RTU and CERN

RTU Prof. Toms TORIMS
CERN Scientific Associate
Representative of Latvia

- Dr.sc.ing. **Toms TORIMS**
- PhD in Mechanical Engineering
- Professor at the Chair of Material Processing Technology at RTU
- Advisor to the Minister of Education and Science (science)
- Advisor to the Rector of Riga Technical University
- Nominated Head of the Centre of High Energy Physics and Accelerator Technologies
- CERN Scientific Associate
- 50+ scientific publications
Content

- What is CERN and why it is important for RTU and Latvia to participate
- Where are we? – story about people – Latvians @ CERN
- EU co-financed projects?
- What are our perspectives and possibilities?
What is CERN?

Accelerating Science and Innovation
The Mission of CERN

- Push back the frontiers of knowledge
  E.g. the secrets of the Big Bang ... what was the matter like within the first moments of the Universe’s existence?

- Develop new technologies for accelerators and detectors
  - Information technology - the Web and the GRID
  - Medicine - diagnosis and therapy

- Train scientists and engineers of tomorrow

- Unite people from different countries and cultures
CERN: founded in 1954: 12 European States “Science for Peace” Today: 22 Member States

~ 2500 staff
~ 1800 other paid personnel
~ 13000 scientific users
Budget (2017) ~ 1100 MCHF

Member States: Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Israel, Italy, Netherlands, Norway, Poland, Portugal, Romania, Slovak Republic, Spain, Sweden, Switzerland and United Kingdom

Associate Members in the Pre-Stage to Membership: Cyprus, Serbia, Slovenia

Associate Member States: India, Pakistan, Turkey, Ukraine

Applications for Membership or Associate Membership: Brazil, Croatia, Lithuania, Russia

Observers to Council: Japan, Russia, United States of America; European Union, JINR and UNESCO
Science is getting more and more global
Next Scientific Challenge: to understand the very first moments of our Universe after the Big Bang.
Big Bang

Proton
Atom

Radius of Earth

Earth to Sun

Radius of Galaxies

Universe

LHC

Super-Microscope

Reproducing conditions

Looking back

AMS

Hubble

ALMA

VLT

Universe

10^{-32}

10^{-28}

10^{-24}

10^{-20}

10^{-16}

10^{-12}

10^{-8}

10^{-4}

10^4

10^8

10^{12}

10^{16}

10^{20}

10^{24}

10^{28}
Exploration of a new energy frontier in p-p and Pb-Pb collisions

LHC ring: 27 km circumference
The Nobel Prize in Physics 2013 was awarded jointly to François Englert and Peter W. Higgs "for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN's Large Hadron Collider".
- Interfacing between fundamental science and key technological developments

- CERN Technologies and Innovation
  - Accelerating particle beams
  - Detecting particles
  - Large-scale computing (Grid)
Medical Application as an Example of Particle Physics Spin-off

Combining Physics, ICT, Biology and Medicine to fight cancer

Accelerating particle beams
~30'000 accelerators worldwide
~17’000 used for medicine

Hadron Therapy

Leadership in Ion Beam Therapy now in Europe and Japan

Tumour Target
Protons light ions

>100’000 patients treated worldwide (45 facilities)
>50’000 patients treated in Europe (14 facilities)

Imaging

Detecting particles

Clinical trial in Portugal, France and Italy for new breast imaging system (ClearPEM)

PET Scanner

Brain Metabolism in Alzheimer’s Disease: PET Scan
The Worldwide LHC Computing Grid (WLCG)

**Tier-0** (CERN and Hungary): data recording, reconstruction and distribution

**Tier-1**: permanent storage, re-processing, analysis

**Tier-2**: Simulation, end-user analysis

WLCG: An International collaboration to distribute and analyse LHC data

Integrates computer centres worldwide that provide computing and storage resource into a single infrastructure accessible by all LHC physicists
CERN Education Activities

Scientists at CERN
Academic Training Programme

Young Researchers
CERN School of High Energy Physics
CERN School of Computing
CERN Accelerator School

Undergraduates
Summer Students Programme

Public visitors
120 thousand per year

Asia-Europe-Pacific
School of High Energy Physics
Fukuoka, Japan, 2012
Puri, India, 2014
China, 2016

Latin American School of High-Energy Physics
Arequipa, Peru, 2013
Ibarra, Ecuador, 2015
San Juan del Rio, Mexico, 2017

CERN School of Physics
Norway, June 2016

CERN Teacher Schools
International and National Programmes
CERN Teacher Programme

Teacher Programme Participants 1998 - 2016  (Total: 10462)

ASSOCIATE MEMBERS

Cyprus 10
Serbia 68
Slovenia 21

8568

ASSOCIATE MEMBERS IN THE PRE-STAGE TO MEMBERSHIP

Others

Algeria 8 Cape Verde 4 Guinea Bissau 1 Malta 36
Angola 7 Chile 3 Iran 7 Mexico 27
Armenia 1 China 2 Ireland 8 Mongolia 1
Australia 7 Costa Rica 4 Jordan 12 Montenegro 15
Azerbaijan 1 Croatia 23 Kazakhstan 8 Mozambique 22
Bahrain 2 Dominican Rep. 71 Kyrgyz 4 Nepal 2
Belarus 3 Ecuador 2 Latvia 25 New Zealand 2
Brazil 187 Egypt 2 Lebanon 1 Palestine (O.T.) 4
Burundi 2 Estonia 79 Lithuania 51 Qatar 1
Cameroon 5 Georgia 121 Madagascar 2 Rwanda 20

399 489 928
Previous cooperation

- 1996 – Institute of Electronics and Computer Sciences of the Latvian Academy of Science participated in the CMS experiment

- until 2000 – The Institute of Solid State Physics, University of Latvia participated in Cristal Clear Project

- until 2011 – LU and RTU scientists successfully participated in the Baltic Grid
RTU – CERN co-operation

- Sine 2012 RTU has Framework Collaboration Agreement with CERN

- *Inter alia* two PhD students working on their doctoral thesis based on this agreement
Future scientists @ CERN

- 2013 – first Latvian PhD students visit to CERN. Participants - PhD students from RTU and other Latvian universities. Hereafter once a year such visits take place.
In January 2015 – RTU Rector and scientists delegation visited CERN. In meetings with leading specialists and group leaders particular scientific cooperation areas are being identified.

- Power electronics and energetics
- Material processing technologies
- Robotics
- Material science

Riga Technical University
RTU is partner in FCC

- 2015 – RTU signs Memorandum of Understanding with CERN about FCC (Further Circular Collider) research project

MoU Future Circular Collider

Memorandum of Understanding for the Future Circular Collider (FCC)
Study hosted by CERN

THE INSTITUTES, LABORATORIES, UNIVERSITIES AND THEIR FUNDING AGENCIES AND OTHER SIGNATORIES OF THIS MEMORANDUM OF UNDERSTANDING AND CERN AS THE HOST LABORATORY (“the Participants”)

Whereas

At a dedicated session of the CERN Council held on 30 May 2013, the Council adopted the Update of the European Strategy for Particle Physics which included inter alia the following statement:

“...Europe needs to be in a position to propose an ambitious post-LHC accelerator project at CERN by the time of the next Strategy update, when physics results from the LHC running at 14TeV will be available. CERN should undertake design studies for accelerator projects in a global context, with emphasis on proton-proton and electron-positron high-energy frontier machines. These design studies should be coupled to a vigorous accelerator R&D programme, including high-field magnets and high-gradient accelerating structures, in collaboration with national institutes, laboratories and universities worldwide.”

The conceptual design study (the “FCC Study”) must be available in time for the next update of the European Strategy for Particle Physics foreseen to take place in 2018.
RTU is partner in FCC

- Prof. Torims represents Latvia and participates in FCC konferences

- 80-100 km tunnel/infrastructure
- unprecedented **power capacity**
- unprecedented **magnetic field**
- pp - collider (FCC-hh)
- e+e - collider (FCC-ee)
- p-e (FCC-he) option
- High energy HE-LHC ar FCC-hh technology

- Challenge in terms of maintenance and repairs...
RTU plays in highest league

- 2016 (march) – RTU, together with other top 40 European scientific Institutes participates in ARIES project coordinated by CERN
- RTU:
  - technologies – improved coating for particle accelerators working surfaces
  - development of innovative radio frequency modulator – energy particle accelerator beam
  - apmācības
- 2017 May 1st project started – RTU is partner in 3 WP. Total 500 000 eur.
Visi of Latvian physics teachers to CERN

- 2016 (jun) – first visit. RTU organized and covered expenses in cooperation with CERN. Visit is successful and CERN agrees to host group of physics teacher from Latvia every year.


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To Whom it May Concern

Geneva, 17 March 2016

Confirmation

I hereby confirm that we have organised the Latvian Teachers Programme which will take place at CERN from 3-8 April 2016 with 24 participants. I enclose the link to the programme for your information: https://indico.cern.ch/e/LVT16.

Dr. Sascha Schmeling
Head of the CERN Teacher Training Programmes
Visit of RTU IZV to CERN

- 2016 – first visit of Latvian pupils to CERN. RTU Engineering Highschool - together with visit of Minister of Education and Since
- First study-online conference with Latvia
Latvia signs «ICA» agreement

- 2016 - 31 Oct. Dr. Kārlis Šadurskis, Minister of Education and Science on behalf of Latvia signs international cooperation agreement with CERN
- Door to CERN is open ...
Visit of Minister of Foreign Affairs to CERN

2017 - 27. Feb. Edgars Rinkēvičs, Minister of Foreign Affairs visits CERN:

- Positively impressed about positive cooperation between Latvia and CERN.

- Confirmed the intention to involve Latvian scientists, companies, teaching staff and students into CERN activities.

- Underlined the importance of cooperation with CERN not only in the field of fundamental research, that would significantly contribute to the development of science in Latvia, but also practical cooperation with Latvian companies.
Latvian Radio visit to CERN

- Series of scientific radio broadcast «Zināmais nezināmajā» – in simple terms explains to the society what is CERN and tells about cooperation opportunities.
Minister of Welfare visit to CERN

2017 - 8. Jun Jānis Reirs - Minister of Welfare together with Vitālijs Gavrilovs - Head of Employers’ Confederation of Latvia and Egils Baldzēns - Head of Free Trade Union Confederation of Latvia visited CERN

- Visits of Latvian ministers are very important due to fact, that Latvia is about to make decision regarding the accession to CERN. It is important for government representatives to see in reality the scope of research activities at CERN.
«Primekss» management at CERN

CERN orders innovative concrete technology – pilot project?
Visit of the Prime Minister
Latvian scientists who worked at CERN
Viesturs Veckalns (RTU)

- Quoting young physician: «We are investigating how color link between two can be observed in the CS detector».

- Perspective after PhD defense in RTU – work at CERN (CMS experiment) as project associate – 2018.

Involved in CERN CMS experiment since 2014. Represents RTU according to the agreement signed in 2012.
Viesturs Veckalns (RTU)

Semileptonic $t\bar{t}$ process

Standard model

Flipped model

Color flow «ttbar decays»
Stepans Šķļariks (RTU)

First CERN summer school participant from Latvia – 2015.

«Collimator thermal function analysis»
Artūrs Ivanovs (RTU)

- 15.02. - 28.04.2017 scientific internship at CERN
- Development and validation of the battery energy dynamic algorithm for LHC robotized device.
- Perspective – PhD at CERN and work ar project associate from 01.08.2017.
CERN Robotics Group

Contract type:
  Project Associate for 3 years

Field of Research:
  Machine Learning for Robotics Applications

PhD Thesis:
  Development of a system for human recognition and wireless vital parameter monitoring in harsh environments

Expected outcome:
  Robotic platform with mounted sensors used by first-response brigades to efficiently locate people and monitor their vital parameters before sending in the rescue team.
Toms Torims (RTU)

CERN scientific associate

- Responsible for accelerator and related technology analysis. The aim is to identify fields, where these technologies can be beneficial for needs of society as well as production (i.e. medicine, mechanical engineering and machine construction).

- Is analyzing EuCARD2 (largest EU particle accelerator technology development project) result analysis in order to estimate the impact of project outcomes to the scientific community and society in general.

- Is advising CERN about strategic goals of ARIES project implementation and about AMICI project scientific and communication structure development.

- De facto Latvian representative at CERN.
Andris P. Stikuts (LU master)

- 2017 CERN summer school

- Is working in CLIC (Compact Linear Collider) team, where electron-positron collision simulations are made

- Simulation are required in order to estimate potential futures perspectives of CLIC (Compact Linear Collider)
Artūrs Vēvers (RTU PhD)

- 2017 CERN summer school
- Engineering Department - Mechanical & Materials Engineering Group
- Is investigating and comparing currently available simulation programs for 3D printing process simulations
- Is developing "End spacer" part simulation and creates supporting structure, that would provide minimal deformation during the printing process
- Is assisting in plant parts 3D printing processes
What is Additive Manufacturing?

Selective Laser Melting (SLM)
CERN scientists in Latvia
World class scientists in Latvia

- Highly appreciated and well attended guest lecturers of leading CERN scientists in RTU CERN. Students from RTU as well as other universities in 2012., 2013., 2015., un 2016.

Dr. Paul Collier  
Dr. Tadeusz Kurtyka  
Dr. Christoph Schaefer
CERN science week in Latvia

22 - 26 May, 2017
Dear Professor Sijbrand de Jong,

On behalf of the Government of the Republic of Latvia, I would like to express our satisfaction about the excellent and evolving cooperation between the European Organization for Nuclear Research (CERN) and Latvia.

In accordance with the above mentioned, I would like to inform you that Latvia is looking forward to bringing this cooperation to a higher stage in order to enjoy the partnership with CERN to the full by considering the application to its membership status at the CERN, first as an associate member, followed by full membership.

Sincerely,

Māris Kučinskis
ARIES project
ARIES projekts

- «Accelerator Research and Innovation for European Science and Society» – CERN coordinated Horizon 2020 project
ARIES project - I

- technologies – improved coating for particle accelerators working surfaces
ARIES project - II
– development of innovative radio frequency modulator – energy particle accelerator beam

Partners: GSI – Darmstadt, Frankfurt University, CERN

Riga Technical University
Prototype design RTU
ARIES project - III

- Education and training – online course about particle accelerators
- RTU is developing online platform
CMS Collaboration
Consortium

- To join CMS as a Full Member in form of Consortium of two Universities, namely, Riga Technical University (RTU) and University of Latvia (LU).
- Two largest universities of Latvia - major players in the Baltic region
- Support from the Ministry of Education and Science
- Envisage to join CMS as from 2018
- Funding available and mechanism is established
Reasons for the application

- Consultations with the CMS management and relevant groups identified that RTU and LU both have wide range of required experience and could directly contribute to the on-going and future activities of CMS.

- Participation in CMS will significantly boost the competence of the RTU and LU in the fields of physics analysis, technology development and computing.

- This would facilitate the on-going process of the advanced particle physics community consolidation in Latvia.

- This will enhance Baltic States cooperation in the field of high energy physics.
RELEVANT FACULTIES

ready to participate:

CENTRE OF HIGH ENERGY PHYSICS AND ACCELERATOR TECHNOLOGIES

COMPUTER SCIENCE & INFORMATION TECHNOLOGY

ELECTRONICS & TELECOMMUNICATIONS

POWER & ELECTRICAL ENGINEERING

MECHANICAL ENGINEERING, TRANSPORT & AERONAUTICS
POTENTIAL AREAS OF COLLABORATION

- Data processing - algorithms, computing, encoding, programming, alignment, data validation and certification, Monte-Carlo simulations, data bases, etc.
- Sensors, data transmission and signal processing
- Manufacturing technology and mechanics - design, prototyping and actual manufacturing (e.g. additive manufacturing)
- Electronics and electrical engineering
- Materials and radiation hardness
- Particle physics
Future evolution

- Initially (in 2018) Consortium is envisaging to contribute to CMS with two participants, e.g.:

  Riga Technical University
  – one scientist (can be post-doc) or one PhD student/engineer

  University of Latvia
  – one scientist (can be post-doc) or one PhD student

- As it is evident from the presentation there are numerous areas of potential contribution

- Collaboration can be enhanced to the larger number of participants and faculty members – up-to four in end 2018 or 2019
Closing remark

- Latvia sees its engagement in the CMS experiment as an strategic opportunity

- It will enhance the scientific potential of RTU and LU by taking part in technology development, computing, and physics analysis

- Latvia considers its engagement in the CMS experiment as important step towards Latvia’s application: for the CERN Associate Member as the pre-stage to membership.
Next steps
What’s next?

- Latvia - CERN associate and full member – we are on the way!
- Door to CERN is open...
- Latvian scientists work at CERN
- Participation in CERN experiments
- Regular teacher group visits
- Regular pupil group visits
- CERN organized events and «schools»
What’s in it for Latvia?

- Opportunity to get support point for moving science in Latvia from the consumer level to potentially profitable level.

- Opportunity to demonstrate to EU and NATO that Latvia is not a country for low qualification work.

- Opportunity to raise quality standards in exact sciences at Latvian universities with support of CERN scientific and technical infrastructure. By doing so, preventing leak of talented students abroad.

- «Interesting» orders for Latvian companies, opportunity to enter new markets, direct access to CERN innovations.
What’s in it for Latvia?

- Politics: we are in NATO and EU, but science?

**Figure I-2-10** R&D intensity 2000, 2007, 2014 and 2020 target (1)

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Riga Technical University

Science, Research and Innovation performance of the EU (EK dati 2016)
What’s in it for Latvia?

- **Science:**
  - Breakthrough and grasp of fresh air to all fields of science (physicians, engineers, medicine etc.)
  - Free access to all experiments
  - Work at CERN for scientists
  - + all activities mentioned before, but from CERN budget

- Possibility to raise EU funds – significantly more than paid membership fee of 1.7 M euro

- Opportunity to play in highest league
What’s in it for Latvia?

- Economics: invested 1,7 M eur per year. What will be the reward?
Entrepreneurs

- **«NanoOptoMetrics»** – surface metrological analysis equipment – in contact with CERN, who showed interest in this technology and equipment

- Promissing **«Primekss»** visit to CERN 05.07.2017 – pilot project?

- start-up company **«Adaplab»** is ready to offer CERN its’ *process control and PLC's (Programmable Logic Controllers)* – in touch with CERN
Next steps

- Latvian participation on CMS project – LU un RTU consortium
- Visits of high level representatives from related ministries to CERN
- CERN EXPO in Latvia April-June 2018
- Governmental Education, Culture and Science Committee visit to CERN
- Visit of entrepreneurs and associations January
- Roadmap for Latvian membership to CERN
Thank you!