The CERN Baltic Group

Prof. Toms Torims, Riga Technical University / CERN

Science Diplomacy

Baltic style

Medus kūka LV

Medaus pyragas LT

Meekook EE

Photo: Shutterstock

Honey Cake

CERN Baltic Group

1. Riga Technical University LV
2. University of Tartu EE
3. Vilnius University LT
4. University of Latvia LV
5. National Institute of Chemical Physics and Biophysics EE
6. Kaunas University of Technology LT
7. Riga Stradiņš University LV
8. Tallinn University of Technology EE
9. Vytautas Magnus University LT
10. Lithuanian Energy Institute LT
11. Daugavpils University LV
12. Lithuanian University of Health Sciences LT
13. Ventspils University of Applied Sciences LV

Transparency
Honesty
Sharing
Collaboration

CERN Baltic Group

Common system of values

Reliable and open

Many challenges = numerous opportunities

Chairman: Ants Koel – TalTech (EE)

Deputy Chair: Brigita Abakevičienė (LT)

10th CBG Meeting in Tallinn – Nov ‘22

11th CERN Baltic Group General Meeting

4 May 2023, 13:45 → 5 May 2023, 17:20 Europe/Vilnius

Emmanuel Levinas Certre

Description

The **General Meeting** is a formal body on information exchange, decision and policy making to reach aims and goals of the CBG stated below:

The mission of the CBG is to coordinate policy and actions related to high energy particle physics and accelerator technologies (*inter alia* big data and computing technologies) within the scientific institutions and universities of the Baltic States and *vis a vis* CERN.

The main objectives of the CERN Baltic Group are:

1. Coordination of the Baltic research institutions activities towards CERN and related Collaborations/Experiments;
2. Strengthening and development of Baltic High Energy Physics community;
3. Foster cooperation between CERN and local industry in the Baltic States and generate new opportunities via joint research projects and contacts;
4. Development of the Baltic international multidisciplinary masters/doctoral level study programme in High Energy Physics and Accelerator Technologies, and related areas.

The main principles of the CERN Baltic Group are: **transparency, honesty, sharing, and collaboration.**

CBG objectives

Coordination of the Baltic research institutions activities **towards CERN** and related Collaborations/Experiments

Strengthening and development of Baltic **High Energy Physics Community**

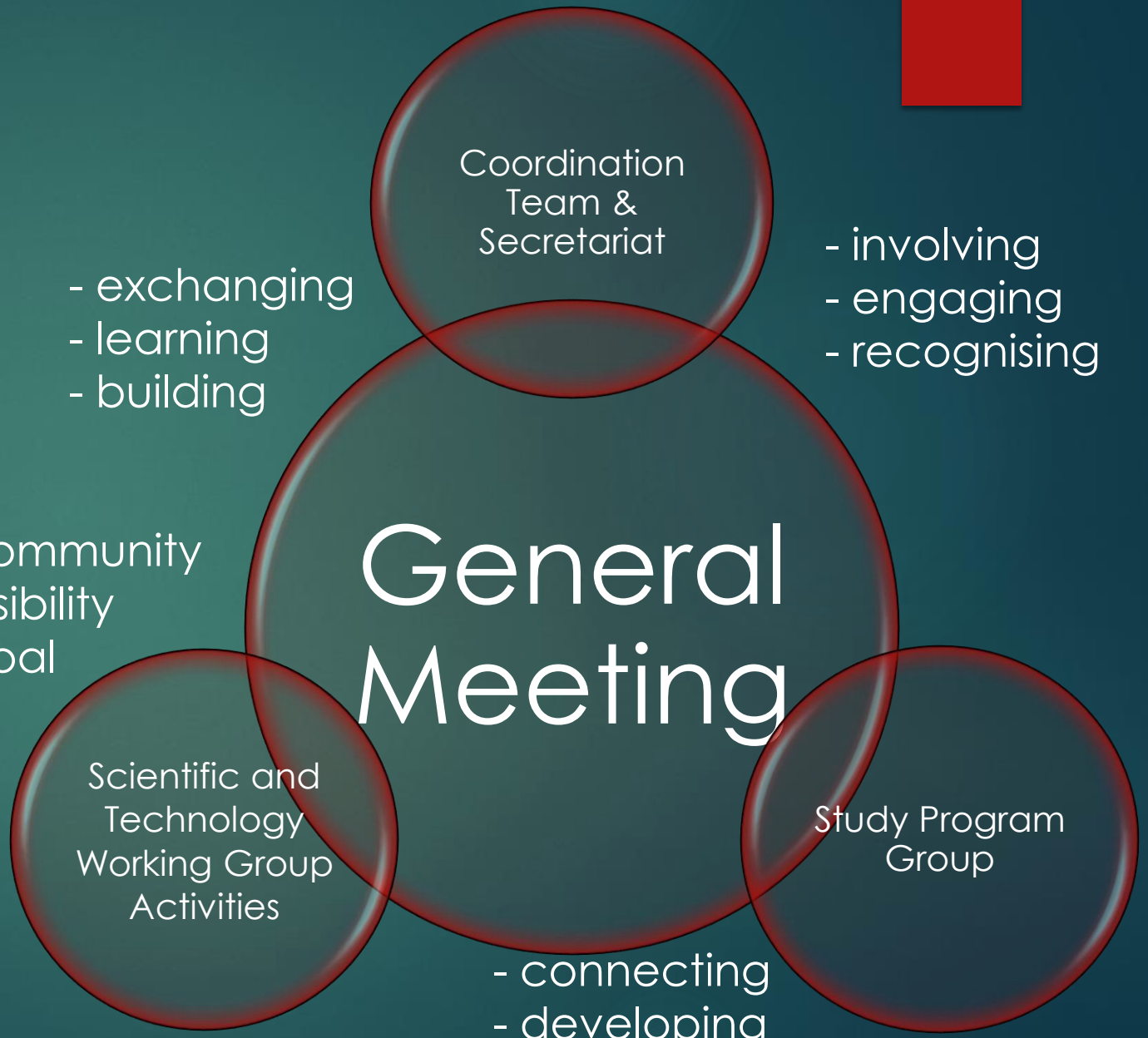
Development of the Baltic international multidisciplinary masters/doctoral level **study programme** in High Energy Physics and Accelerator Technologies

How it works?

- **General Meetings**: Riga, Geneva, Tallinn, Vilnius, Kaunas
- Regular work of the Coordination Team and Technical Coordination Meetings
- Sub Group Activities and meetings
- Industry engagement

∑ 60+ joint events

- Well documented
- Well coordinated and strong together



https://indico.cern.ch/category/10023/

Science Diplomacy

CERN Baltic Group

Bottom-up initiatives

Clear responsibilities

Different levels

Different stakeholders

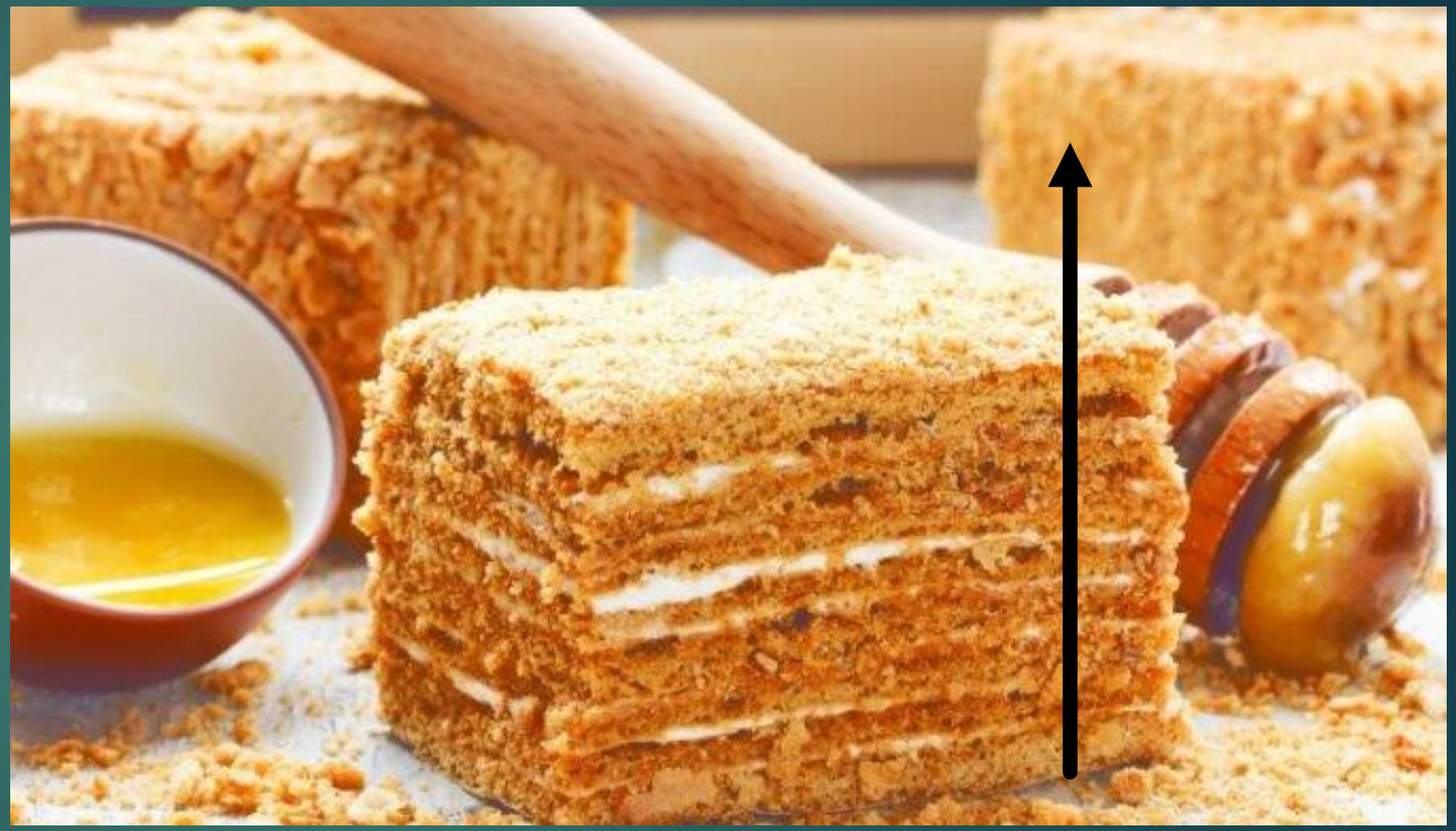


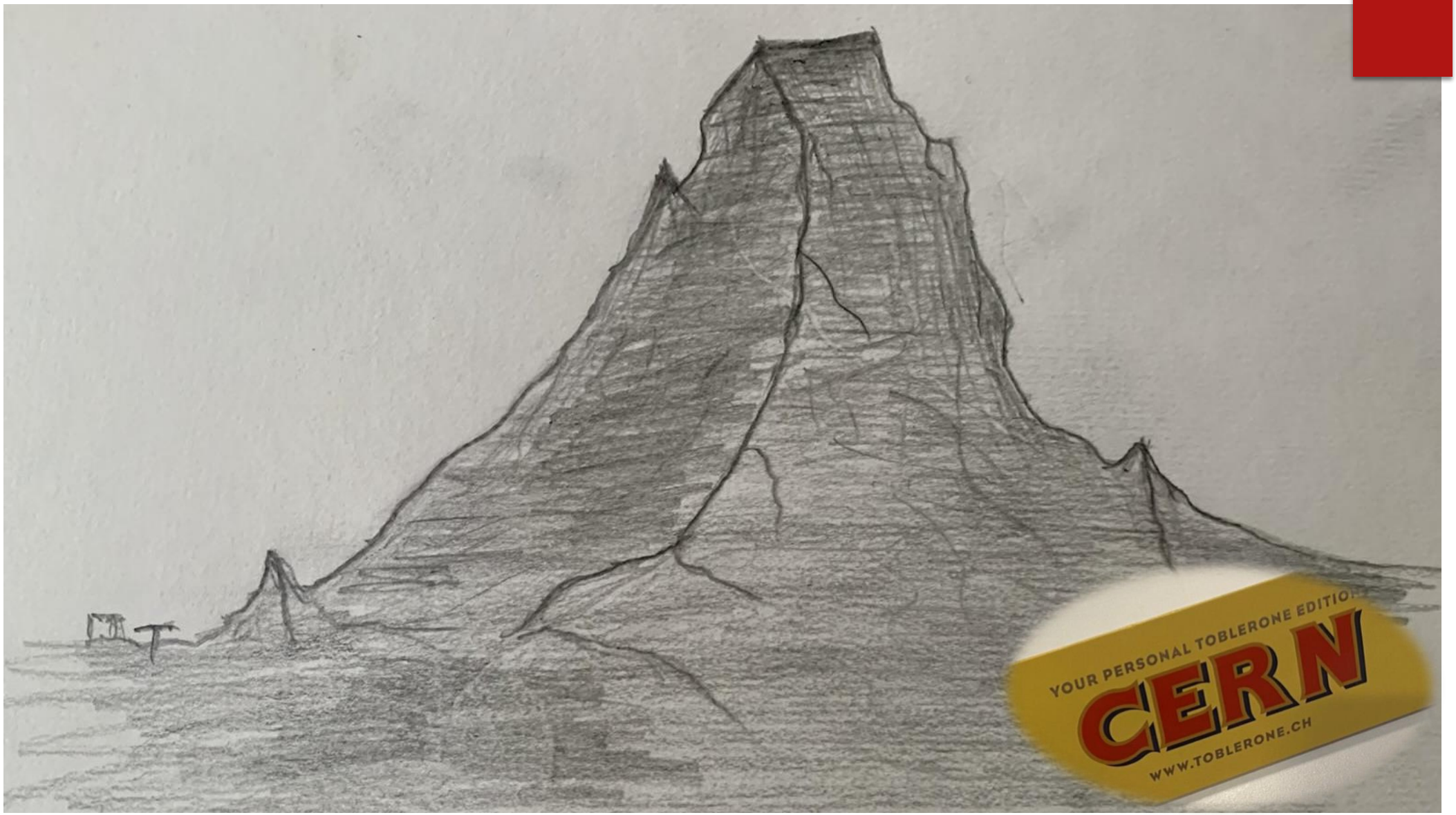
Photo: Shutterstock

Approach of CERN Baltic Group - STEM

- What is CERN and what STEM means to CERN?
- What is CBG? Who are we?
- Role of the CBG in the **Attraction** to STEM
- How Baltic States are benefiting from being CERN Associate Member States?
- What tools we have?
- What are challages?
- What is our "Way forward"?

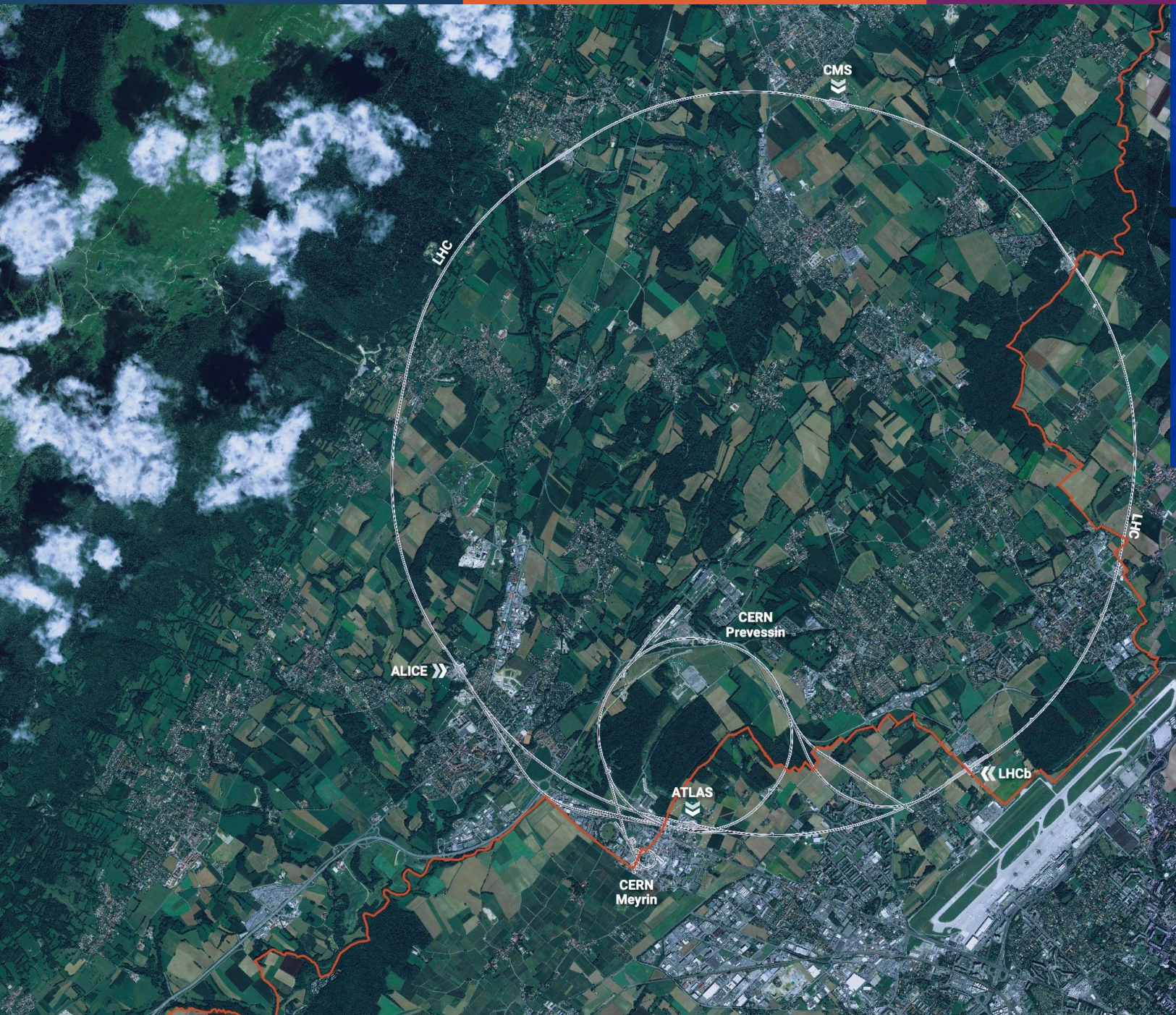
Google, NASA or CERN?

Maths and physics or latin language?

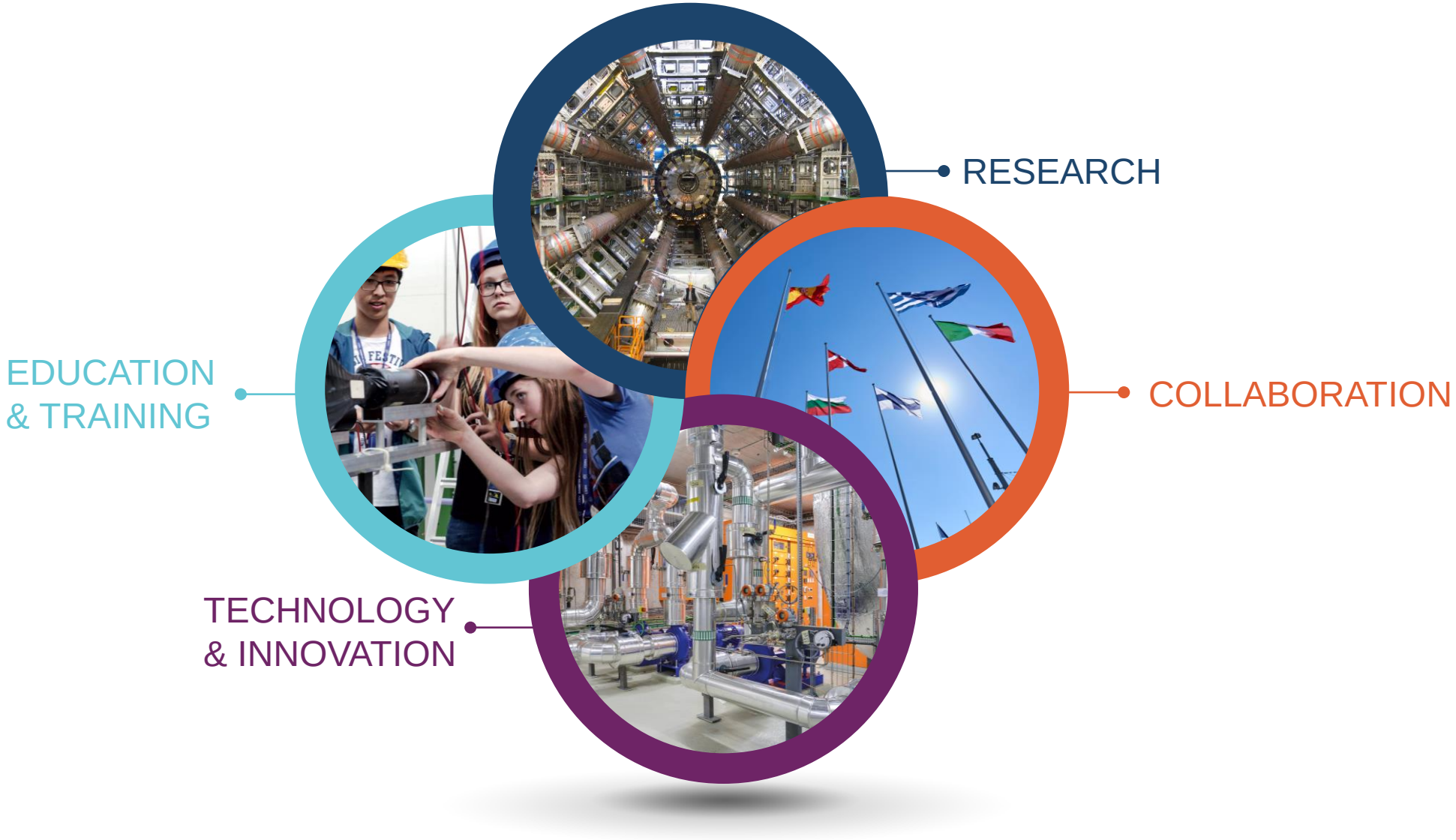

YOUR PERSONAL TOBLERONE EDITION
CERN
WWW.TOBLERONE.CH

CERN is the world's biggest laboratory for particle physics.

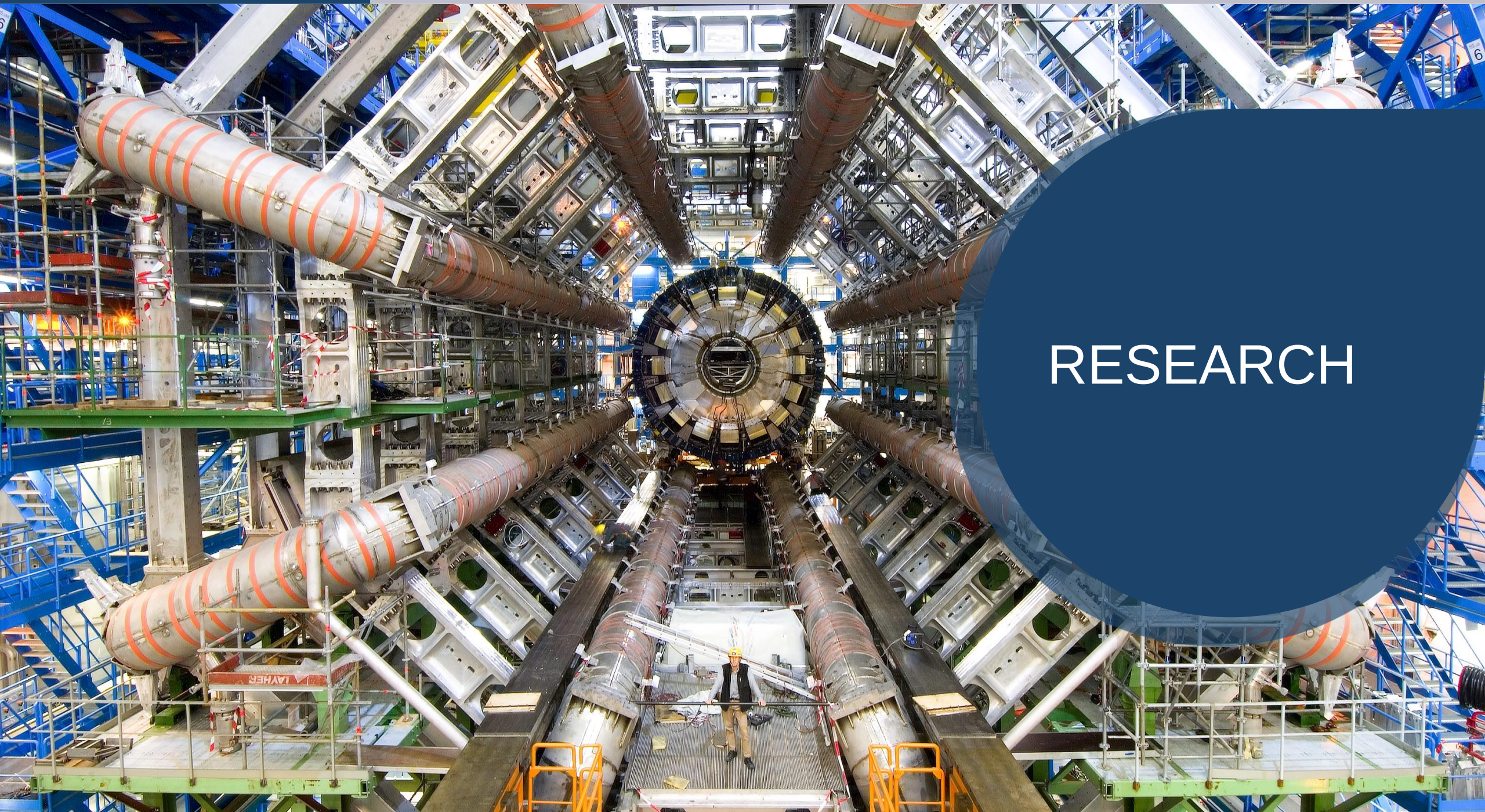
CERN goal is to understand the most fundamental particles and laws of the universe.



Four pillars underpin CERN's mission



COLLABORATION



RESEARCH

TECHNOLOGY & INNOVATION

EDUCATION & TRAINING

CERN's training, education and outreach programmes

Undergraduate students in **Summer programmes**

Fellows, **Technical and Doctoral Students** in research and applied physics, engineering and computing

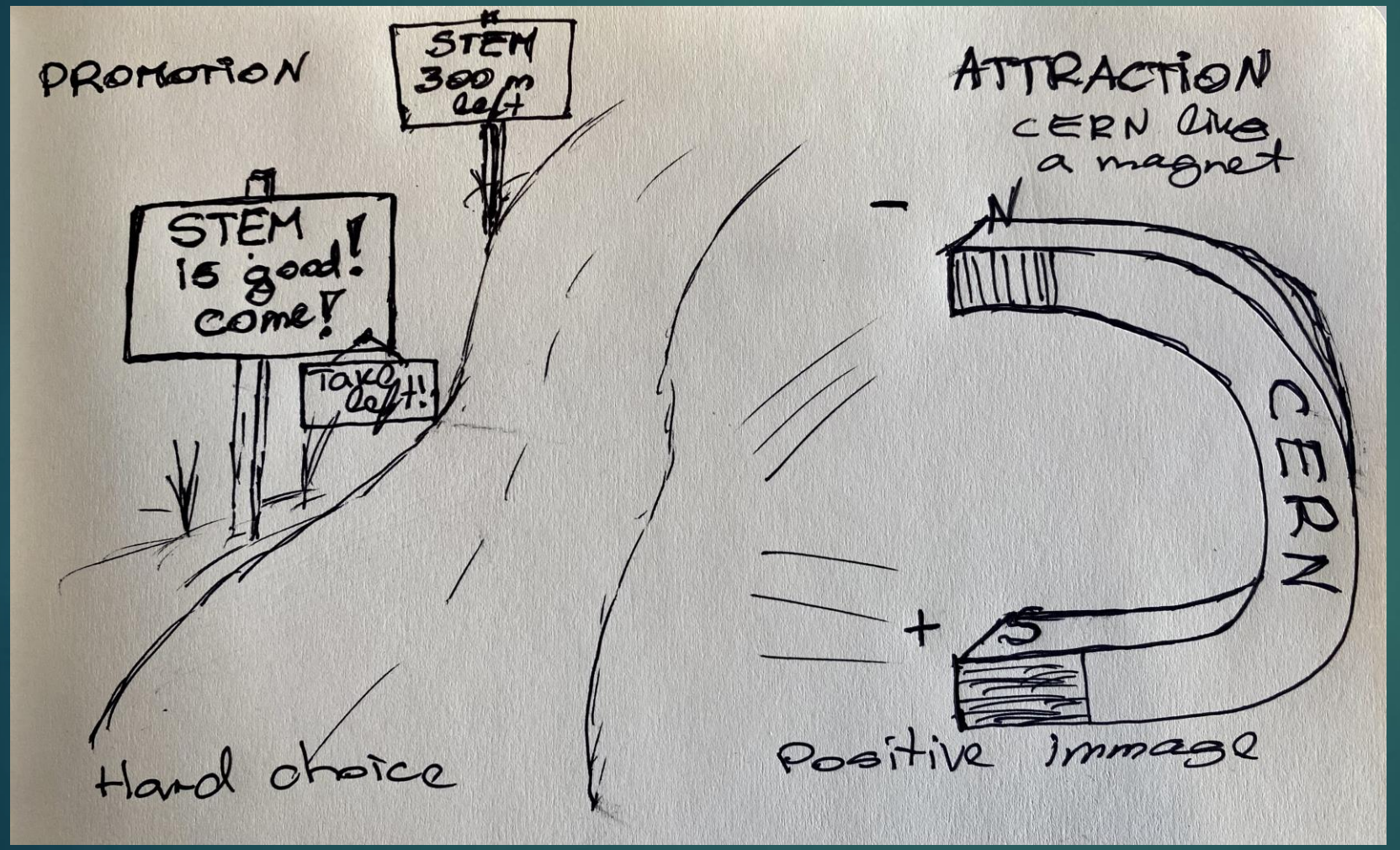
Physics teachers training visits to CERN

Visits on guided tours

CERN engages with citizens across the globe:
on-site and travelling exhibitions
in 15 countries, > 1 million visitors

Science Gateway will open in 2023, expanding CERN's outreach reach and impact, locally and globally.

CERN is cool and it is interesting!



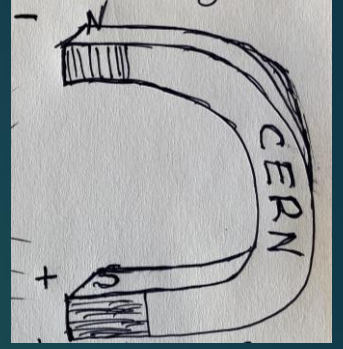
Google, NASA or CERN?
Maths and physics or latin language?

Perspective

How to respect technical specifications?

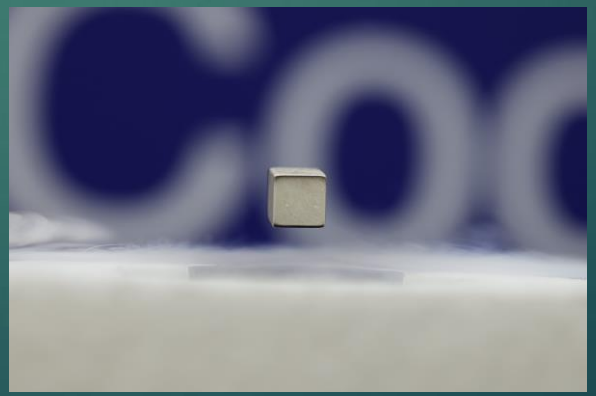
How volcano happens?

STEM activities – **school level**



- High-school pupils shadow scientists @ CERN
- School (class) visits to CERN
- CERN School-Lab

https://scoollab.web.cern.ch



Baltics physics teacher programme @ CERN - **school level**

- ~~19th century physics~~
- Cool physics of 21st century and passionate engineering
- Smart, knowledgeable and motivated teachers (I was at CERN!) = the best promoters of STEM

- CERN staff visits to meet the teachers in-situ

WOMEN IN TECHNOLOGY

> One of the things I will take home is that an environment of collaboration and open discussion, rather than competition, can do wonders and can engage not only more girls, but also my more introverted male students.
>
> - I. Molefi, Physics Teacher and participant in the 2015 International Teacher programme

CERN & Society Foundation

1. Promote **public understanding of science** and the various ways it affects our daily life;
2. **Encourage and support young people's interest in the subjects** of science, technology, engineering and mathematics, with an emphasis on physics and engineering (STEM);

STEM activities – university level

- HEP&AT doctoral Study Programme is up-and-running
- CERN Baltic School of High-Energy Physics and Accelerator Technologies – this year in Estonia
- CERN Baltic Group Conference - CBC 2022 in Lithuania

- Master programme still to be created
- Joint Baltic Diploma?

TAL TECH | TALLINN UNIVERSITY OF TECHNOLOGY

BALTIC SCHOOL OF HIGH-ENERGY PHYSICS AND ACCELERATOR TECHNOLOGIES 2022

Saaremaa, ESTONIA
August 8–12, 2022

LECTURERS:
Prof. Dr. Jonathan Ellis
Prof. Dr. Yuri Dokshitzer
Prof. Flyura Djurabekova
Dr. Maurizio Vretenar
Dr. Walter Wuench
Dr. Andi Hektor
Prof. Leonid Rivkin

SCIENTIFIC COMMITTEE:
Prof. Fjodor Sergejev (TalTech)
Prof. Veronika Zadin (UT)
Prof. Toms Torims (RTU)
Dr. Kristjan Kannike (NICBP)
Prof. Brigita Abakevičienė (KTU)
Dr. Thomas Gajdosik (VU)
Prof. Mārcis Auziņš (UL)
Dr. Jevgenijs Proskurins (RSU)

LOCAL ORGANIZING COMMITTEE:
Prof. Fjodor Sergejev (TalTech, EE)
Dr. Erki Kärber (TalTech, EE)
Prof. Veronika Zadin (UT, EE)
Dr. Kristjan Kannike (NICPB, EE)

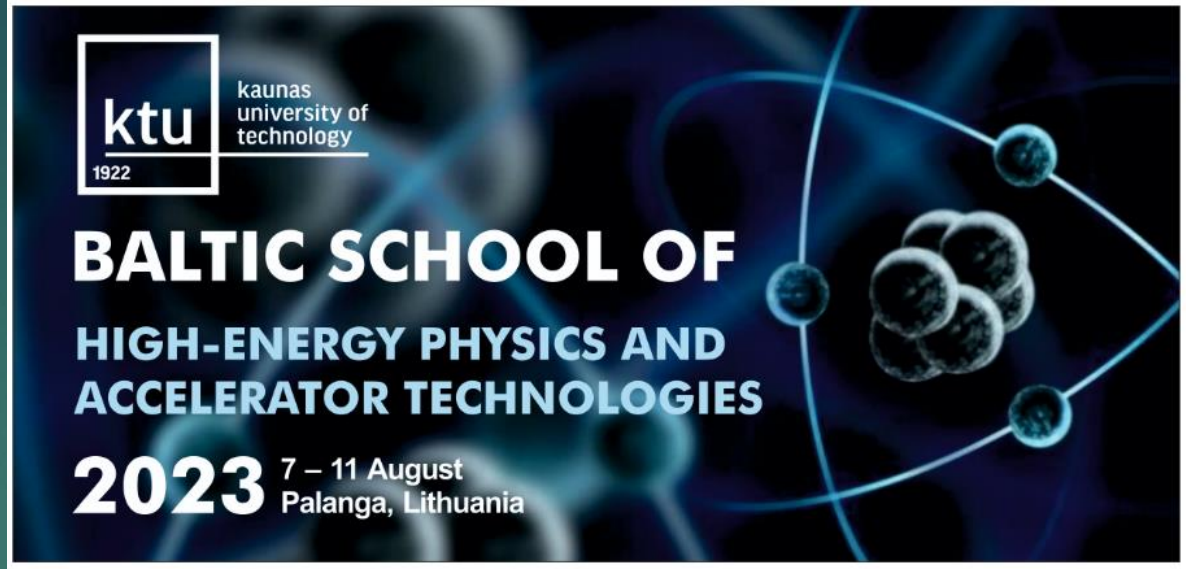
SCIENTIFIC PROGRAMME:

Quantum Field Theory
Standard Model and Beyond
Physics at Colliders
Early Cosmology
Dark Matter
Gravitational Waves and New Physics
Accelerator Technologies
Accelerator Applications

Further information: **indico.cern.ch/e/CBG2022**
Preliminary registration deadline: **June 1st**

CERN Baltic Group

Co-funded by H2020 ERA Chair MATTER (Grant Agreement No 856705)



The third edition of the **Baltic School of High-Energy Physics and Accelerator Technologies (HEP&AT)** will be hosted by the Kaunas University of Technology (KTU) and held in, a seacoast resort, Palanga, LITHUANIA.

The school will focus on the fundamental aspects of high-energy physics theory and touch on the cutting edge research currently on-going. In addition, the school will also cover both the basic principles and the current cutting edge technologies of particle accelerators, as well as their applications.

The school is organized by the CERN Baltic Group, a collaboration of thirteen higher education and research institutions in the Baltic states, and is endorsed by CERN.

CERN Baltic Group

Final announcement of the 2nd CERN Baltic Conference (CBC 2022)

10 – 12 October, 2022, Vilnius, Lithuania

The 2nd CERN Baltic Conference (CBC 2022) to be held in National Centre of Physical and Technological Sciences in Vilnius, Lithuania. It is an annual conference organised b the CERN Baltic Group (CBG), where location is rotated within CBG member countries and hosting institutions

Goal and Objectives

In the spirit of CBG principles (transparency, honesty, sharing and collaboration), the Conference has the following objectiv

- **Connect** and **build** CERN (and beyond) community in the Baltic states.
- **Induce** collaboration(s) by sharing who is doing what? What are the interests, topics, competences, aspirations?
- **Provide** multidisciplinary networking **platform**, where individual researchers, scientific groups and companies from the Baltic states can find synergies and opportunities for collaboration.
- **Inform** and **engage** stakeholders and industries across the Baltic states.

The Conference aims to gather the Baltic scientists and research institutions, and to help organizing activities towards the long-term mission, such as that of CERN and related collaborations/experiments

The Scope and Topics

The scientific and technical CERN Baltic Conference covers the full spectrum of CERN and related activities (e.g. research, engineering, computing, industrial, and policy).
Topics are related, but not limited to: **Accelerator, Detector and other Advanced Technologies, High Energy Physics, Data Science and Computing, Nuclear Medicine**. From physics to engineering, from fundamental science to industry. Topics will be logically linked to the CBG activities within the CERN collaborations, experiments and studies: such as CMS, CLIC, FCC, MEDICIS, AEGIS, CLOUD, and others.

Target Audience and Participants

CERN-related researchers, engineers, students (of all levels), and industrial representatives (incl. CERN Industrial Liaison Officers of EE, LT, and LV) as well as stakeholders of the Baltic states. Expert speakers form CERN and CBG Member institutions will be invited to participate and to contribute to the each of the topics.

Important deadlines
Registration and Event Page: **https://indico.cern.ch/e/cbc2022**
Abstract submission closes: October 2nd
Conference starts: October 10th

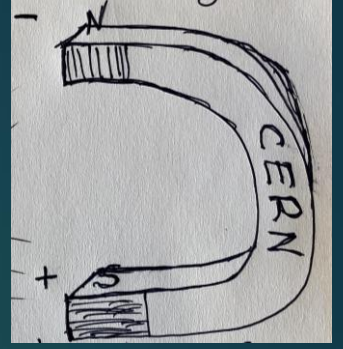
Conference (dinner) fee*: 40 Eur
*possible to opt out

Venue:
Room A101 (next to the main entrance)
National Center for Physical Sciences and Technology
Saulėtekio av. 3, LT-10257 Vilnius, Lithuania

TAL TECH · NICPB KBFI · UNIVERSITY OF LATVIA · VENTSPILS UNIVERSITY OF APPLIED SCIENCES · RĪGA STRADIŅŠ UNIVERSITY · CERN · LITHUANIAN UNIVERSITY

CBG Annual Conference

Opportunities for Baltic Students



- **Doctoral Student Programme** - thesis while spending up to 36 months at the forefront of science - CERN
- **Technical Student Programme** - 4 to 12 months at CERN during the course of your studies (Bachelor or Master)
- **Administrative Student Programme** - students specializing in administration, to spend a training period of 2 to 12 months during the course of their studies (Bachelor or Master)
- **Summer Student Programme** - lectures, visit CERN facilities, take part in discussions and workshops with people who are leaders in their fields. In fact, it will be a summer like nowhere else on Earth.

CERN Science Gateway

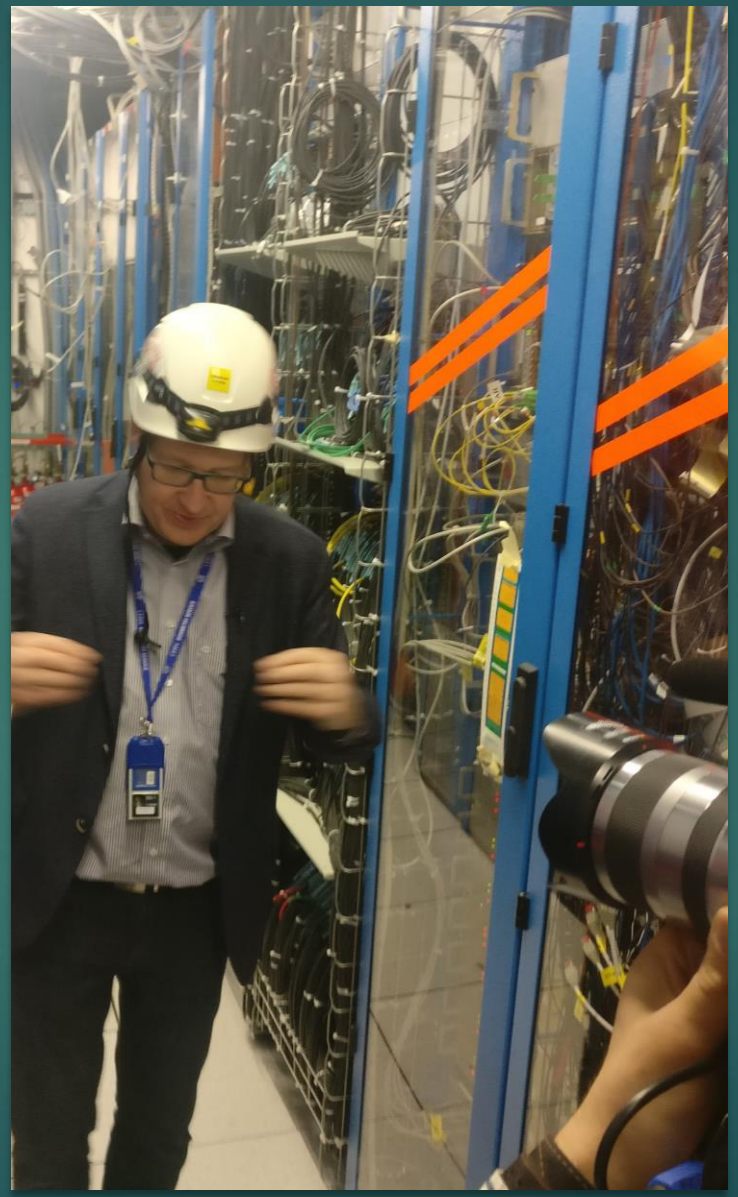
CERN’s new education and outreach centre for all publics aged 5-plus.

Opening beginning of 2023.

Immersive exhibitions, education labs, events and shows.

Still bit of promotion

- Journalists who can inspire
- Young physics teachers
- On-line classes for the school children from the CMS control center – real scientists who speak in human language



Success of CBG

- Collaboration with Baltic Assembly
- Joint/coordinated position vis-à-vis CERN
- Strong and united position at CERN Council
- Stakeholder engagement
- Major regional events and conferences
- Joint study programme
- Flagship project **Advanced Particle Therapy Center for the Baltic States**

In the spirit of CERN

Knowledge

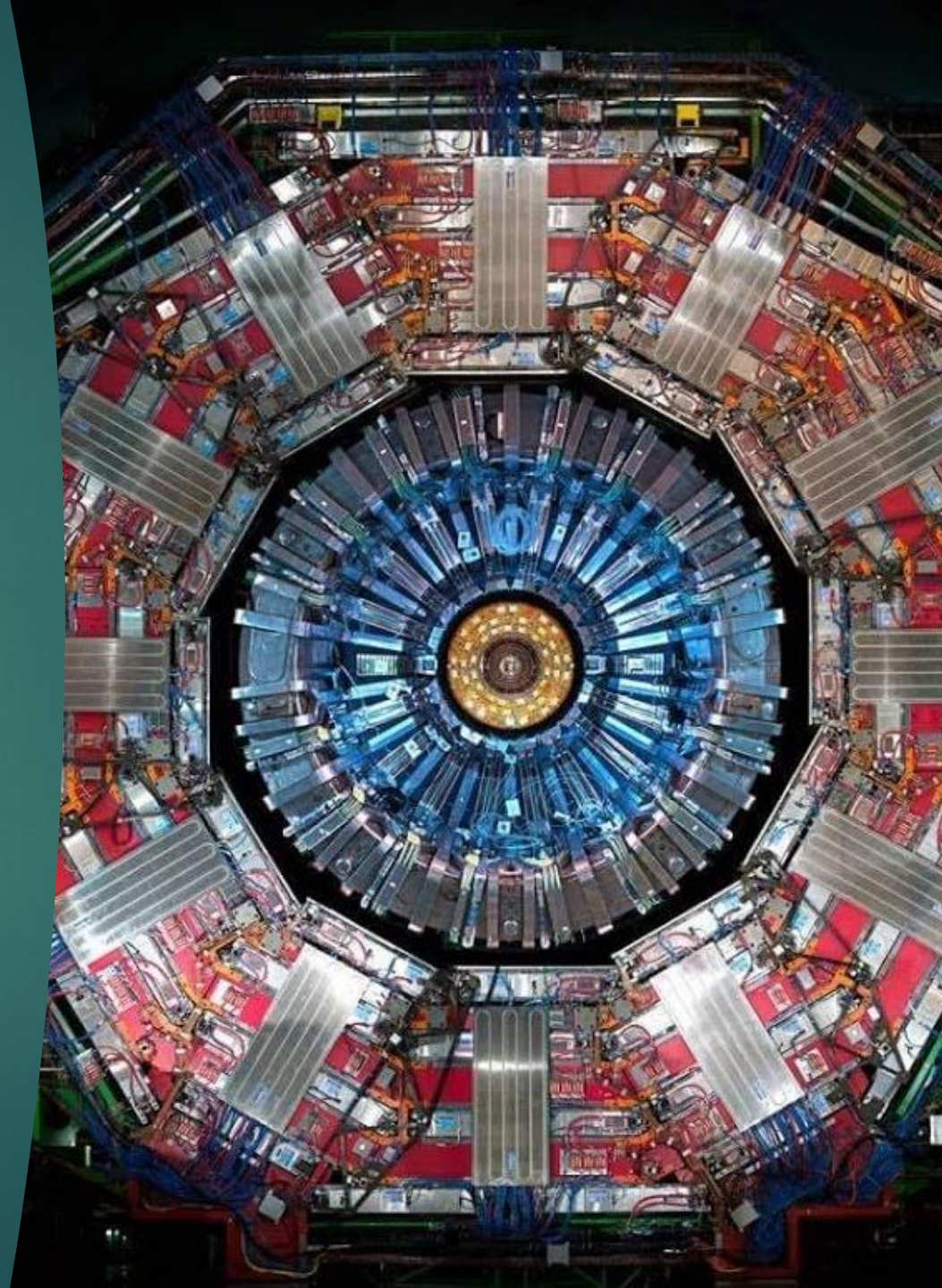
Transparent

Honest

United

Successful

Regional grasp



CERN is our lab!

- You are doing a great job in educating our children
- How can we help you?
- How can be usefull to you at your work?
- Use your national contacts @CERN


NUESTRO SOCIALISMO
ES
IRREVOCABLE

CERN Baltic Group

We are strong together

Advanced Particle Therapy center for the Baltic States

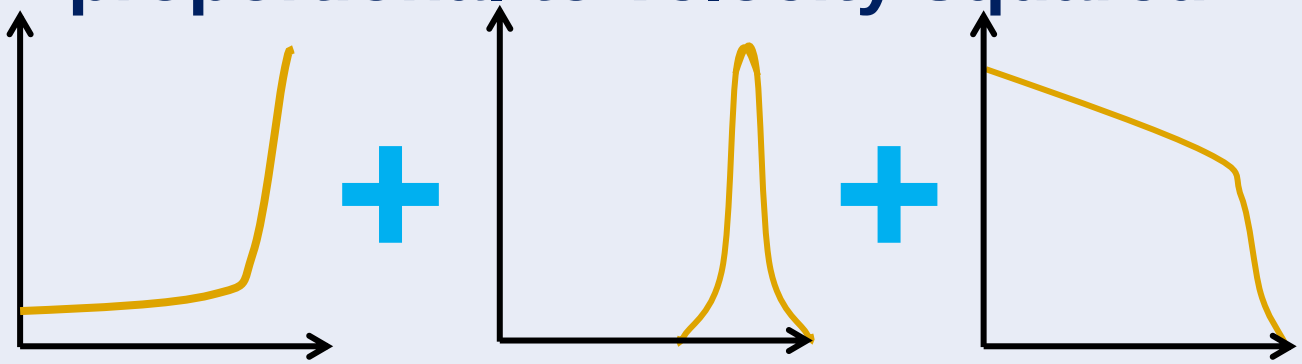
Kristaps PAĻSKIS
PhD student and researcher @ Riga Technical university Institute of Particle Physics and Accelerator Technologies
Doctoral student @ CERN

I feel.. like I owe you something

Why does the Bragg peak happen?

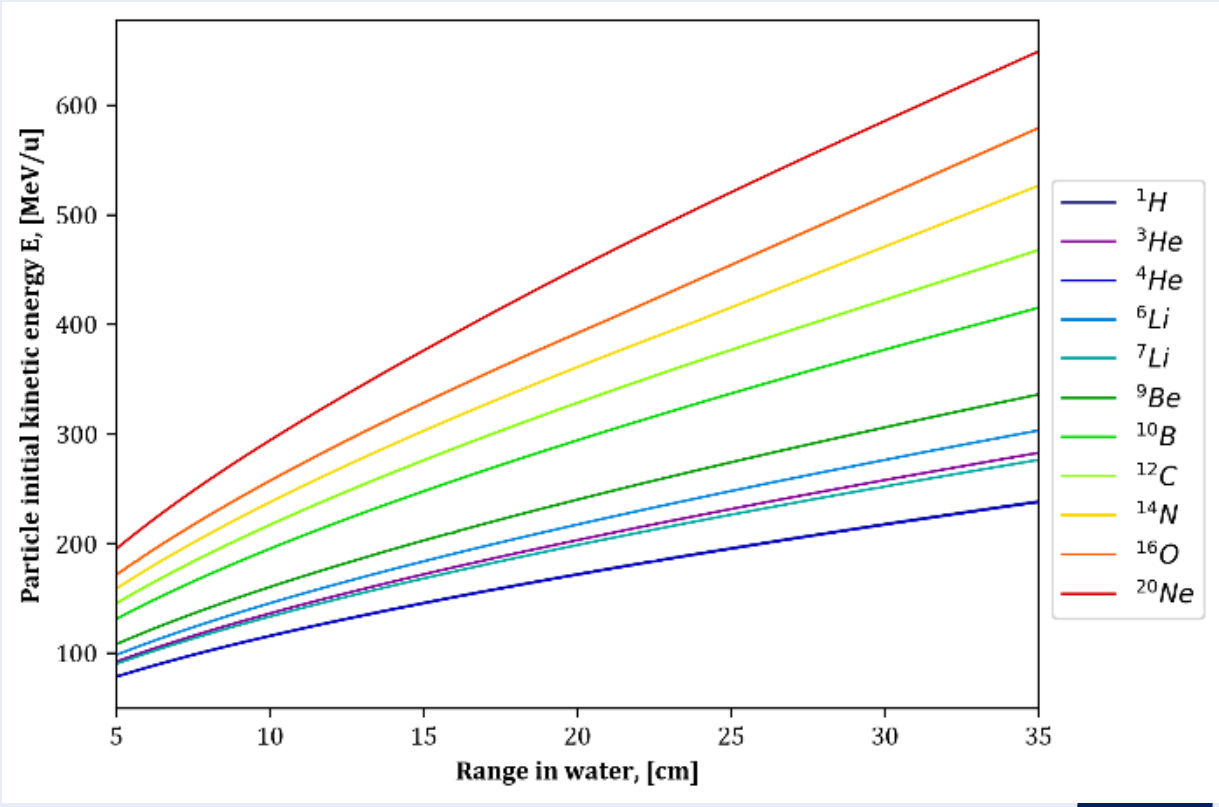
$$-\left\langle \frac{dE}{dx} \right\rangle = Kz^2 \frac{Z}{A} \frac{1}{\beta^2} \left[\frac{1}{2} \ln \frac{2m_e c^2 \beta^2 \gamma^2 T_{\max}}{I^2} - \beta^2 - \frac{\delta(\beta\gamma)}{2} \right]$$

Energy loss is **inversely proportional to velocity squared**



Primary particle energy loss + **Range fluctuations** + **Primary particle loss**

How do we change treatment depth ?



I feel.. like I owe you something

Another good overview of proton therapy and perfect animations for pencil beam scanning from ~ 1:50

https://www.youtube.com/watch?v=OTd5dv3VDws

Availability of particle therapy

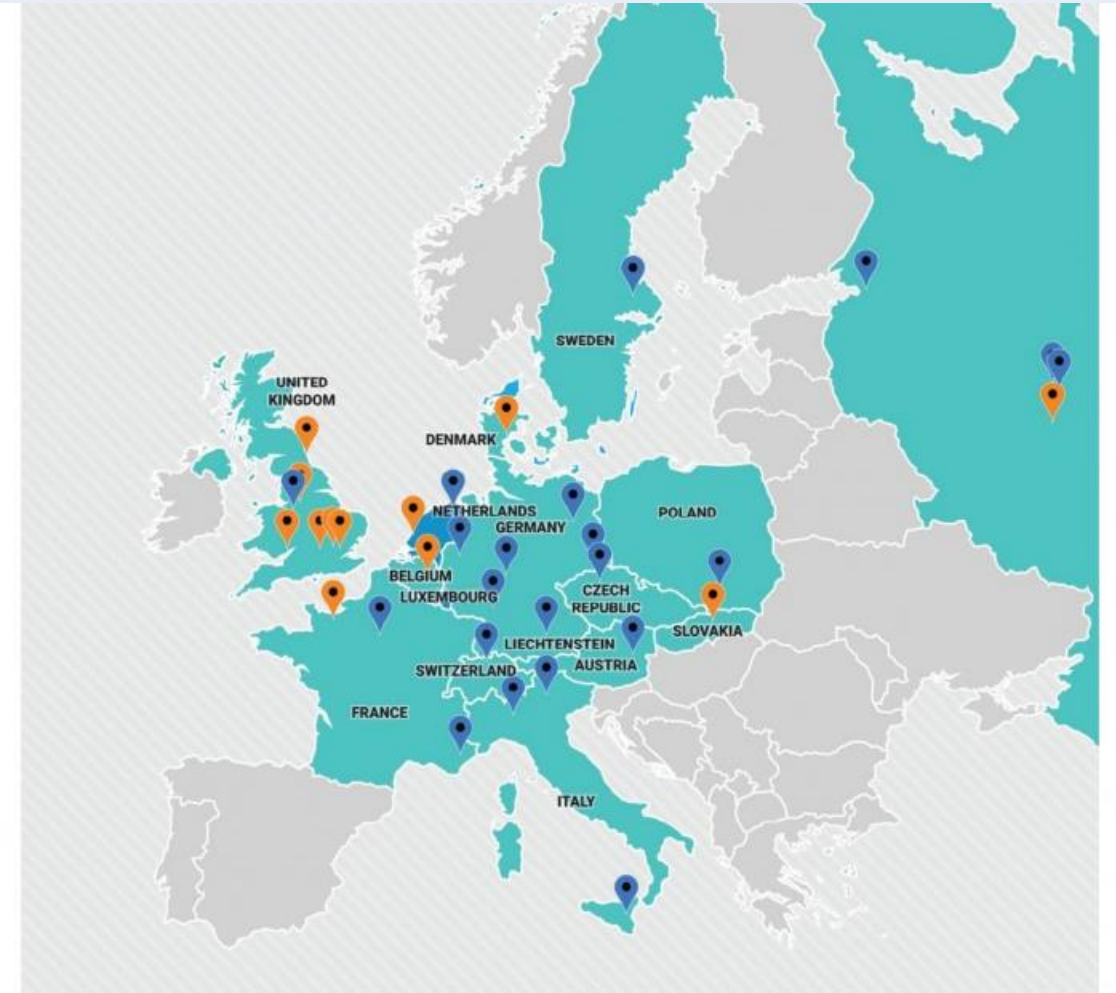
In 2018 – 4.23 million new registered cancer cases in Europe

By 2040 – estimated 5.2 million new registered cases

More than 50% of cancer patients require radiation therapy **BUT**

1 in 4 patients do not receive the treatment

One of the main causes – **lack of technology**



For specific cancer types – particle therapy is the ONLY optimal treatment modality

Benefits of particle therapy

Physical interactions of **protons** and **positively charged ions** with matter create more favourable dose distributions compared to conventional radiotherapy with high energy photons – **the Bragg peak**

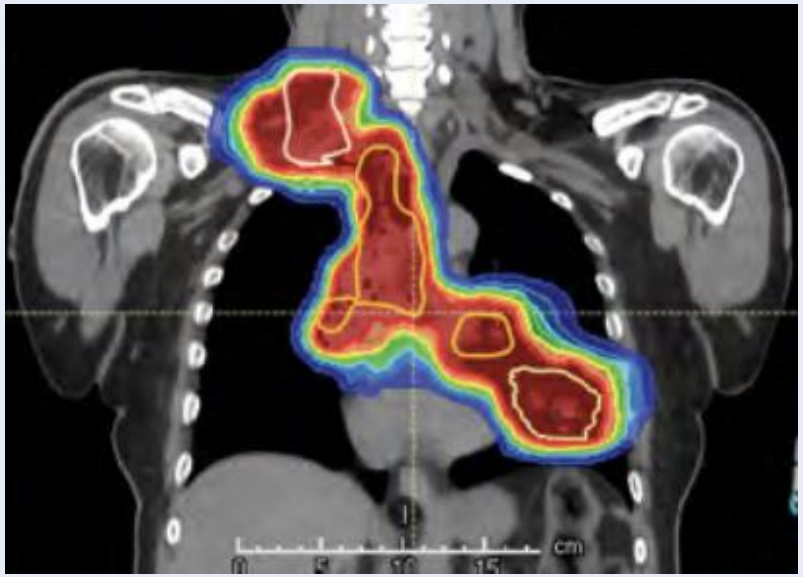
In clinic, particle therapy has already shown benefits in treatment of

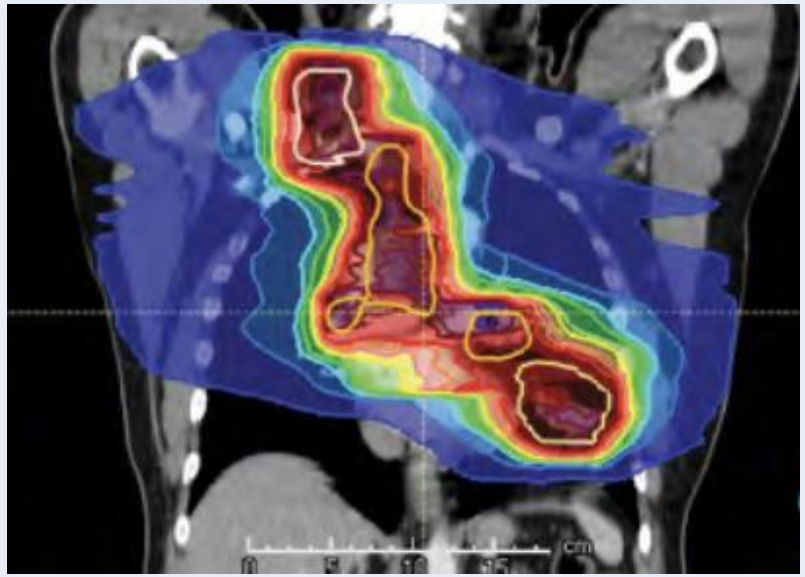
paediatric oncological malignancies

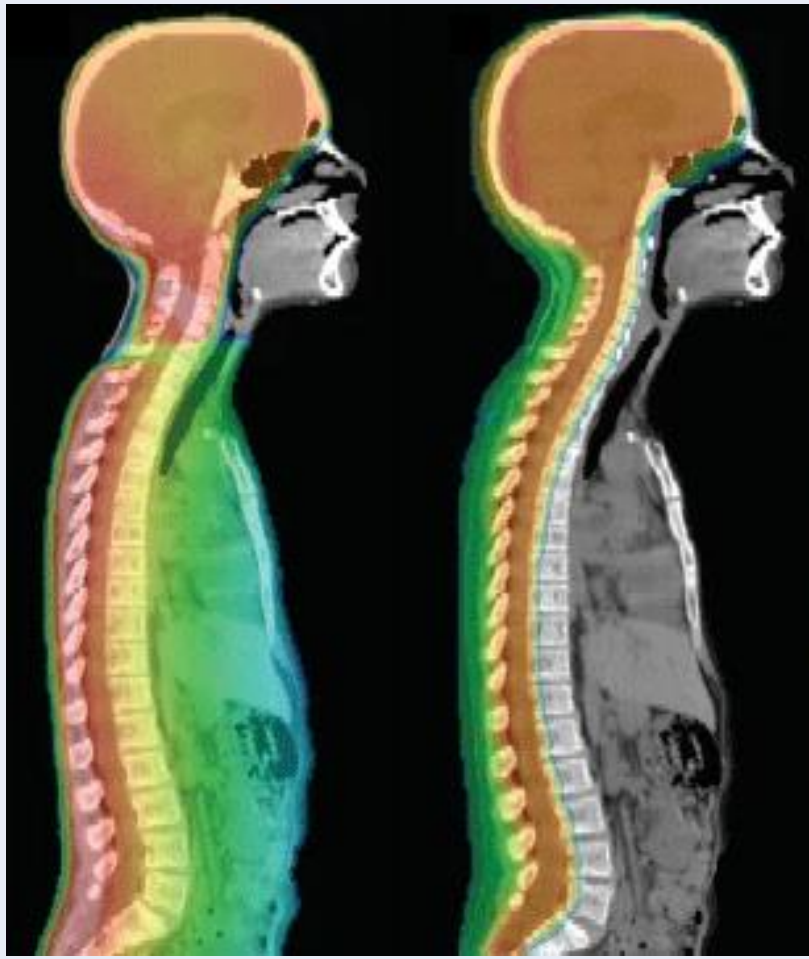
brain and head and neck region tumors

other localizations in vicinity of critical vital organs

Heavy ions – possibility to treat tumors that are otherwise radioresistant to conventional radiation therapy, such as gliomas and sarcomas.







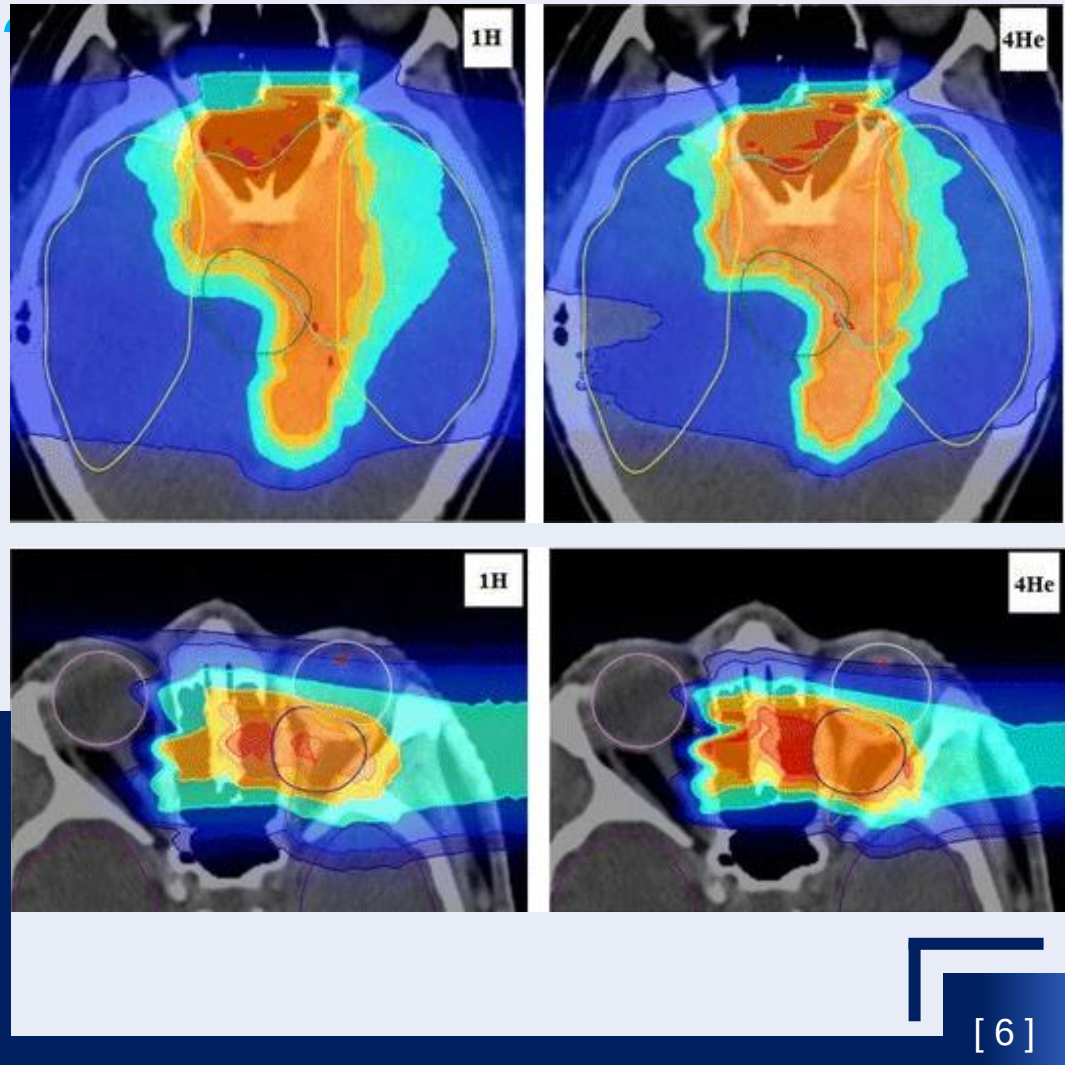
Source: Rowe LS, Krauze AV, Ning H, Camphausen KA, Kaushal A. Optimizing the Benefit of CNS Radiation Therapy in the Pediatric Population-PART 2: Novel Methods of Radiation Delivery. Oncology (Williston Park). 2017 Mar 15;31(3):224-6, 228.

Helium ion therapy

Helium ions are «returning» to the horizon of novel particle therapy treatments

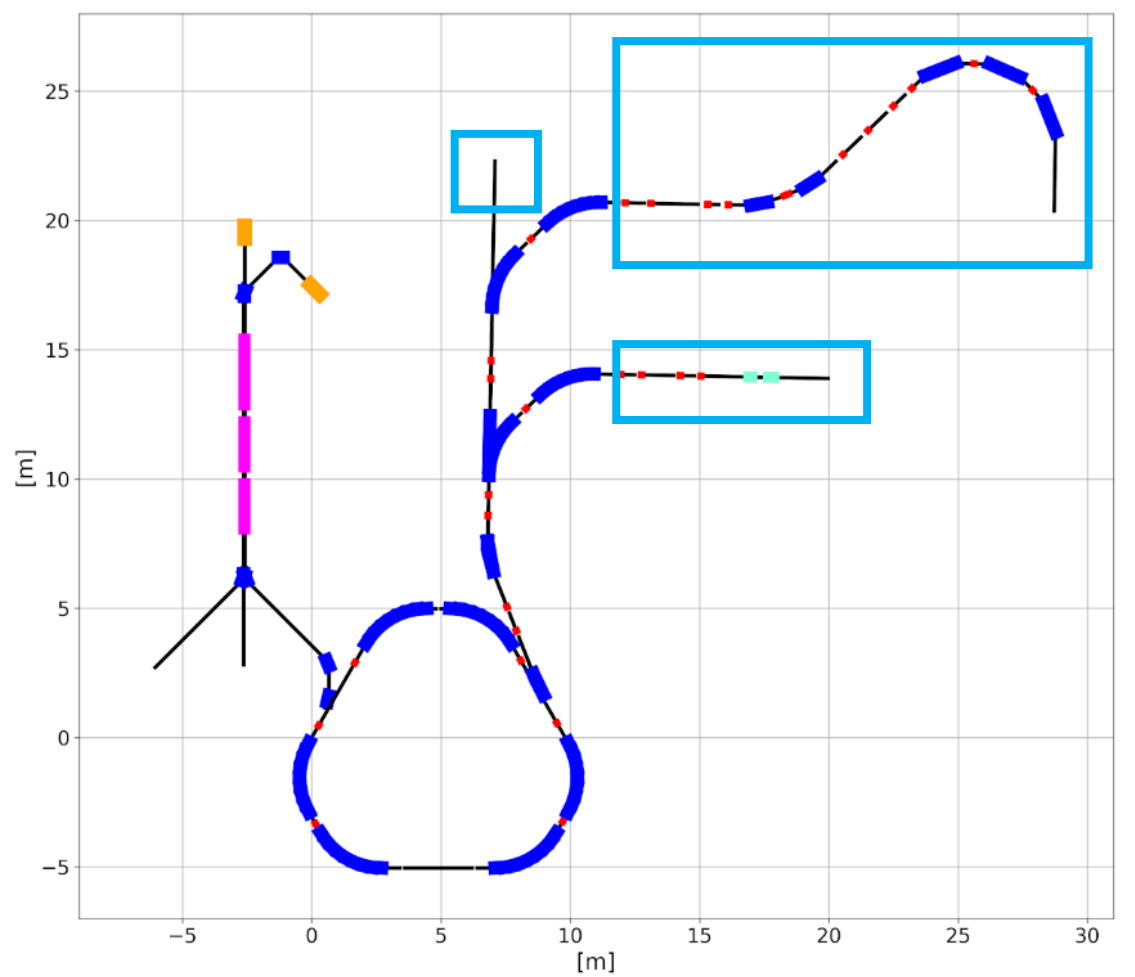
Why **helium-4 ions** over **protons**?

- Decreased lateral scattering and range straggling – **better conformality**
- **Increased radiobiological** effect
- **Increased LET** – possibilities to **overcome low-level hypoxia**
- *From physics perspective* – lower neutron dose associated risks



In terms of radiobiological effect and dose conformality – **golden compromise**

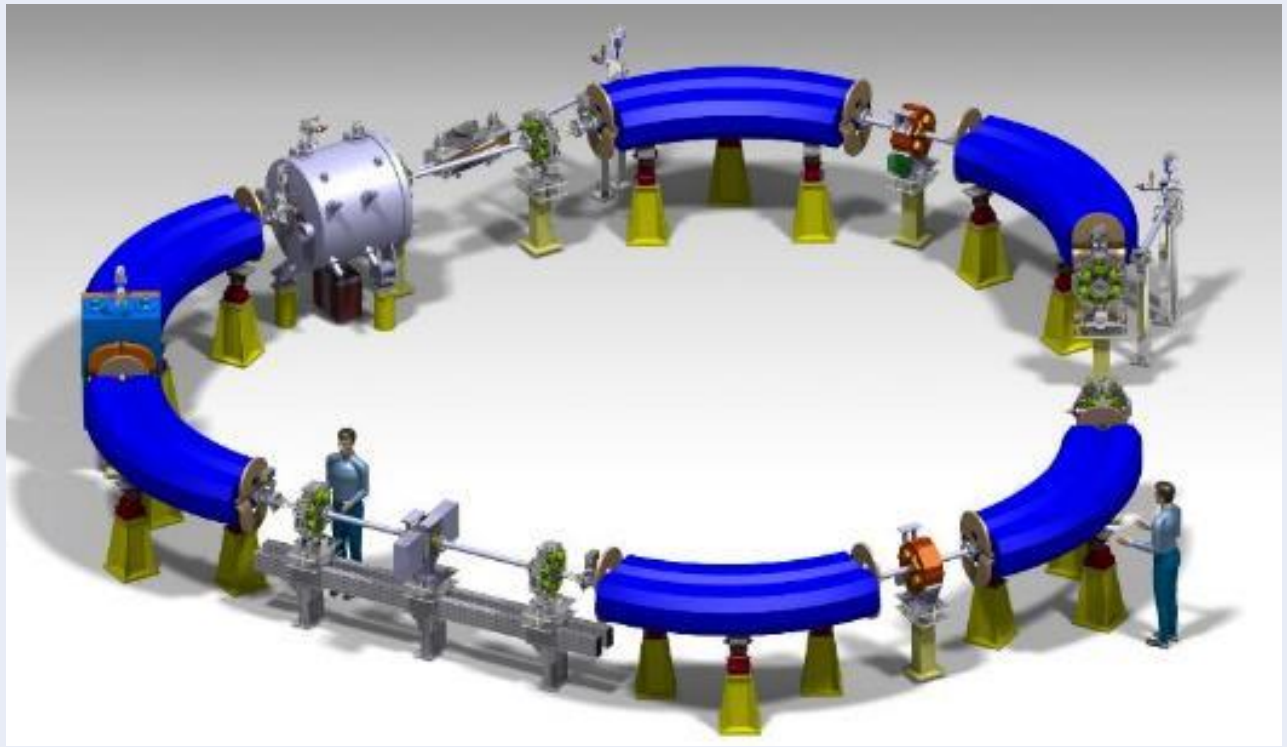
Helium synchrotron



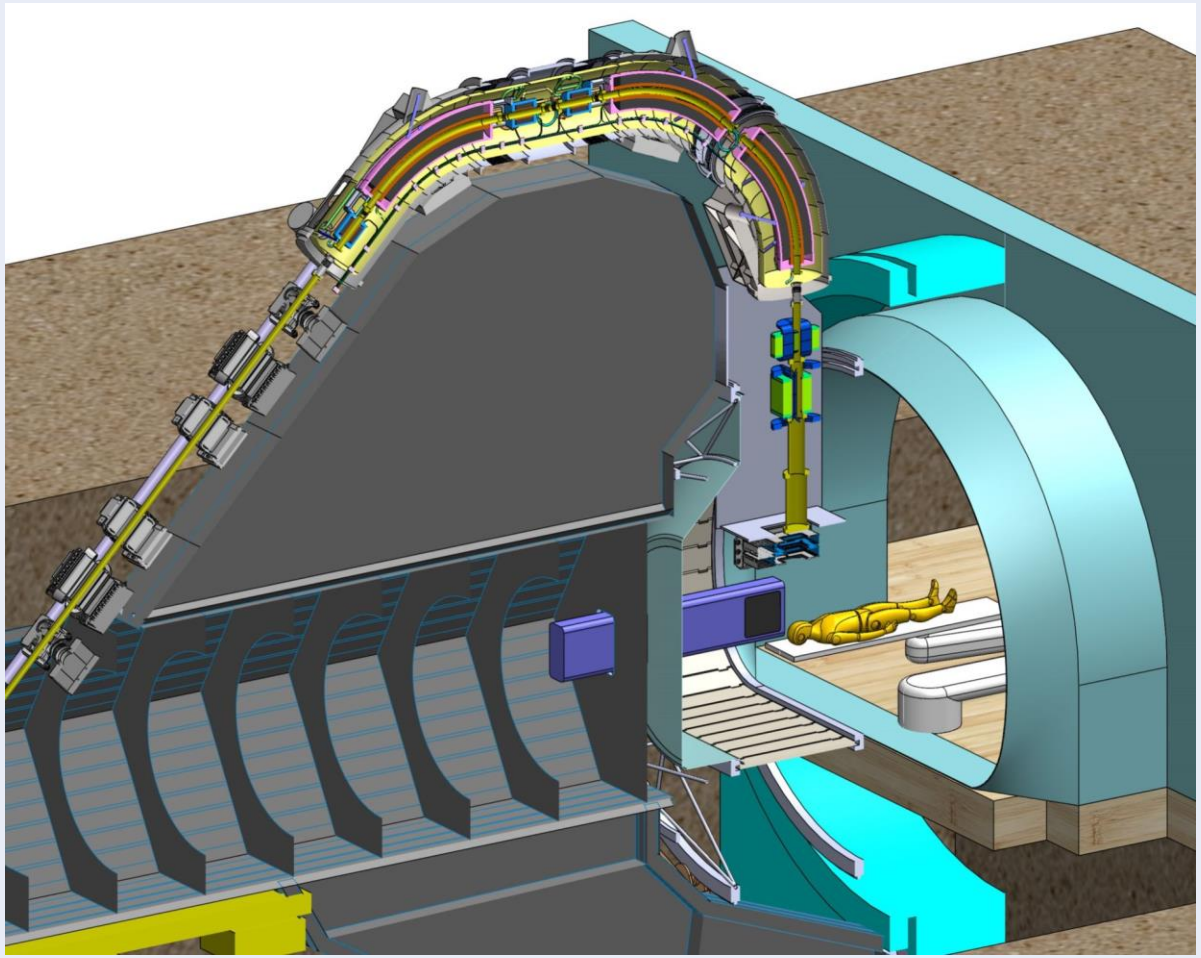
Design by *Mariusz Sapinski, Elena Benedetto and Maurizio Vretenar*

- Ion sources providing both **protons** and **helium-4** ions, option to use heavier ions (carbon, oxygen) for biophysical research in the future
  - – He-4 ions: max 220 MeV/u
  (30 cm treatment range)
  - – Protons: max around 700 MeV
  (possibilities for proton radiography)
- Possibility for parallel radioisotope production (*investigated – 7 MeV/u alphas)*
- **One static horizontal beam-line**, for possibility of expanding with rotating couch/chair system + vertical CT
- **One rotating gantry beam-line**, for multiple angle delivery. RTU working on a carbon ion gantry design – for ^{4}He - **decreasing to 2.8 T** superconducting magnets.
- **One beam-line dedicated for research**

Visualizations



Courtesy of Maurizio Vretenar (CERN)



Courtesy of Luca Piacentini (RTU, CERN)

Radioisotope production

Why **linear accelerator based production?**

Compared to conventional cyclotron production, linear accelerators could offer more efficient and less demanding *(decreased beam losses and lower shielding neccessities)* **especially** for production with **alpha and deuteron beams**

The need to couple particle therapy with nuclear medicine

…Diagnostics capabilities **essential for modern cancer therapy** ([^{18}F]-FDG) and **possibilities of providing novel treatment techniques** – dose painting, selective avoidance of functionally active organ-at-risk regions, tumor hypoxia estimation and incorporation in treatment planning

Radioisotope	Usage of radioisotope
Scandium-43	Diagnostic – PET
Scandium-44	Diagnostic – PET
Cobalt-57	Diagnostic – SPECT
Copper-64	Theranostic (β^-)
Copper-67	Theranostic (β^-)
Indium-111	Diagnostic – SPECT
Tin-117m	Theranostic (β^-)
Samarium-153	Theranostic (β^-)
Rhenium-186	Theranostic (β^-)
Astatine-211	Therapeutic (α)

Radioisotopes of interest

Scandium-43 and Scandium-44

PET diagnostic alternative of gallium-68

Copper-64 and Copper-67

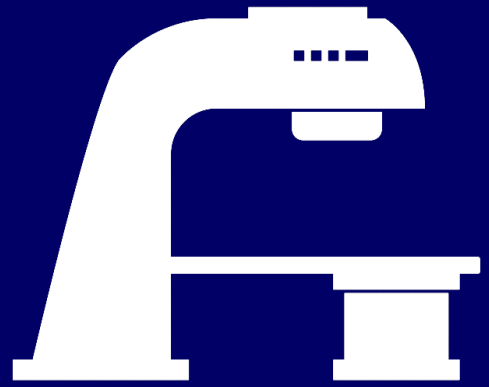
Theranostic pair, replacing diagnostic gallium-68 and therapeutical lutetium-177 capabilities

Astatine-211

Potential radioisotope for targeted therapy – 100% alpha particle emission, no toxic daughter products and SPECT quantification (77-92 keV)

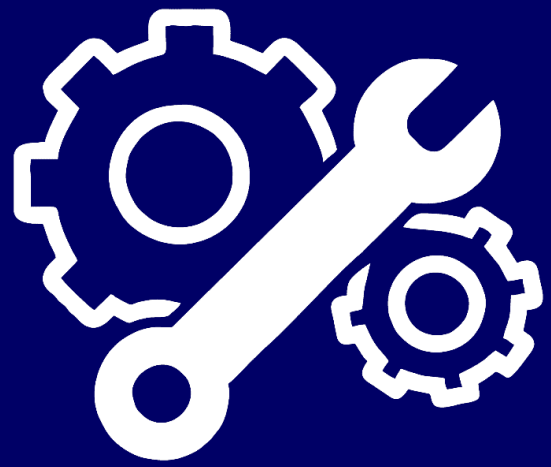
Not just the clinical facility

Research institution



Clinical cancer treatment facility

Particle therapy and nuclear medicine



Industry involvement infrastructure

Research directions . . .

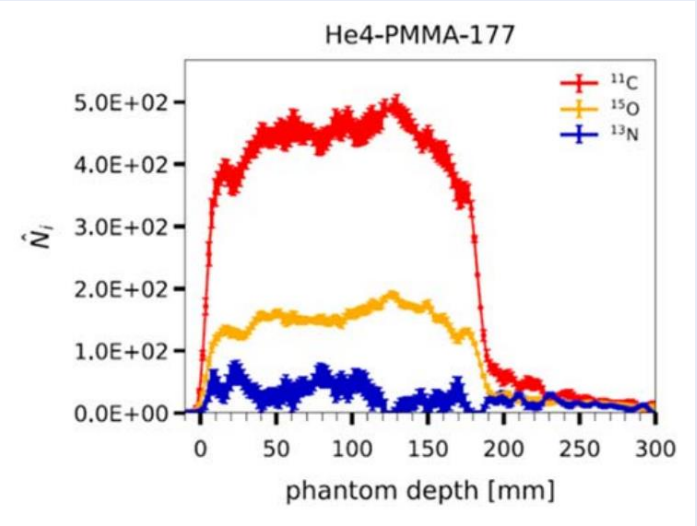
All necessary clinical and pre-clinical research for helium therapy

Ion therapy treatment associated research directions:

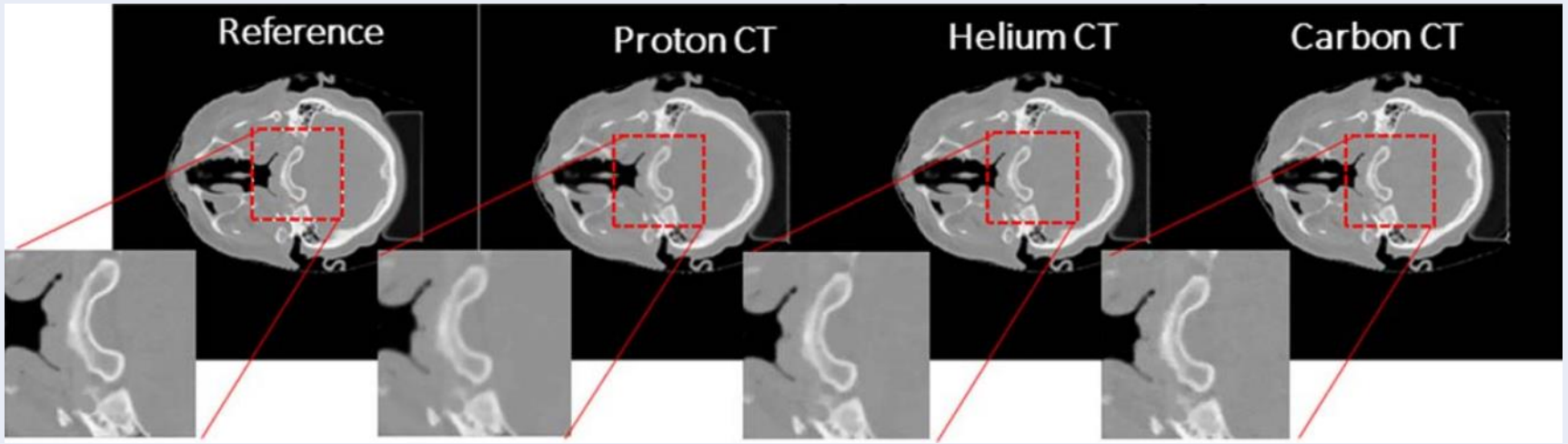
- Medical physics aspects and dosimetry, radiobiology
- Material science, nuclear physics
- Accelerator technology and physics
- Novel treatment technique development activities

Other research directions:

- Radioisotope production, radiation chemistry
- Material science for target design of radioisotope production



In-vivo range verification: positron emitters and gamma emmisions



Ion radiography and tomography: proccessing algorithms and detector design

Source:Mairani A, Mein S, Blakely E, Debus J, Durante M, Ferrari A, Fuchs H, Georg D, Grosshans DR, Guan F, Haberer T, Harrabi S, Horst F, Inaniwa T, Karger CP, Mohan R, Paganetti H, Parodi K, Sala P, Schuy C, Tessonnier T, Titt U, Weber U. Roadmap: helium ion therapy. Phys Med Biol. 2022 Aug 5;67(15).

Where we are ?

End of 2022 : Bilateral meetings with relevant medical associations, universities and political stakeholders

therapeu ology associatio in Latvia and L ia

Concluding remarks

For more information:
we welcome you to explore
https://indico.cern.ch/category/16259/

A unique proposal for large-scale scientific and clinical infrastructure development in the Baltic States –
not an opportunity to be missed!

Thank you again for your attention and enjoy rest of the week!

Opportunities for Graduates

Early Career Professionals

ORIGIN TAKE PART!

ORIGIN: the point or place where something begins.

DURATION? 6 – 36 months

WHEN? 4x/year selection moments: November – March – May – August

WHO? Member States and Associated Member States candidates

HOW? 2 jobs (Technical/administrative certificate & Bachelor/Master)

WHAT? On-the-job learning with support and guidance from supervisor and team

> The smartest way to kick-start your career and give it real momentum.

ORIGIN (eligibility)	Total stipend	CHIS contribution	PF contribution	Take-home
Specialised studies/technical degree < 2 years (! incl. admin profiles)	4500	216	699	3535
Bachelor degree < 2 years	5000	243	699	4058
Master degree < 2 years	5500	267	699	4534

Project Graduates

QUEST
TAKE PART!

QUEST: an intellectual pursuit of knowledge.

DURATION? 6 – 36 months

WHEN? 2x/year selection moments: March – October

WHO? Member State and Associated Member State candidates
(Non-Member State exceptionally possible)

HOW? Specific job description for one project

WHAT? Work on well-defined project from A to Z with clear deliverables
Deepen your expertise
Expand your professional network by working with the best
Opportunity to supervise student

> "Deepen your knowledge and expertise faster than anywhere else.

QUEST (eligibility)	Total stipend	CHIS contribution	PF contribution	Take-home
Master degree 2 – 4 years	6050	294	699	5057
Master degree 4 – 6 years or PhD 0 – 3 years	6650	323	699	5628

Research Fellows

DURATION? 6 – 36 months

WHEN? 2x/year selection moments: November – May

WHO? Member State and Associated Member State candidates, limited number for Non-Member State

HOW? Research topic to be submitted, 2 jobs (Cat. 1: PhD + 6 & Cat. 2: PhD + 3)

WHAT? Establishing credibility and gaining international exposure

Research Fellows (eligibility)	Total stipend	CHIS contribution	PF contribution	Take-home
PhD 0 – 3 years	6650	323	699	5628
PhD 3 – 6 years	7050	343	699	6009

Opportunities for Students

Short-term Internship Programme

100 positions / year

Fields: Applied physics, engineering, computing

Length: up to 6 months

Eligibility: be a full-time student at undergraduate level (post-secondary)

This includes: Technical/Vocational qualifications, Associate degree, Bachelor and Masters' degrees.

Features: A technical project with a CERN supervisor, and a living allowance of 1,516 Swiss Francs per month.

Timeline: Applications will re-open in November 2022

Technical Student Programme

200 positions / year

Fields: Applied physics, engineering, computing

Length: 4 to 12 months

Eligibility: Completed 18 months of undergraduate studies before applying

Features: A technical project with a CERN supervisor, and a living allowance, incl. health insurance, 3319chf/month

Timeline: Applications will re-open at the end of August 2022 with a deadline on November 7th 2022

Technical Student Programme

Mechanical Engineering	Human Robot Interface Development
	HL-LHC collimators technical support
Applied Physics	Electron Cooling studies in AD and ELENA
	Vacuum design and simulations for a Hollow Electron Lens in the LHC
IT, Mathematics, Robotics	Full-Stack Developer
	Evolution of Software Tools
Material and Surface Science	Thermo-mechanical characteristics of advanced materials up to 2000°C
	Vacuum compatibility studies of mild steel
Electrical or Electronics Engineering	FPGA development for radiation testing
	Modeling of LHC superconducting magnet circuits
General and Civil Engineering	Geographical Information System for FCC

Administrative Student Programme

30 positions / year

Fields: translation, human resources, advanced secretarial work, logistics, law, finance, library and information science, engineering management, science communication, education, audiovisual, communication and public relations are some examples!

Length: 2 to 12 months

Eligibility: Completed18 months of undergraduate studies before applying

Features: Living allowance incl. health insurance, training, on-the-job learning, 3319chf/month

Timeline: Applications will re-open at the end of August 2022 with a deadline on November 7th 2022

Summer Student Programme

300 positions / year

Fields: Physics, engineering, computing

Length: 8 to 13 weeks, during the summer

Eligibility: 3 years of full-time undergraduate studies

Features: High-quality lecture programmes, visits, and workshops, 90chf/day

Timeline: Applications will re-open in November 2022 with a deadline to apply in January 2023 and the selection will be confirmed in April 2023.

Doctoral Student Programme

80 positions / year

Fields: Applied physics, engineering, and computing

Length: 6 months - 3 years

Eligibility: Enrolled in a doctoral programme

Features: A technical project, leading to a PhD thesis co-supervised by the university thesis advisor and a CERN staff member. A living allowance, incl. health insurance. 3719chf/month

Timeline: Applications will re-open at the end of August 2022 with a deadline on November 7th 2022.