

# LATVIA - CERN: STATE-OF-PLAY

**Prof. Toms Torims, Representative of Latvia at CERN**

**Dr. Kārlis Dreimanis, CMS Latvia Team Leader, Director of RTU HEP@AT center**

**Latvia is reliable and honest partner of CERN**

**Latvia – CERN Strategy**



# Latvia - CERN strategy

Government approved – consensus based - stakeholders and ministries

Overarching goals:

- 1. Meaningful and coordinated** participation of Latvia at CERN in the **Associate Member** state status
- To become **Full Member** state within **2-3 years**



# Meaningful and coordinated participation of Latvia at CERN

## Tasks for associate membership

1. To benefit from the **opportunities** at CERN – in the best possible way and at all levels
2. To provide sustainable contribution in attaining the **State priorities** in education, science, economic development and R&D
3. To foster environment of the **scientific excellence and industrial leadership**
4. To concentrate available and to attract new **human resources** / to use strategically available **financial instruments**
5. Within the next years to achieve “**well balanced country**” status and to ensure **60/40 proportion** for scientific HR / industrial return



## **Benefit from the opportunities at CERN**

**– in the best possible way and  
at all levels**





# Scientific/research portfolio

Based on the bottom-up initiatives / balance & diversity / strategic approach

## **CERN based experiments and collaborations**

- **CMS** as a **HEP flagship** project (RTU+LU)
- **MEDICIS** (RTU+LU)
- AEGIS (LU)
- ISOLDE/LIEBE (LU)
- Crystal Clear Collaboration (LU)

## **Development of new projects and technologies at CERN**

- Accelerator & Technology Sector /ATS-DO
- Engineering and Technology Departments
- FCC

## **EU funded projects** CERN coordinated/associated

### **Riga Technical University (RTU)**

- I.FAST
- HITRIplus
- HERTIS
- NIMMS

### **University of Latvia (UL)**

- PRISMAP
- QuantHEP

+ Muon Collider Collaboration



# Latvia @ CERN

Personal based long term @CERN: USER, COAS, PJAS, DOCT, FELL  
- snapshot at 21/11/2022

## CMS-Latvia HEP group

*Users (rec. COLA) 100% at CERN*

1. Senior researcher PhD in HEP – CMS Team leader
2. Senior researcher PhD in HEP – Top physics analysis group
3. PhD student – Technical Integration
4. PhD student – Higgs physics analysis group

## Latvia Accelerator Technology group

*PJAS and COAS 100% at CERN*

5. Senior researcher – COAS / ATS-DO
6. Senior researcher – PJAS / ATS-DO
7. PhD Student AT – COAS / ATS-DO+CMS
8. PhD Student AT – DOCT /ATS-DO **paid by NIMMS**

## AD-Antihydrogen Experiment

9. PhD Student Atomic physics - USER / AEgIS+CMS

## CERN-Latvia doctoral programme

10. PhD Student AT – DOCT / ATS-DO+CMS
11. PhD Student MEDICIS – DOCT/SY-STI-RBS+CMS
12. **PhD Student Top physics – DOCT / EP-CMG+CMS**

## CERN Doctoral Programme

13. **PhD Student Top physics – DOCT / EP-CMD+CMS – only DOCT paid by CERN**
14. PhD Student AT – DOCT / ATS-DO so far paid by Latvia

## With no link to Latvia scientific community

15. CERN Fellow - FELL / EP-DT-EO - **only FELL paid by CERN**

+ numerous short (2-3 months) term stays @CERN paid from the Latvian budget



**To continue capacity and competency building in HEP and AT**

**To maintain strong CERN related scientific institute with multidisciplinary research team and presence at CERN**





# Institute of Particle Physics and Accelerator Technologies

@Riga Technical University

Faculty of Materials Science and Applied Chemistry

100% CERN related research

## ***Elected academic staff - vision***

1. Prof. Yuri Dokshitzer - **HEP**
2. Asoc.prof. Kārlis Dreimanis – **HEP**
3. Dr. Markus Seidel – **HEP** lecturer, PhD supervisor
4. Prof. Toms Torims - AT
5. Asoc.prof. Andris Ratkus - AT

## ***Research staff***

Elected HEP and AT Senior researchers / researchers / scientific assistants - **12 in total**

+ admin staff.

- Leading and running **CMS-Latvia HEP group**
- Executing **State Research Programme** in HEP and AT
- Running **Doctoral Programme** (jointly with University of Latvia) in HEP and AT
- Institutional partner of **CMS, FCC, Muon Collider**
- Collaborator and contributor to **I.FAST, HITRIplus** and **NIMMS** projects
- Leader of **HERTIS** project
- Leader of CMS **Tier2 center** project
- Representing RTU in **CERN Baltic Group**
- + Supervisory role of **HEP and AT students** at CERN



# Dedicated doctoral programme

- In collaboration with CERN Baltic Group – **designed by CBG** Study Programme Working Group
- Students in programme: 3<sup>rd</sup> year – **1**; 2<sup>nd</sup> year **6**; 1<sup>st</sup> year **5**
- Students are **co-supervised by CERN** staff
- Strong presence of **international students**
- Executed in Latvia with mandatory **term at CERN**
- **World class** lecturers: Latvia, CBG, CERN, PSI
- Balance between **HEP** and **AT**
- [International Study Program Council](#)
- Relevant **master programme** is being developed



# CERN research in Latvia

Other institutes carrying out CERN related research and projects

## University of Latvia

1. Institute of Chemical Physics – Prof. Elina Pajuste group - **CMS** and **MEDICIS**
2. Faculty of Physics, Mathematics and Optometry - Prof. Mārcis Auziņš group – **AEgIS**
3. Faculty of Medicine – Prof. Maija Radziņa group – **MEDICIS/PRISMAP**
4. Institute of the Solid State Physics – Dr. Anatoli Popov group- **Crystal Clear Collaboration**
5. Institute of Physics – Dr. Kalvis Kravalis group – **ISOLDE / LIEBE**
6. Quantum Computing group of Prof. Andris Ambainis - **QuantHEP**

## Riga Technical University

1. Department of artificial intelligence and systems engineering - Prof. Agris Nikitenko group – **I.FAST** + Mechatronics, **Robotics** and Operations section **at CERN**
2. Institute of technical Physics – Prof. Arturs Medvids group – **I.FAST**
3. Institute of Industrial Electronics and Electrical Engineering – Prof. Pēteris Apse-Apsītis group - **ARIES**
4. Students of Institute of Mechanics and Mechanical Engineering - **I.FAST** and **HITRIplus**
5. High Performance Computing (HPC) Centre – **Tier2** project at **CMS**

# State Research Programme

Strengthening the development of the Latvian scientific community in the field of **high-energy physics** and **accelerator technology** in cooperation with the CERN

**Programme call  
(2020-2022)**  
to be finalized  
31.10.2022

➤ **900 000 EUR** ➤

Project leader:



RIGA TECHNICAL  
UNIVERSITY

Project partners:



UNIVERSITY  
OF LATVIA



INSTITUTE OF SOLID STATE PHYSICS  
UNIVERSITY OF LATVIA



Develop world-class knowledge



Develop human capital & technologies



Create products & services



Involve scientific & academic staff, students, PhD applicants & young scientists

**Programme call  
(2022-2026)**  
to begin  
implementation  
**Autumn 2022**

➤ **1 500 000 EUR** ➤

**Eligible participants of the open call:**

Research organizations, public organizations. Several partners must be involved



Ensure the programme's continuity



Foster research capacity



# Outreach activities in Latvia

Integral part of the Latvia – CERN strategy / boosting interest in STEM

## **Latvian National Library**

- permanent CERN exposition and classroom for children and general public – CERN as a centre of excellence for technology and innovation

## **Latvian Physics Teachers Association**

- Participation in events, lectures of Latvian scientists @CERN and CERN staff / selection of teachers for the CERN visits

## **School of the Young Physicists of Latvia**

- Virtual and in-person lectures + events

## **Job shadowing at CERN**

- Every year 4-5 school children come to CERN to shadow Latvian scientists and engineers with preparatory and post-events in Latvia

**+ many other** events and activities



# Latvia - CERN Stakeholders Group

Encompassing all relevant stakeholders - platform for engagement and exchange

<https://indico.cern.ch/category/11669/>

- 10 **regular meetings** since Nov 2019
- Organised by CERN **National Contact point**
- All **relevant** research institutions, business entities and associations, related ministries and agencies, CERN Council Delegates and ILO
- **Informing** the stakeholders about the relevant CERN-based and CERN-related activities
- Directly supporting the stakeholders' **engagement** with CERN
- Managing the information **exchange** and **collaboration** vis-à-vis CERN and the stakeholders





# Geneva / CERN based ILO

To ensure meaningful Latvian business participation @CERN

## **CERN as priority**

- ILO KPI's are directly based on industry engagement

## **Knowledge Transfer**

- Technological and knowledge return to Latvia by engaging R&D capable companies

## **Well-balanced industrial return**

- To ensure fulfilment of the current 'quota' ~ 400 000 CHF
- To prepare industrial portfolio for the full-membership @CERN
- To closely collaborate with Latvian scientific and engineering community at CERN

# **Latvia – CERN Strategy**

## **Full membership at CERN**



# Full membership at CERN

## Tasks - liaison with decisionmakers and stakeholders

1. To **ensure support** of the CERN Management and Member states
2. To actively **participate** in the work of the CERN Council and its committees – *inter alia* to cultivate **positive attitude** towards Latvia's full membership
3. To **coordinate** Latvia's position at Council meetings and its committees
4. To facilitate coordination among the **Baltic States**: at CERN Baltic Group and Baltic Assembly level – to foster **joint position** vis-à-vis CERN
5. To ensure **continuous support** from the Government, Parliament, scientific community, entrepreneurs, other partners and society at large



# Full membership at CERN

## Tasks – scientific and technical measures

1. To ensure stable **financial framework** for CERN activities in Latvia – ensuring **50/50 principle** – where proportion of the national funding is gradually exceeding CERN membership
2. To continue **capacity and competency** building in HEP and AT: to maintain strong CERN related **scientific institute** with interdisciplinary research team and presence at CERN; to run master level programme in HEP and AT
3. To facilitate **industrial return** and engagement with CERN; including ILO organised dedicated events in Latvia
4. To cultivate **positive image** of Latvia – CERN cooperation *#LatvijaCERN*

# Proposed timeline for full membership

**2023 1st half**

## **March Council**

Government letter of intent to become associate member in pre-stage to the full membership - to the President of CERN Council and DG

**2023 1st half**

## **June Council**

Favourable CERN Council decision and invitation to apply for the associate membership in pre-stage to full membership

- subsequently application is submitted

**2023 2nd half**

## **Sept Council**

CERN Council Decision to form the Task Force

Task Force visit to Latvia

## **December Council**

CERN Task Force report is evaluated and DG is mandated to negotiate agreement

**2024**

Agreement negotiations

Cabinet of Ministers decision

Signature of pre-stage Agreement

Ratification procedure

**2025**

prospective time when Latvia becomes associate member in pre-stage to the full membership at CERN



**To ensure stable financial  
framework for CERN activities  
in Latvia**



# Membership payments

Currency	2023	2024	2025	2026	2027
	Associate Member	Associate member in pre-stage to full membership	Associate member in pre-stage to full membership	Full member	Full member
CHF	1 024 850	1 281 250	1 793 750	2 494 000	2 494 000
EUR	1 019 553	1 274 588	1 784 423	2 481 032	2 481 032



# CERN experiments and programmes

Activity	2023	2024	2025	2026	2027
<b>CMS*</b>	222 084	350 000	360 000	450 000	450 000
<b>MEDICIS</b>	40 000	50 000	80 000	100 000	100 000
<b>Teacher programme</b>	12 000	12 000	12 000	12 000	12 000
<b>Student programmes</b>	6 000	6 000	9 000	9 000	9 000
<b>Total EUR</b>	<b>280 084</b>	<b>418 000</b>	<b>461 000</b>	<b>571 000</b>	<b>571 000</b>

\* 3->4 authors; 2->3 students at CERN; 3->4 senior scientists  
+ Phase II upgrade



# CERN National Contact Point @ Science Council of Latvia

Activity	2023	2024	2025	2026	2027
Staff and admin costs	88 435	88 800	112 800	112 800	50 400
Communication & PR	8 000	8 000	8 000	8 000	8 000
Outreach – visits to CERN	20 000	20 000	20 000	20 000	20 000
Network events with CERN	5 000	5 000	5 000	5 000	5 000
<b>Total EUR</b>	<b>128 935</b>	<b>139 300</b>	<b>163 300</b>	<b>163 300</b>	<b>100 900</b>

+ 99 000 EUR/per annum to cover living costs Latvia's Representative at CERN

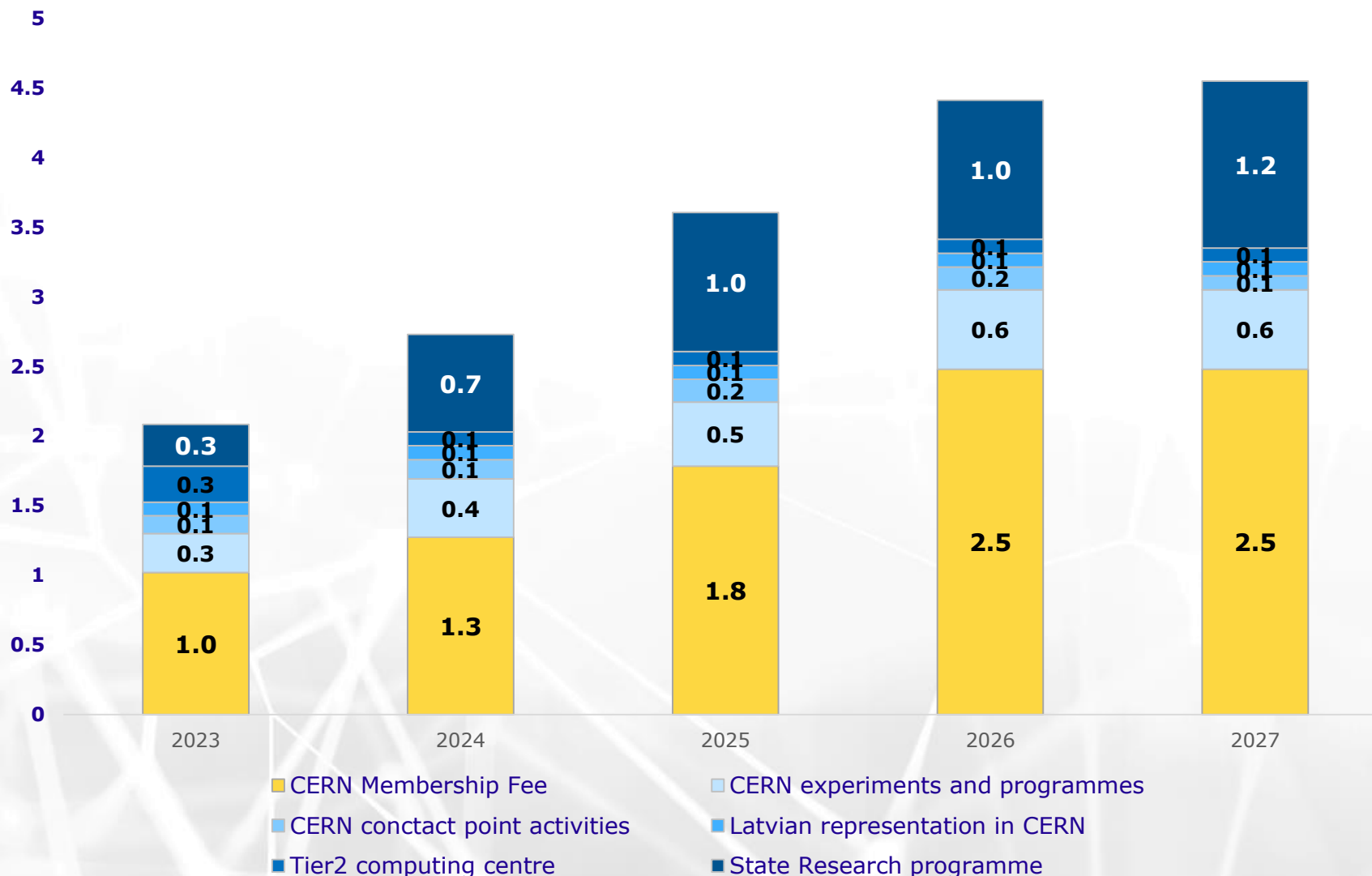


# National CERN activities

	2023	2024	2025	2026	2027
State Research Prog. in HEP and AT	300 000	700 000	1 000 000	1 000 000	1 200 000
Tier 2 Center	260 000	100 000	100 000	100 000	100 000
Total EUR	560 000	800 000	1 100 000	1 100 000	1 300 000

# Proposed Latvia - CERN budget until 2027

Latvia - CERN budget (in million euros)



**Ensuring 50/50 principle – where proportion of the national funding is gradually exceeding CERN membership**



# Participation in Accelerator Projects

By Latvia Accelerator Technology Group at CERN  
Leader Dr. Andris Ratkus



# Research directions

- Innovation and development of accelerator technologies
- Accelerator medical applications
- Accelerator environmental applications



# **Accelerator Technology Group in Latvia and at CERN**

# Accelerator Technology Team

- **Before Latvia's Associate Member State at CERN**

- Toms Torims
- Guntis Pikurs PhD student
- Andris Ratkus



# Accelerator Technology Team

## ▪ After Latvia's Associate Member State status

- Jānis Vilcāns PhD student
- Luca Piacentini PhD student\*

2021 Oct – Dec



- Lazar Nikitovics PhD student\*
- Dagnija Kroģere MSc student
- Kristaps Paļskis PhD student\*

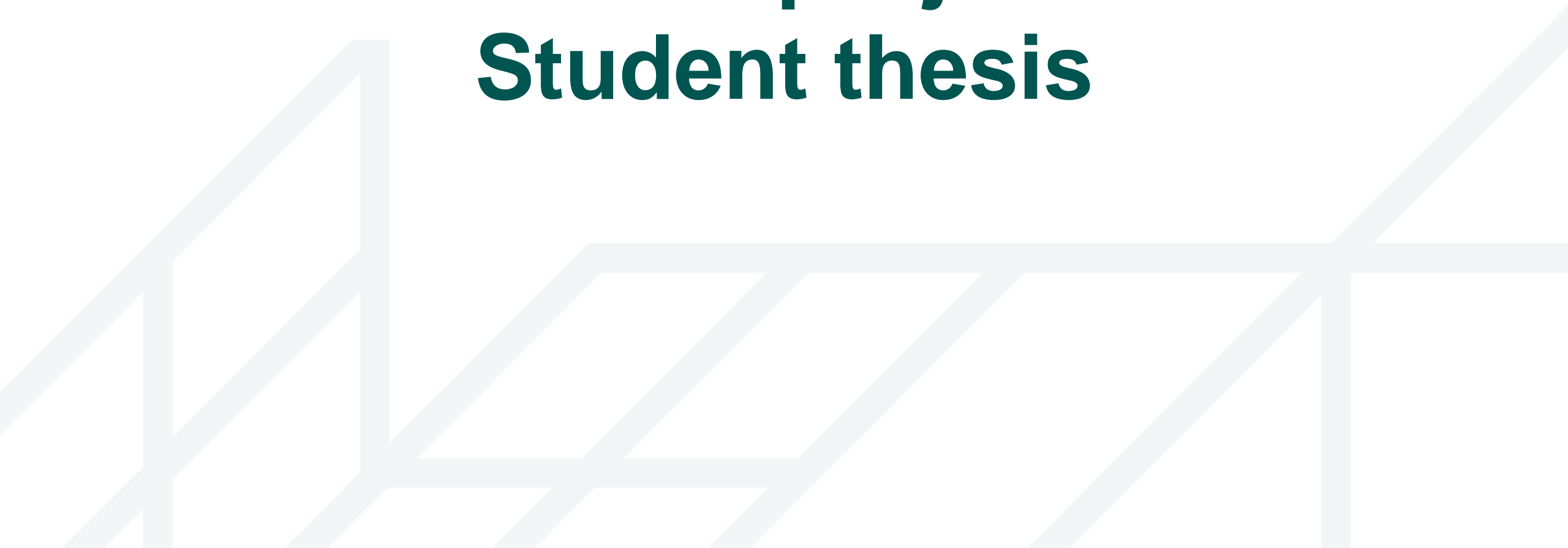
2022 Feb – Mar



- *Viesturs Lācis MSc student*

*2022 CERN summer school student*

# **Accelerator projects and Student thesis**



# Accelerator research and Innovation for European Science and Society



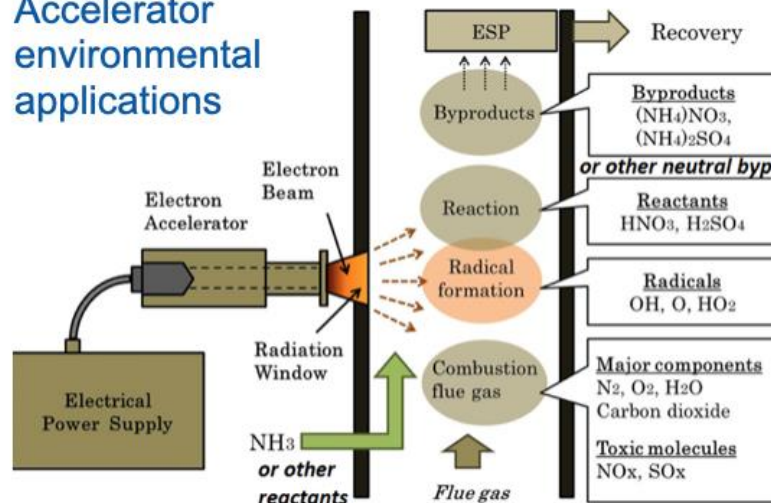
- Development of hybrid electron accelerator system for the treatment of marine diesel exhaust gases

(Finished)

Accelerator community-promising technology

Maritime industry-demand for better solution

Accelerator environmental applications



- MARPOL Annex VI - sulphur content shall be reduced to 0.50%
- Economically viable solution is still not there
- No technology can remove simultaneously SO<sub>x</sub> and NO<sub>x</sub>

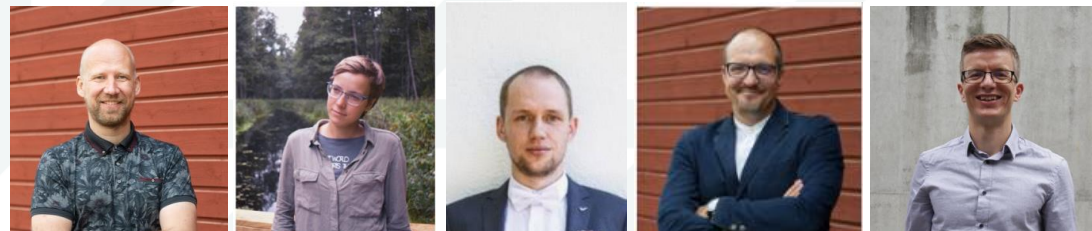




# Innovation Fostering in Accelerator Science and Technology



- WP1: Management, coordination and dissemination
  - Task 1.2: Information Flow Management and Cross-coordination (Task Leader RTU)
- WP10: Advanced Accelerator Technologies (Coordinator RTU)
  - Task 10.1: Coordination and Communication (Task Leader RTU)
  - Task 10.2: Additive Manufacturing - Survey of applications and potential developments
  - Task 10.3: Refurbishment of accelerator components by AM technologies (Task Leader RTU)
- WP12: Societal Applications
  - Task 12.1 sub task 3: Environmental applications of electron beam



# Student thesis

- **Guntis Pikurs PhD thesis:**

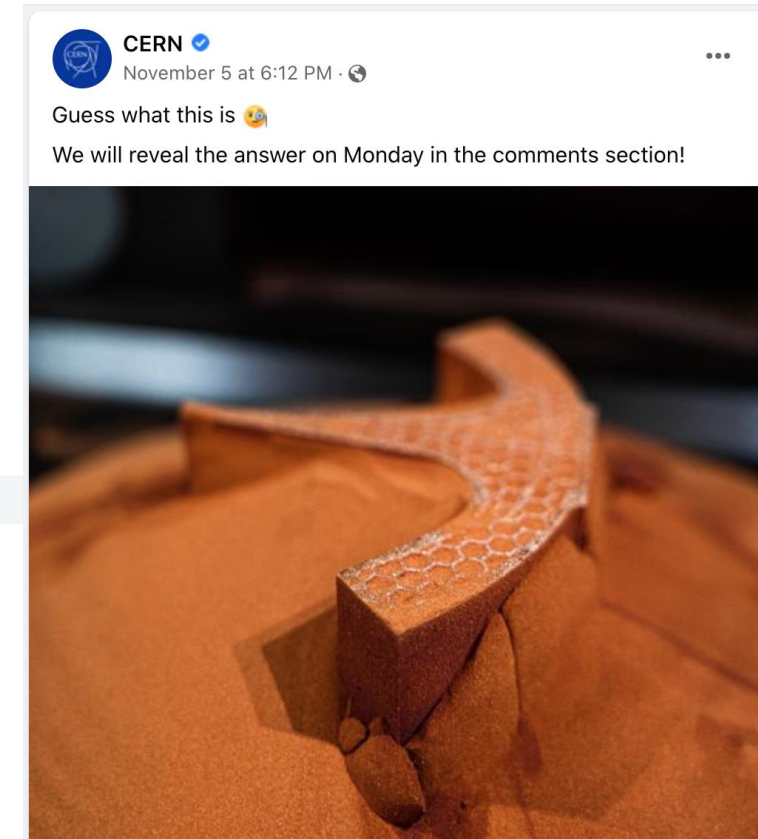
Research on performance improvement of accelerator and detector components by additive manufacturing

- **Dagnija Krogere MSc thesis (Defended):**

Research of additive manufacturing applications and strategies for repairing particle accelerator components

- **Viesturs Lācis MSc thesis:**

Laser Polishing of Additively Manufactured RFQ Prototype



# Formnext Frankfurt 2022





# Hybrid Exhaust-gas-cleaning and Accelerator Technology for International Shipping



Based on promising results of the ARIES PoC

**HERTIS Collaboration** was established between multiple partners

objectives:

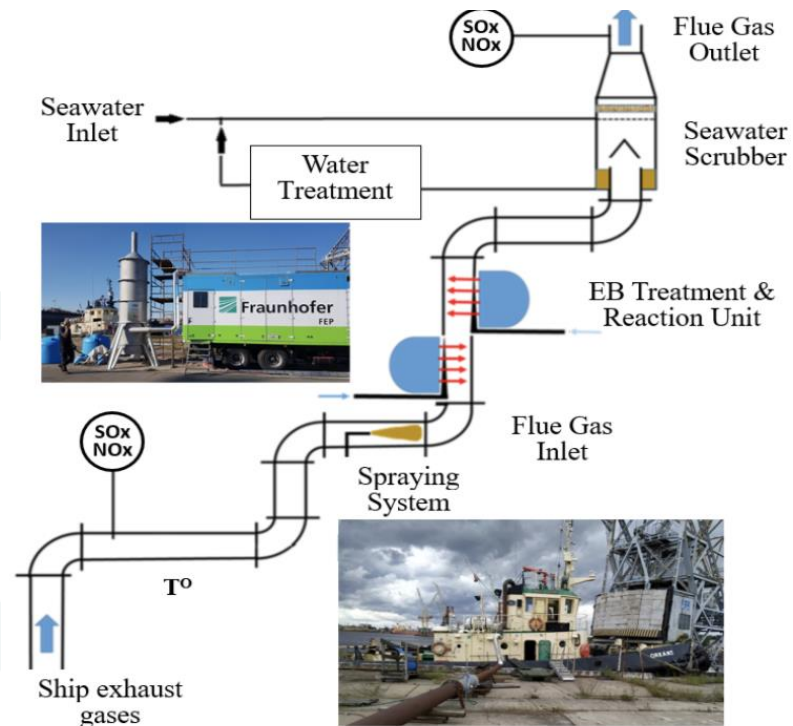
- To foster multidisciplinary cooperation between Accelerator and Maritime Communities
- To develop and maintain joint Strategy
- To prepare and submit the Projects on behalf of the Collaboration.



# Student thesis

- **Ekaterina Tskhay MSc thesis (Defended):**

Qualitative and quantitative analysis of the hybrid electron accelerator exhaust gas abatement technology impact to the selected maritime logistics aspects



# Heavy Ion Therapy Research Integration



- WP 7: Advanced accelerator and gantry design
  - Task 7.4: Injector Linac Design
  - Task 7.5: Integration of an innovative superconducting gantry: optics, mechanics, beam delivery



# PhD Student thesis

- **Lazar Nikitovics thesis:**

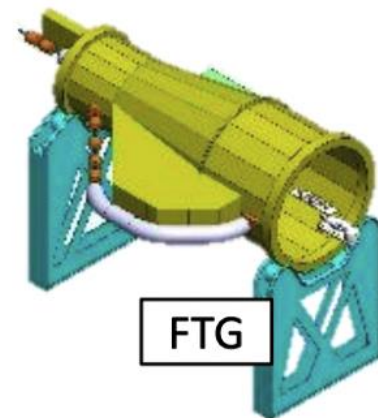
Design study of a high-frequency linear accelerator for the purposes of injection into a therapy synchrotron and parallel production radioisotopes

- **Janis Vilcans thesis:**

Development of the rotational (mobile) cryostat system for the superconducting magnets in the hadron therapy installations

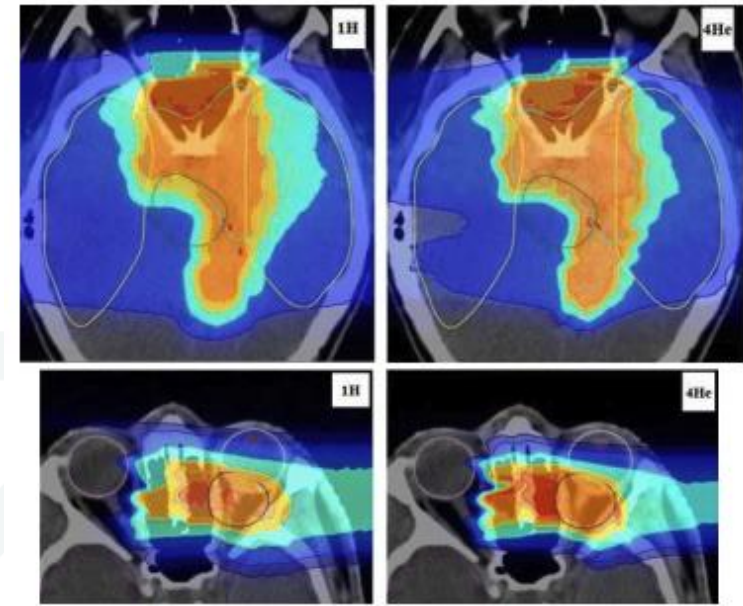
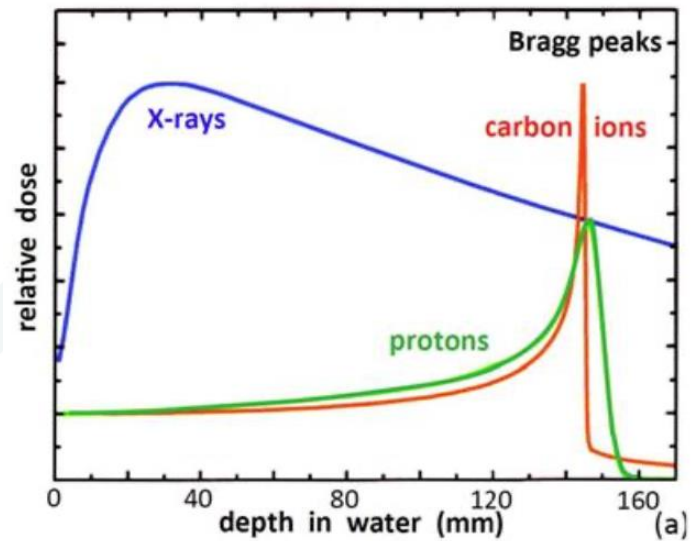
- **Luca Piacentini thesis:**

Mechanical integration of systems, instruments and components of a carbon ion rotating gantry for medical treatments



# Next Ion Medical Machine Study

- Developing new technologies for the future generation of accelerators for cancer therapy

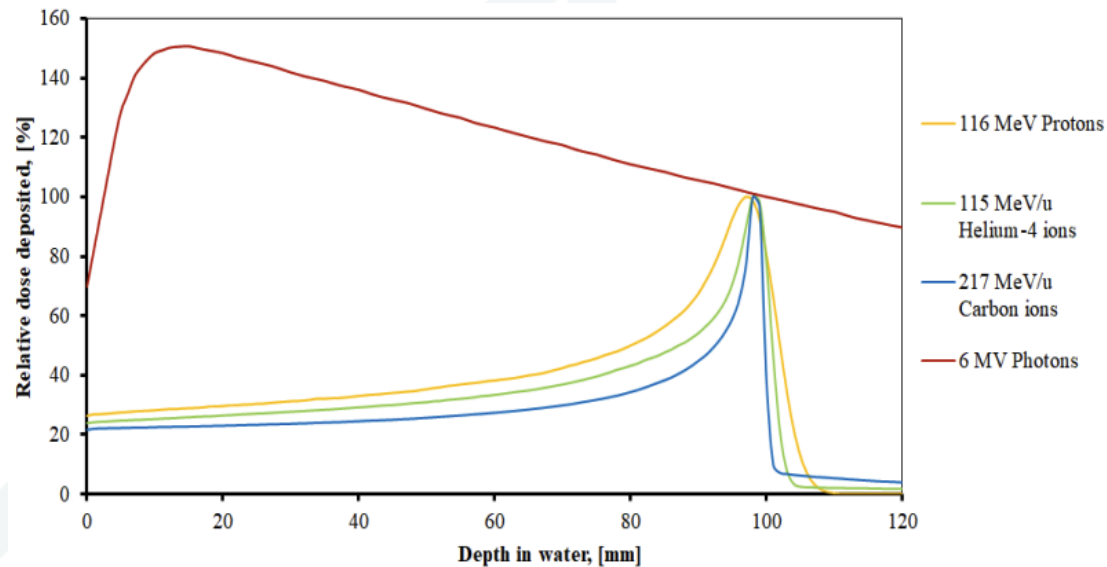




# Student thesis

## ▪ Kristaps Palskis PhD thesis:

Studies of different ion types and their use for radiation therapy, *FLASH* therapy aspects. Optimization of ion beam parameters for very high dose rate (FLASH) radiotherapy



# Accelerator medical applications



*Particle therapy centre geography in Europe, ENLIGHT 2020*





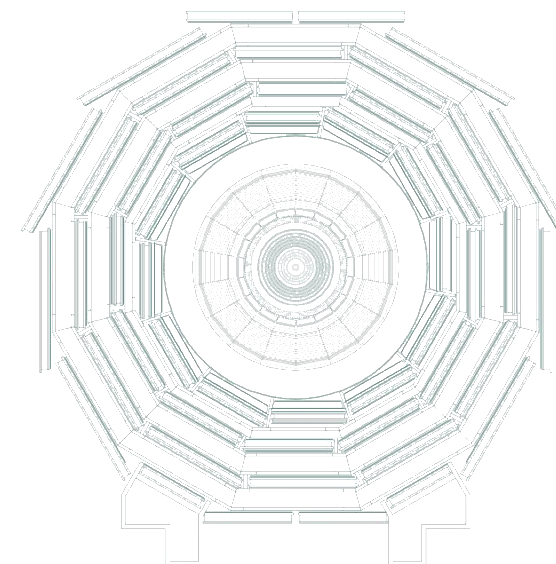
RIGA TECHNICAL  
UNIVERSITY

Centre of High-Energy Physics and  
Accelerator Technologies

# HEP in Latvia: the CMS-Latvia group

**Dr Kārlis Dreimanis**

Director of the Centre of High-Energy Physics and Accelerator Technologies





# Overview of the group



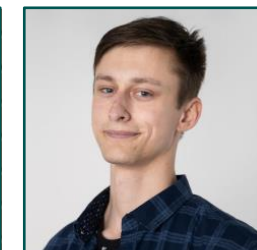
at present consists of ...

- Two senior researchers;
- Three PhD students (2 RTU, 1 UL);
- Two engineers [part-time];



...involved in

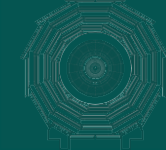
- SM Physics - Vector Boson group; [secondary activity]
- Higgs physics analysis group; [secondary activity]
- Technical Integration team; [secondary activity]



4 more personnel at UL and Institute of Solid-State Physics working on studying the LYSO crystals to be used in the barrel layer of the MTD;

Goals:

- To continuously ... in experimental HEP at CMS;
- To ... of the group and to expand the breadth of the topics covered;
- To ... research cluster, highly attractive to talent from abroad;
- To ... early-careers ... through our doctoral program;



- During 2019-21 developed a doctoral study program in “High-energy physics and accelerator technologies”:
  - Invaluable tool towards capacity building in HEP;
  - Allows us to train local talent and to attract international talent at the graduate studies level;
  - Demonstrably highlights the pathway to world-leading research institutions, such as CERN, for students/pupils;
  
- First intake of students, academic year 2021/22:
  - 6 students enrolled [2 students in HEP at CMS];
  - 1 CMS student transferred from a different study program into the 2<sup>nd</sup> year;
  - Currently 3 full-time PhD students working at the CMS experiment;
  - About to intake 3 more full-time CMS PhD students for the academic year 2022/23:
    - One local student;
    - Two foreign students (Spain and Greece);  
(they will begin their studies on the 3rd of October);
  
  - 2 AT students also to be enrolled in *cotutelle* with cooperating institutes in Estonia and Italy;
  
- We provide the option for students to go on a long-term attachment to CERN (up to 24 months) in Y2&Y3 [Invaluable! Speaking from my own experience.]









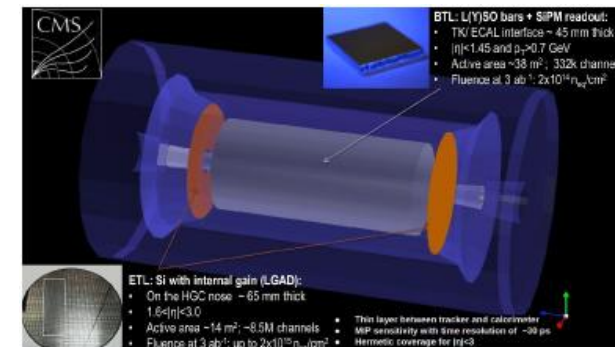


# Current CMS detector program



□ **High Level Trigger (HLT) and Data Acquisition (DAQ) system**

- **HLT-1** (CPU-based) and **HLT-2** (FPGA-based) for real-time event selection
- **DAQ** system for data transfer from the detector to the storage
- **DBS** (Database Service) for managing the data distribution



□ **Simulation and Data Processing**

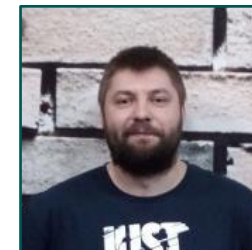
□ **Software and Infrastructure**

- **Simulation** (Pikurs [eng])
- **Data Processing** (K. Dreimanis)
- **Software Development** (A. Gaile [PhD])
- **Infrastructure** (N. Strautnieks (UL) [PhD], D. Osīte [PhD])
- **Quality Assurance** (C. Diaz [PhD])
- **Documentation and Training**



- G.Pikurs and J.Vilcāns are involved in the CMS Technical Integration (TI) team:

- Core engineering team part-responsible for the operation of the CMS experiment;



- Various tasks:

- Development of the cushioning system to suppress the vibration from the dual-phase CO<sub>2</sub> cooling plants t CMS (G.Pikurs);
- Development of the automation of the doors for the *garage* of the forward calorimeter (HF), (G.Pikurs);
- Development of the support gantry for the installation of the High-Granularity Calorimeter (HGCAL) for Run 4 (J.Vilcāns);

- The TI activities are not *directly* HEP-developing, however:

- These provide us with a readily available access to our own engineers for the detector development work on the MTD and elsewhere;
- Shows us as being a willing and trustworthy collaborating institute within CMS;
- Increases our visibility within CMS: key to attracting more talent from abroad for engineering and physics!



# **Take away message**

**Latvia is reliable and honest partner of CERN**

**CERN – Latvia collaboration is yielding many mutual benefits**

**Latvia is ready to take the next step – to become full member of CERN**



# Thank you!

