. The research aims to ensure efficient use of resources. Planned work packages and objectives are defined clearly, appropriately and credibly	The implementation of the project is well constructed and the deliverables and milestones realistic. Leadership is shared between the (postdoctoral/junior professorship level, but with established appropriate expertise) PI's (Dr Karlis Dreimanis, Dr Andris Ratkus) and the more established (in some cases, world-renowned) collaborating researchers (Prof Yuri Dokshitzer (HEPAT), Dr Elına Pajuste (UL) and Dr Anatolijs Popovs (ISSP)), all of whom have access to the requisite infrastructure nationally and internationally, and are furthermore embedded in the international networks that ensure the feasibility of the proposed research. Establishing a	

3.2	scientific qualifications of the principal investigator and lead participants according to the submitted Curriculum Vitae (CV)	program over four years furthermore heightens the likelihood of success, as does the inclusion of a range of related, but partly independent, project goals. The risk management table is very complete, and the considered risks well addressed. Data management and dissemination plans are appropriate and exist in the framework of those of the CMS experiment, although the degree to which the general public will access the thus provided detailed data can be subject to debate. More importantly, all publications are open access, as guaranteed through the CERN agreements with publishers of journals in High Energy physics and in accelerator technologies. The research plan is very ambitious, with some risk that it cannot be fully completed within the allocated time of this proposal. However, several results and advances are almost guaranteed on the path to full integration of Latvia as full member of CERN, with consequently many advantages for academic research, industrial applications and society at large.
3.3	appropriate research management, including quality management is planned. The management organisation allows to keep track of the progress of the research project. Possible risks have been evaluated and a plan for risk prevention and negative effect mitigation has been drafted	
3.4	sufficient research infrastructure, including access to the equipment of cooperation partners (if applicable) for carrying out the research	
3.5	the institution and cooperation partners (if applicable) implementing the research have the necessary knowledge and competence	

Criteria	**Scientific Excellence**	**Impact**	**Implementation**	**TOTAL**
Points	Score 1	Score 2	Score 3	Score Sum = 13.5
Weight	30%	50%	20%	K = 13.5