

# RĪGA TECHNICAL UNIVERSITY'S COLLABORATION WITH THE CENTRE FOR EUROPEAN NUCLEAR RESEARCH

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The history and the idea of establishing a contact point between CERN (Centre for European Nuclear Research) and Latvia was a well-known necessity since yesteryears, but the chain of events that brought HEP RTU (Centre of High Energy Physics and Accelerator Technology, Rīga Technical University) and Latvia to this point started in 2005 when, following the persistent effort and will of the country and the scientific community to cooperate with CERN, Latvian researchers from the University of Latvia (UL) and the Rīga Technical University united and successfully participated at the Baltic Grid project. As a result, in January 2012, the Latvian Ambassador to Geneva at that time, Raimonds Jansons, started direct collaboration with CERN. Consequently, in the same year, the first meeting between CERN Director-General and RTU Rector, together with RTU delegation, took place at CERN where the next-steps collaboration strategy was set up. Six months after the meeting, in October 2012, plans were implemented and CERN signed the collaboration agreement with RTU.

The agreement signed between CERN and RTU allowed for the first time in the history opened exchange of CERN members, and Latvian researchers and students between countries, offering, among other things, the chance of organising guest lectures by various CERN researchers in Latvia, visits of Latvian doctoral students, teachers, and students to CERN, and participation in EU-funded projects coordinated by CERN – projects in which the Latvian scientists saw numerous areas of scientific collabo-

ration related to power electronics and energy, robotics, and material science after the RTU scientific delegation visited CERN in January 2015.

In November of the same year, RTU signed the Memorandum of Understanding with CERN on membership in the Future Circular Collider (FCC) research project. Since then, Latvian researchers have been contributing actively on the new concept development for the FCC tunnel, its operation and repair by using robots and telemanipulation, as well as laser cladding. Furthermore, the FCC research project involves also integration of the existing CERN accelerator facilities (SPS, Tevatron, LHC), after being upgraded to reach higher energy levels and resolution.

In 2017, RTU agreed to participate in the ARIES (Accelerator Research and Innovation for European Science and Society) projects coordinated by CERN, together with other European top scientific institutions. In total, three RTU research teams and two industrial application teams took part in the ARIES project to transfer the advantages and usability of particle accelerators technology to science and society.

After the year 2016, there were multiple involvements of Latvia in several high-energy particle physics projects coordinated by CERN, which was the first time in 20 years that Latvia worked so extensively with CERN – to the meeting of the Latvian Minister of Education and Science, Kārlis Šadurskis, and Fabiola Gianotti, CERN Director-General in October of the same year. In the meeting the two authorities signed the agreement on scientific and technical collabora-

tion in high-energy particle physics between the Republic of Latvia and CERN. The action that followed those strategic decisions made in the past resulted in several events involving the international organisation (CERN) and RTU, for the benefit of young students, science and industry in Latvia.

To help implementing those and new benefits for Latvia, the RTU Senate established, in 2017, the Centre of High Energy Physics and Accelerator Technology, which has already been in operation almost for three years. The centre acts as a contact point between CERN and Latvia and works actively on the implementation of particle accelerators for society. One of the most recent remarkable success achievements is the leadership of the ARIES Prove of Concept (PoC) project in the development of hybrid electron accelerator system for treatment of marine diesel exhaust gases, which officially started at the same time when the Centre was established.

#### CURRENT PROJECTS AT HEP



*Fig. 1.*  
Members of the ARIES PoC at the Rīga Shipyard during the experiment show up on 5 July 2019

This experiment was performed at the Rīga Shipyard in July 2019, together with other European institutions, and implies the first test of a particle accelerator to clean the exhaust gases of a ship, with encouraging results (Fig. 1). The development of this innovative solution claims to reduce the content of harmful pollutants contributed by the maritime traffic – a single cruise ship emits as much particulates as one million cars.

Several technologies are being explored to reduce

the content of sulphur and nitrogen oxides and of particulate matter in the exhausts of maritime diesel engines. However, the solution proposed by accelerator scientists consists in a combination of irradiation by an electron beam accelerator of a few hundred kilovolts, and subsequent purification in a “wet scrubber”. The electrons induce molecular excitation, ionization and dissociation, thus breaking the larger NO<sub>x</sub> and SO<sub>x</sub> molecules, and easing their removal in a small scrubber placed after the accelerator. The scrubber washes out the polluting molecules using water.

The experience and knowledge gained thanks to collaboration, experimental work performed by all the partners, and coordination work by HEP RTU help in better understanding of this novel gas treatment technology, which will lead to further development of this technology in the year 2020, when the members of the original ARIES PoC project together with new partners will work on the Horizon 2020 EU research and innovation programme. In this programme scientists and industrial partners want to boost the technological level of the concept proved in Rīga.

#### STUDY PROGRAMME TO BRING THE FUTURE

Furthermore, the HEP RTU works on the development of a study programme on fundamental interdisciplinary research in the field of high-energy particles and accelerator technology in the Baltic region, and enrolling Latvian scientific staff, academic staff, students and industry in nuclear research on the national and international levels, in particular the Compact Muon Solenoid (CMS) experiment at CERN. Therefore, the CERN Baltic Group (CBG) is an establishment where currently all participants (among them RTU) join their efforts to foster particle physics and accelerator technology research, and education community, in the Baltic States (Latvia, Estonia, Lithuania). The development of such a multidisciplinary master/doctoral level study programme in High Energy Physics and Accelerator Technologies strengthens the Baltic High Energy Physics community.

Taking CERN as a reference, technology transfer from particle physics can also add high-value tech-

nology in classical industries such as the food industry and material science, production, innovative diagnostic and therapeutic methods, computing and imaging techniques. These are all proven examples of the way how scientific achievements can contribute to the benefits of society and on the long term will benefit Latvia and her citizens. The programme is planned to be developed together with the University of Latvia as a joint study programme 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 on the creation of study programme.

#### DEVELOPMENT STATUS OF THE STUDY PROGRAMME AND DISSEMINATION



Fig. 2.  
Latvian student group on the Shadow Day at CERN

HEP RTU was working even before the official establishment in bringing particle physics, also in early stages, to the Latvian students. Since 2016, HEP RTU has organised a scientific mission for pupils on Latvian Shadow days to CERN (Fig. 2). On these trips to CERN, every year RTU PhD students and school students are guided around CERN and introduced or get a deeper understanding of fundamental physics, research and research facilities performance.

On a regular basis, RTU HEP is working on the coordination of the Baltic research institutions' activi-

ties towards CERN and related collaborations/experiments, and in addition to strengthening and development of Baltic High Energy Physics community. One of the most recent actions to develop and strengthen the community was celebrated in Kaunas University of Technology, Lithuania on 9–10 October 2019.

Eight Baltic research institutions and CERN gathered for a regular meeting to discuss the latest scientific collaboration successes, including joint scientific projects with CERN, to boost particle physics and accelerator technology expertise in the Baltic (Fig. 3).

In this meeting future joint actions of the CBG were planned and discussed, e.g., the annual organisation of the CERN Baltic School of High Energy Physics and Accelerator Technologies, starting from 2020, or support of continuous expert work for development of the doctoral and master study programme on the above subjects.

The group is also working to strengthen Baltic Industry engagement in collaboration with CERN in the series of events, and networking opportunities during 2020, and to closely coordinate scientific and industrial engagement in the CERN-based CMS experiment.

#### PARLIAMENTARY SECRETARY OF THE MINISTRY OF EDUCATION AND SCIENCE, ANITA MUIŽNIECE, VISITS CERN

As Latvia continues its path towards membership of the Centre for European Nuclear Research, a delegation from the Ministry of Education and Science visited CERN on 11 October 2019, at the initiative of Toms Torims, Professor of RTU and CERN Scientific Associate. Anita Muižniece, Parliamentary Secretary of the Ministry of Education and Science, was introduced with CERN activities and scientific achievements.

They were accompanied by the Ambassador of Latvia to the UN in Geneva, Jānis Kārkliņš, and Toms Torims. Latvian representatives met a large delegation of CERN scientists and representatives, including RTU PhD student and CERN Researcher Artūrs Ivanovs. During the visit, participation of Latvian scientists in CERN experiments, joint scientific





Fig. 3  
4th CERN Baltic Group Meeting in Kaunas



Fig. 4.  
Anita Muižniece, Parliamentary Secretary of the Ministry of Education and Science, visits CERN

projects and plans for future were discussed. The activities of CERN Baltic Group were discussed and supported. The delegation visited the CMS experiment and CERN laboratories, and met Latvian scientists working at CERN. CERN expert group was invited to visit Latvia on 20 November 2019 to work on the application file and to coordinate the next steps. For 60 years, CERN has been a world's leading science centre with globally significant scientific breakthroughs. It is CERN that invented the Internet, but one of the most well-known inventions is the existence of Higgs boson, proven by the Large Hadron Collider six years ago. For Latvian scientists, membership in CERN will open up new opportunities to conduct research, participate in CERN scientific projects and to collaborate with other countries, and for doctoral students to develop their doctoral thesis at CERN, citadel for world's physicists. Industry will be able to apply for CERN tenders as scientific activities require a variety of technological equipment that can be supplied by Latvian companies (Fig. 4).

The opportunities to collaborate in EU-funded projects coordinated by CERN has led to participation of RTU in several ARIES projects, together with other European top scientific institutions. In total, three RTU research teams and two industrial application teams took part in the ARIES project to transfer the advantages and usability of particle accelerators technology to science and society. The research teams focussed their scientific expertise in WP 2, Training, Communication and Outreach for Accelerator Science in Europe; WP 15, Thin Film for Superconducting RF Cavities (SRF); and WP 16, Intense RF modulated E-Beams. One of the industrial application teams worked on the development of a hybrid electron accelerator system for treatment of marine diesel exhaust gases while the other worked for the Nuclear Medicine Centre together with Faculty of Medicine of the University of Latvia intending to join CERN MEDICIS.