Advanced particle therapy for Cancer treatment in the Baltics

Prof. Toms Torims

Chairman of the CERN Baltic Group

CERN Baltic Group

We are ready to stand at the side of those who need us

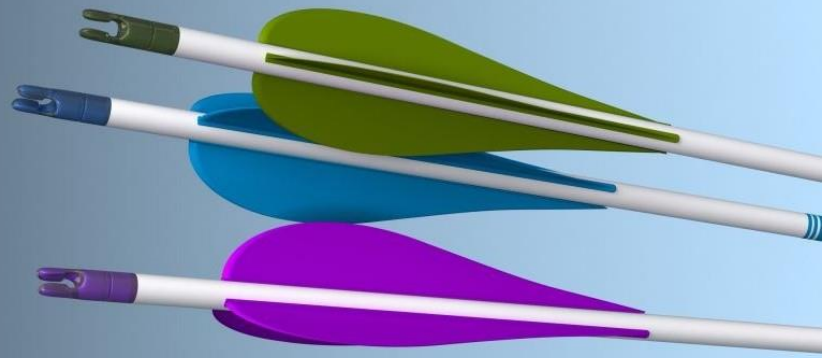
- Riga Technical University
- University of Tartu
- Vilnius University
- University of Latvia
- National Institute of Chemical Physics and Biophysics
- Kaunas University of Technology
- Riga Stradinš University
- Tallinn University of Technology
- Vytautas Magnus University

+Lithuanian University of Health Sciences
+Tartu University Hospital

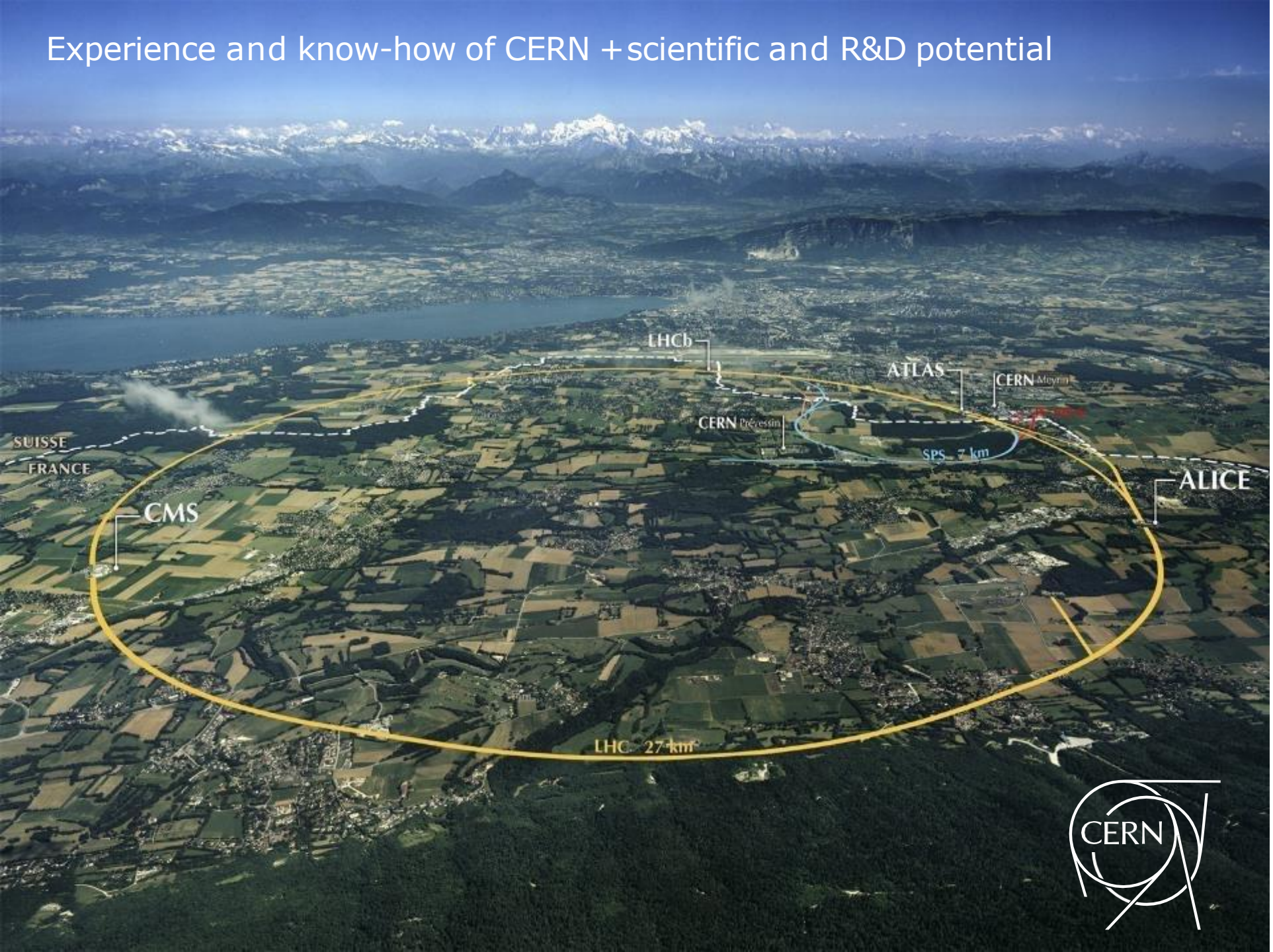
Joint flagship project

We are strong together

Advanced Particle Therapy Center in Baltics



Experience and know-how of CERN + scientific and R&D potential



Next Ion Medical Machine Study

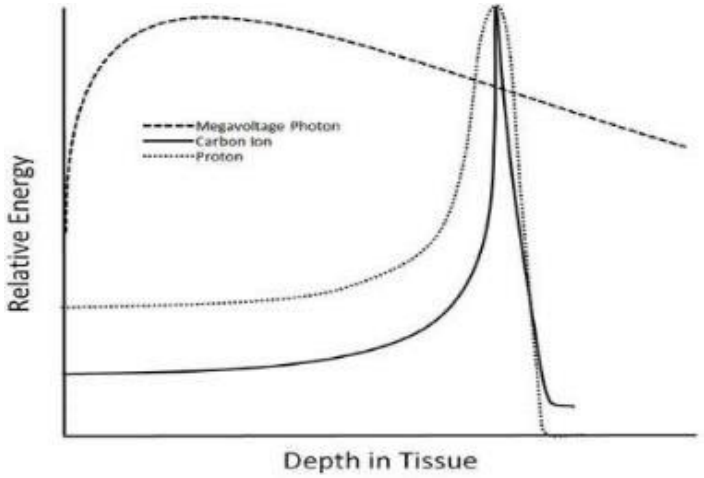
@ CERN

nimms

HITRI plus

Heavy Ion Therapy Research Integration

Therapy of cancer with particle beams

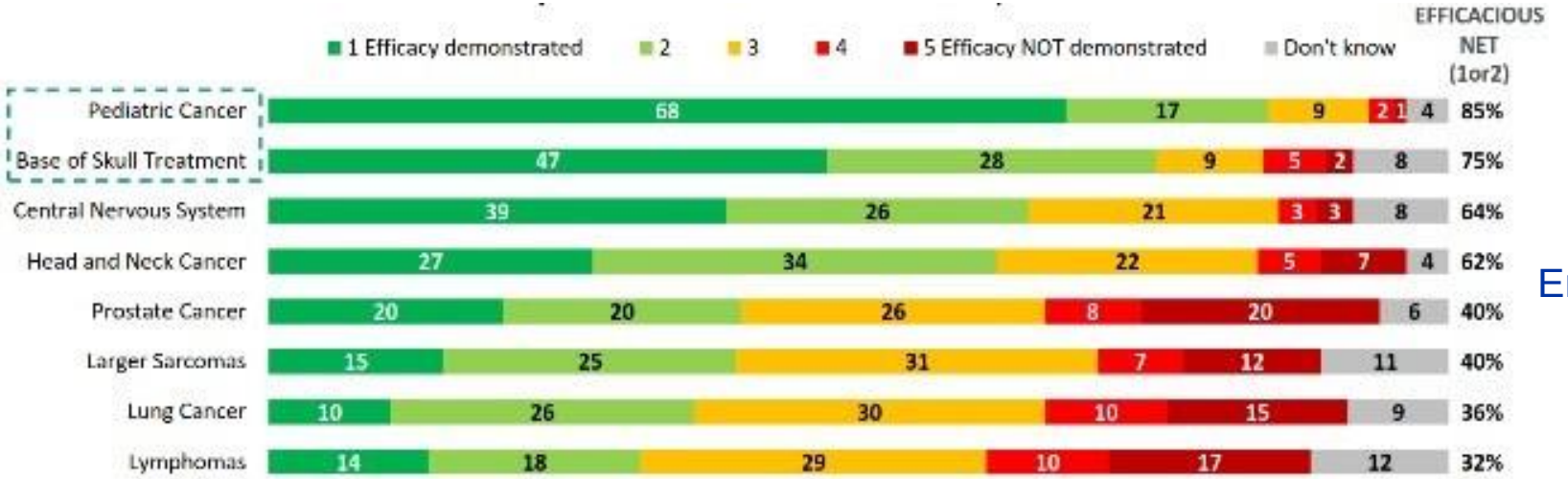


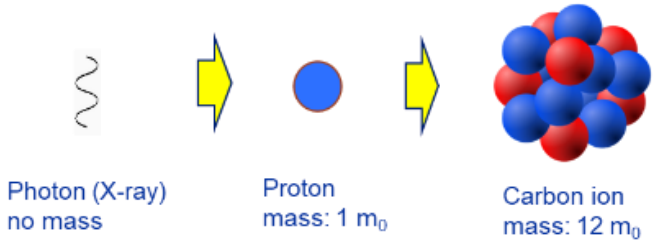
Protons and heavier ions present a characteristic **Bragg peak:** particles deposit energy at a given depth corresponding to its energy

Can destroy a cancer with minimum damage to the surrounding tissues

Proton therapy is now recommended for many types of cancer, in particular for children covered by health insurance in most EU countries

Source: IBA proton therapy fact-sheet





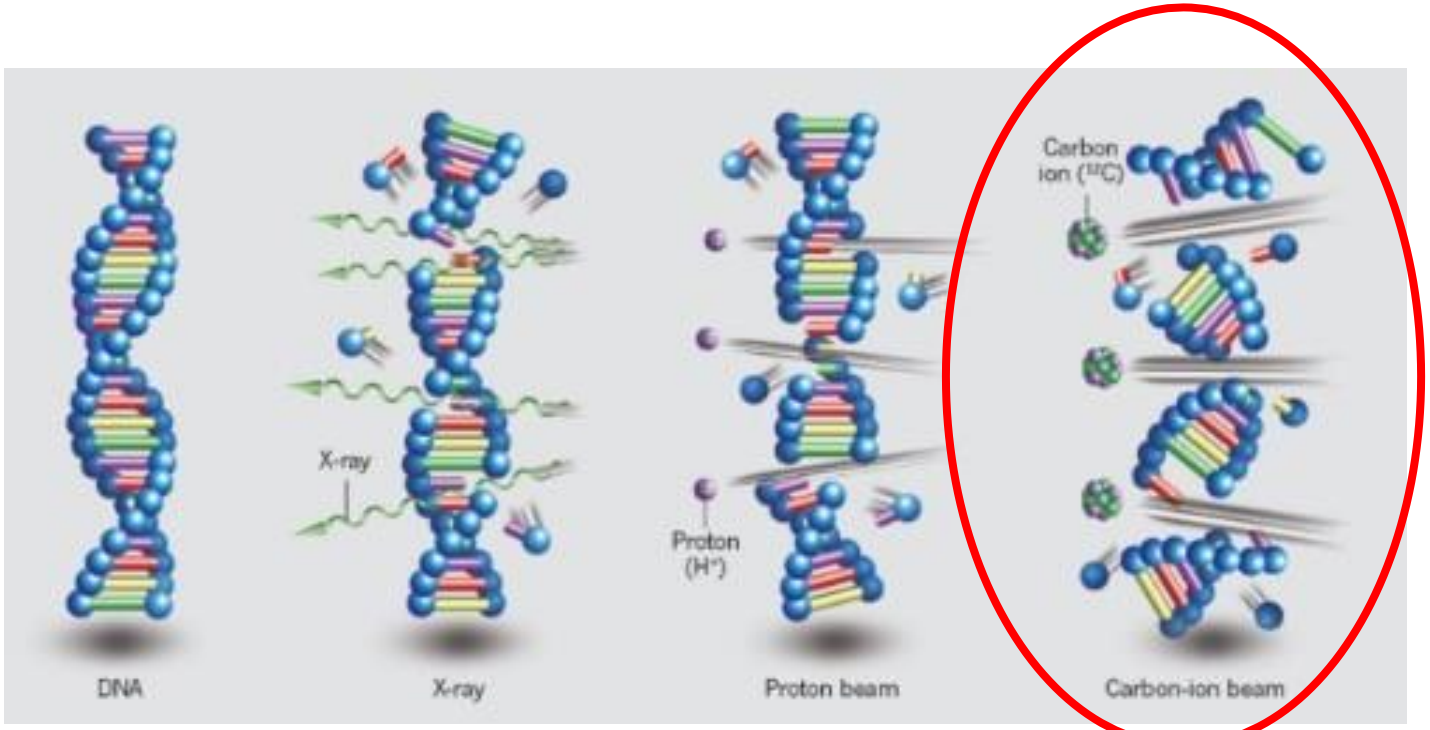
Energy deposition of X-rays, protons, carbon ions

New opportunities: FLASH therapy

Cancer therapy with heavier ions

Heavy ions are **more effective than protons or X-rays** in attacking cancer:

1. Higher energy deposition results in a large number of **double-strand DNA breakings** that are not reparable by the cell itself
2. **Energy deposition more precise**, with lower straggling and scattering
3. Recent studies show that ion therapy combined with immunotherapy may be successful in treating diffused cancers and metastasis



Marx, V. (2014, April 4). Sharp shooters. 508. Nature, p. 137.

Patients are treated with Carbon ions since 1994, but much research is still needed, in terms of optimisation of ion type, delivery modality, new techniques (flash), integration of dosimetry, etc.:

Ion treatment is still in its infancy!

Present and the future

The main limitation to the diffusion of ion therapy is the cost and size of the accelerator

Only 4 ion therapy facilities operating in Europe (+ 6 in Japan, 3 in China, 1 in construction in US)

➢CNAO and MedAustron based on a **design** started **at CERN** in 1996. 1st patient at CNAO in 2011.

➢ HIT and MIT based on a **design** started **at GSI** (Germany) in 1998 . 1st patient at HIT in 2009.

Layout of the Heidelberg Ion Therapy facility

Technology has made a huge progress in the last 20 years - developing new more compact and less expensive accelerator designs

Baltics **today** can benefit form the new accelerator designs and to implement the latest advances in accelerator technologies

All ion facilities worldwide operate with Carbon but there is a strong interest in **lighter ions like Helium** that could keep the advantages of carbon but require a smaller machine

Geography of particle therapy in Europe

Only 2 areas in Europe without particle therapy facilities:

- South East Europe
- Baltics

Per end of 2020 more than 290'000 patients have been treated worldwide with Particle Therapy,

close to 250'000 with protons, close to 40'000 with C-ions and about 3'500 with He, pions and with other ions.

Particle therapy centres in Europe. Courtesy of ENLIGHT, 2020

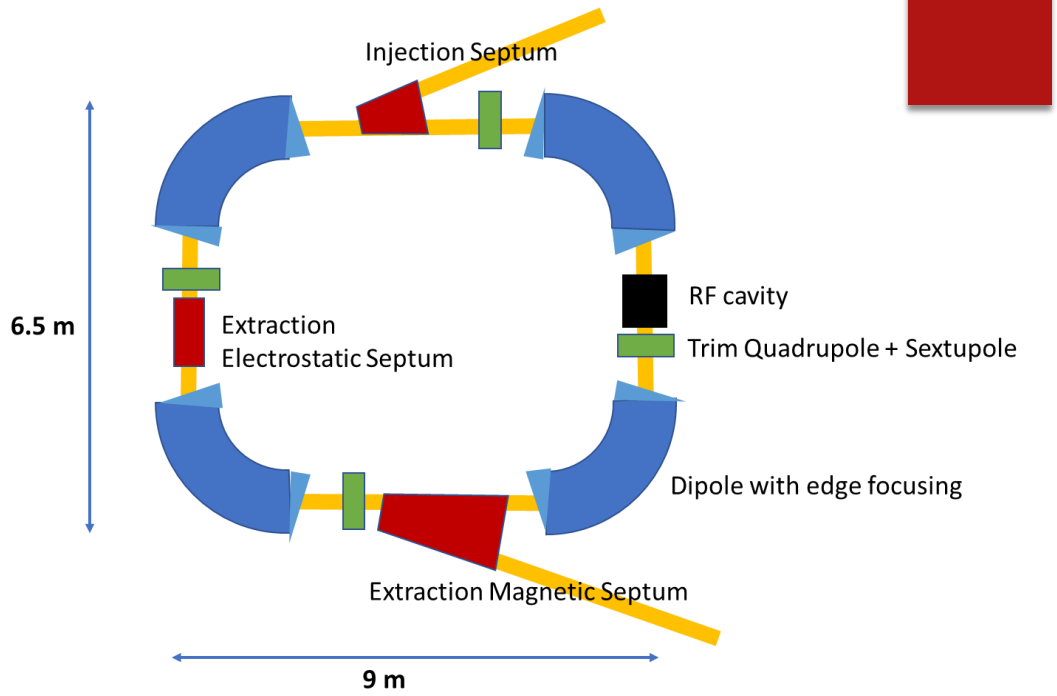
Flagship project for the Baltics

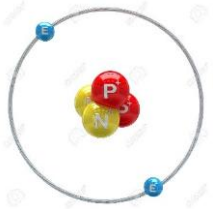
An advanced facility that could open the way to new ion therapy treatments (e.g. with Helium), providing:

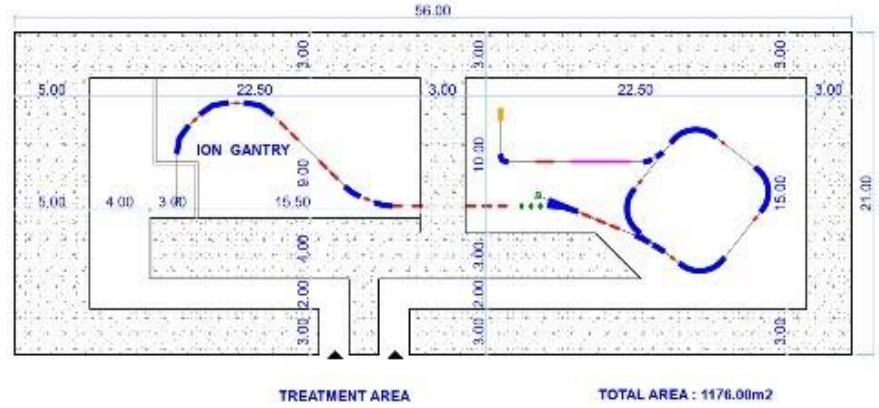
- treatment of patients
- A research programme on cancer therapy with particle beams (and isotopes)
- Parallel production of radioisotopes for imaging and therapy;
- New beam delivery techniques like FLASH;

and:

- avoiding competition with existing projects
- at an acceptable cost
- providing a frame for regional (Baltic) and international collaboration







A single-room facility with compact He synchrotron and superconducting gantry


Proton centres
C-ion centres
We can change that!
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RUSSIA
NORWAY
SWEDEN
IRELAND
UNITED KINGDOM
BELARUS
KAZAKHSTAN
POLAND
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