



# RTU HEP & AT centre activities in Accelerator Projects

Andris Ratkus

Accelerator Technology Group Leader

12.10.2022



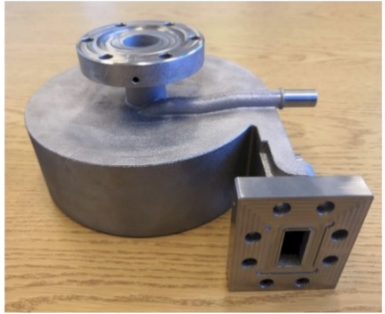
VPP-IZM-CERN-2020/1-0002

# Research directions

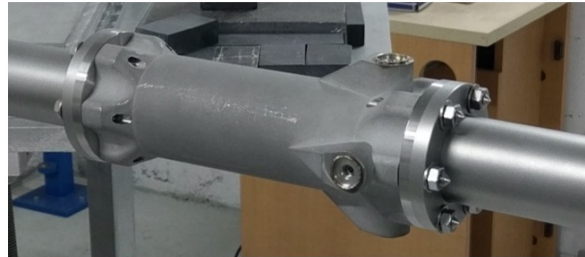
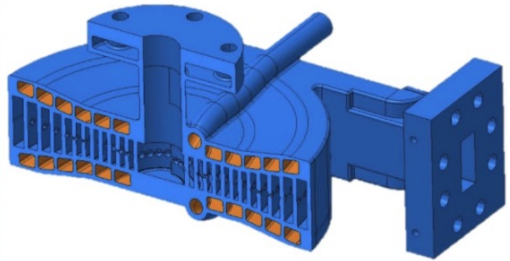


# Research directions

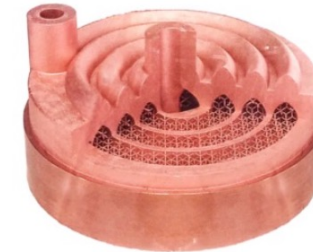
- Innovation and development of accelerator technologies



CERN



IJCLab



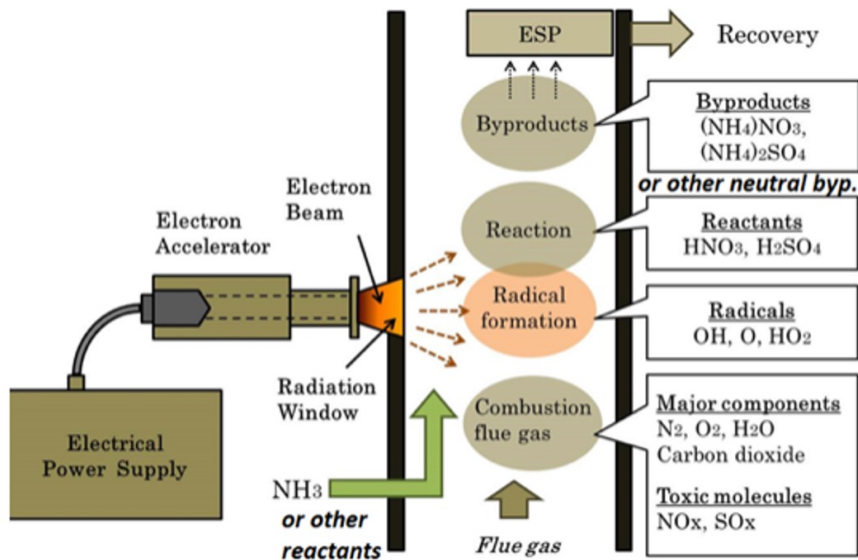
INFN PD



Fraunhofer IWS

# Research directions

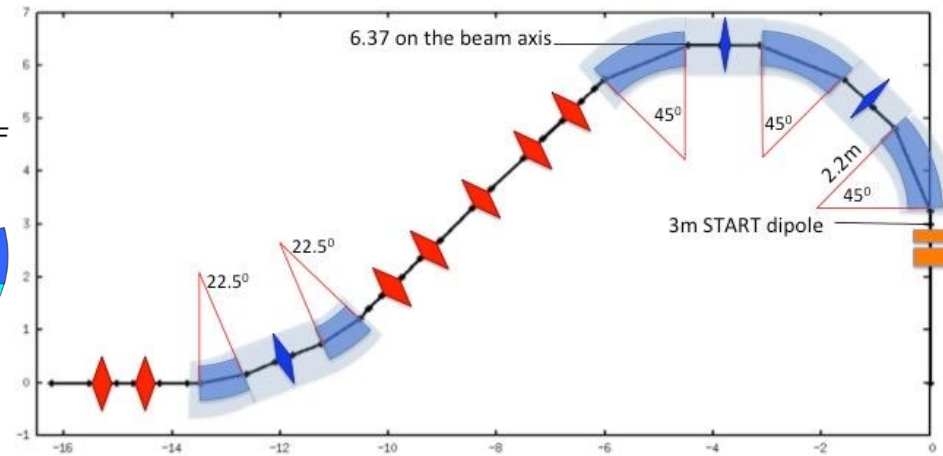
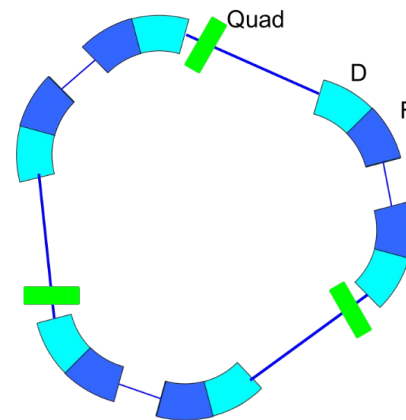
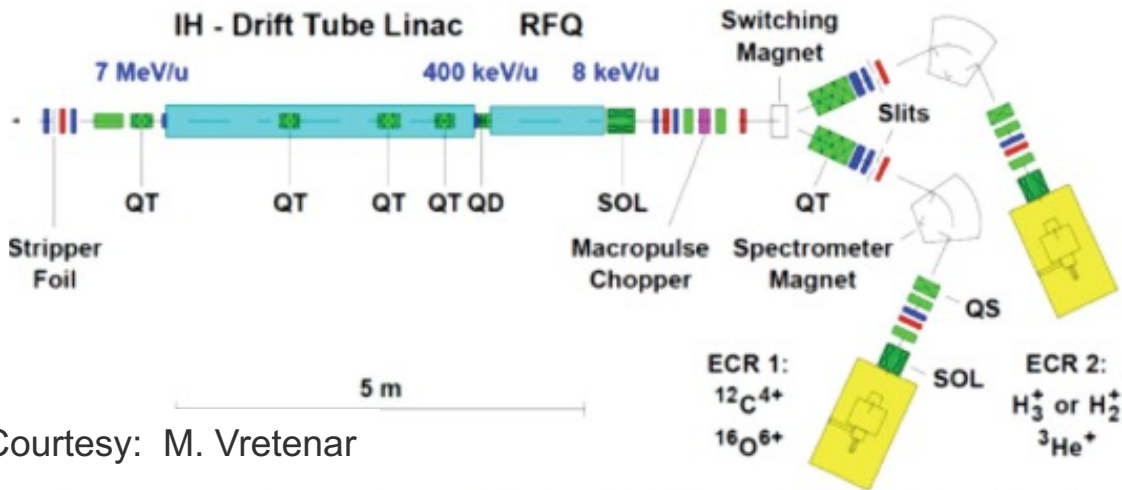
- Innovation and development of accelerator technologies
- Accelerator environmental applications



Courtesy: T.Torims

# Research directions

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



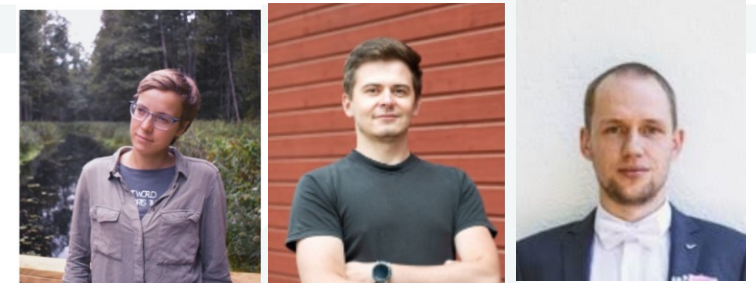
Courtesy: M. Vretenar

# Accelerator Technology Team



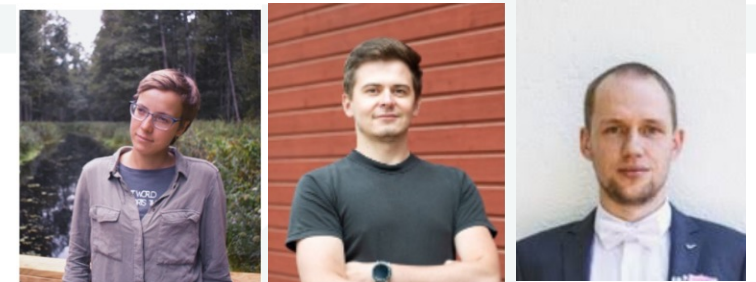
# Accelerator Technology Team

- Prof. Toms Torims
- Guntis Pikurs PhD student
- Dr. Andris Ratkus
- Jānis Vilcāns PhD student
- Luca Piacentini PhD student
- Lazar Nikitović PhD student
- Dagnija Kroģere MSc student
- Kristaps Paļskis PhD student
- Viesturs Lācis MSc student



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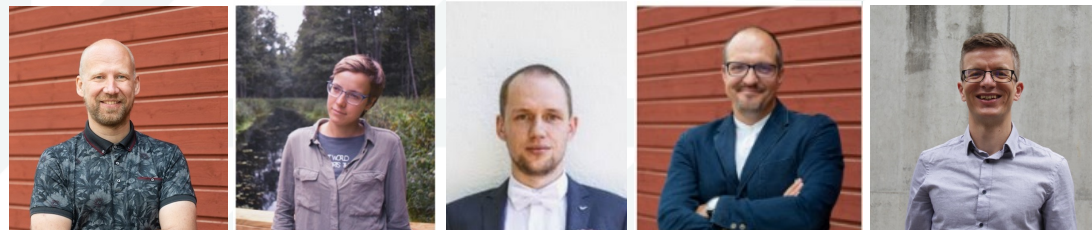
# Accelerator projects

The background features a light blue, abstract geometric pattern. It consists of several thick, parallel lines that intersect to form a series of overlapping, elongated rectangular shapes. The lines are oriented at various angles, creating a sense of depth and movement. The overall effect is a modern, minimalist design that complements the text.

# Innovation Fostering in Accelerator Science and Technology (I.FAST)

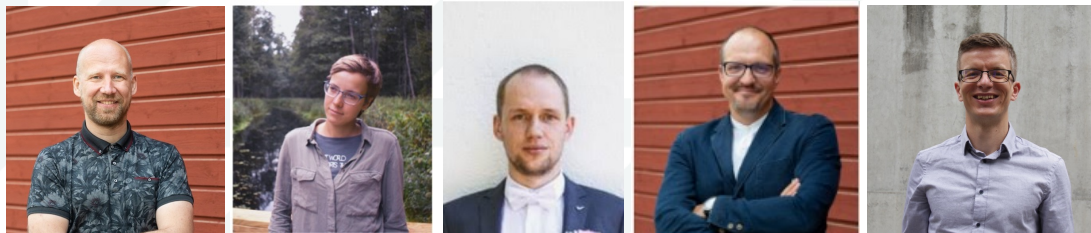


- **WP1: Management, coordination and dissemination**
  - Task 1.2: Information Flow Management and Cross-coordination (Task Leader RTU)
- **WP10: Advanced Accelerator Technologies (Coordinator RTU)**
  - Task 10.1: Coordination and Communication (Task Leader RTU)
  - Task 10.2: Additive Manufacturing - 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



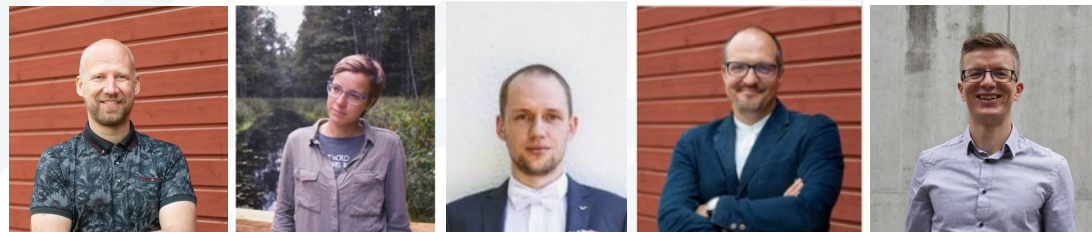
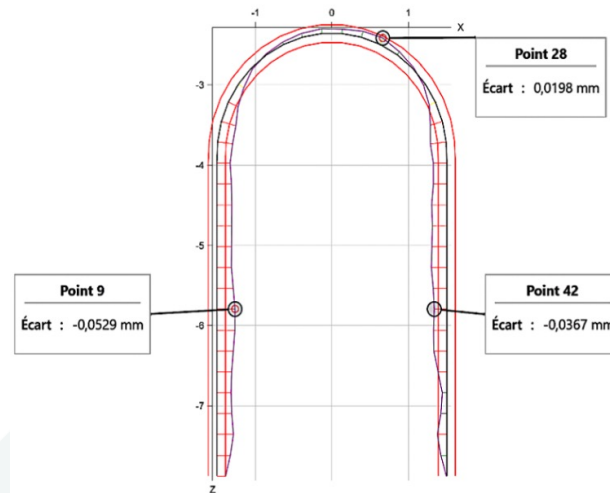
# I.FAST achievements

- Pure Cu (Cu-ETP) ¼ RFQ manufactured by AM



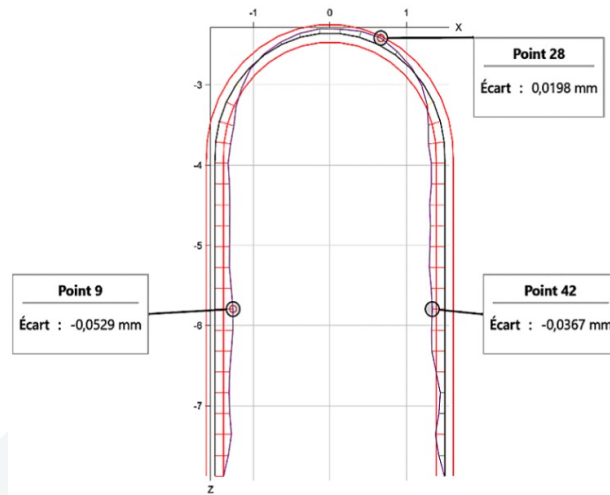
# I.FAST achievements

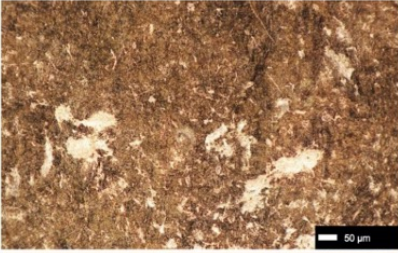
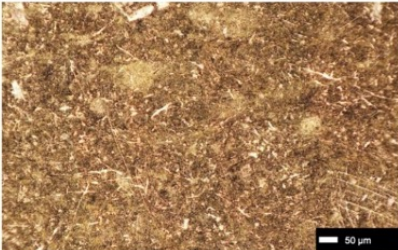
- Pure Cu (Cu-ETP) ¼ RFQ manufactured by AM

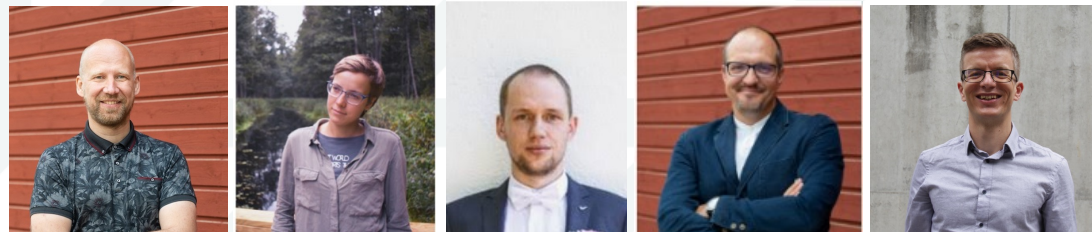


# I.FAST achievements

- Pure Cu (Cu-ETP) ¼ RFQ manufactured by AM

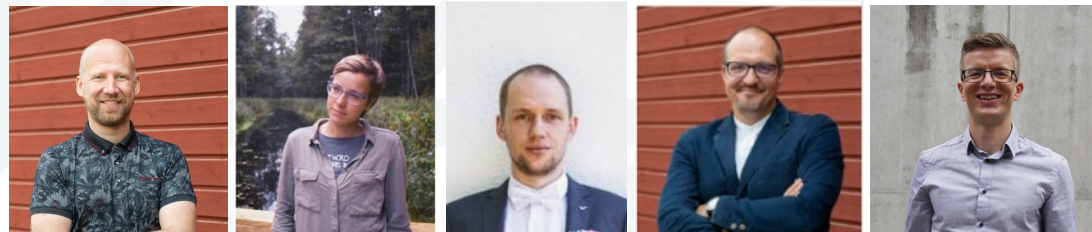
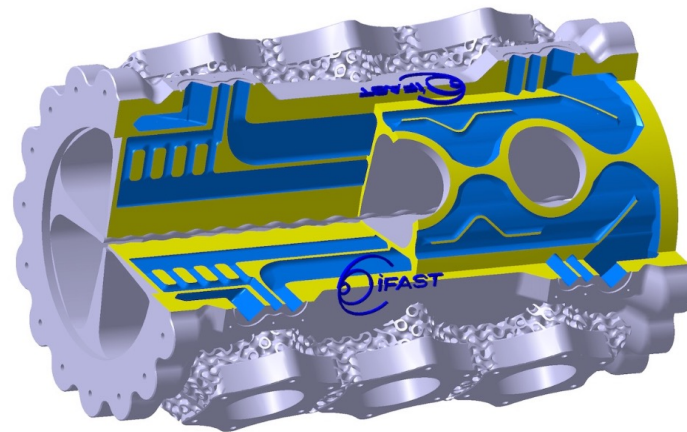
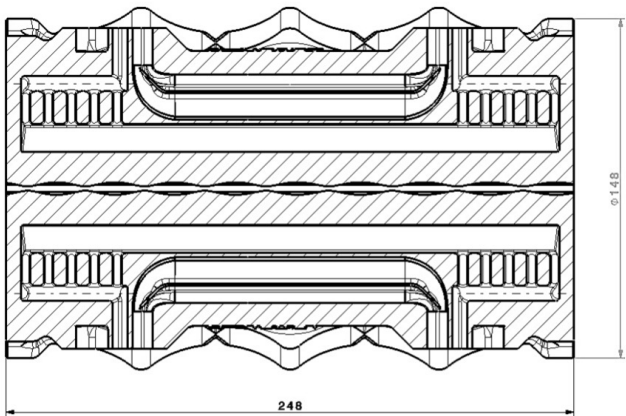


#1: mechanical treatment		<b>Ra (µm)</b> 0,28 ± 0,12
		<b>Rz (µm)</b> 2,09 ± 0,89
#2: chemically assisted process		<b>Ra (µm)</b> 0,28 ± 0,09
		<b>Rz (µm)</b> 1,56 ± 0,50



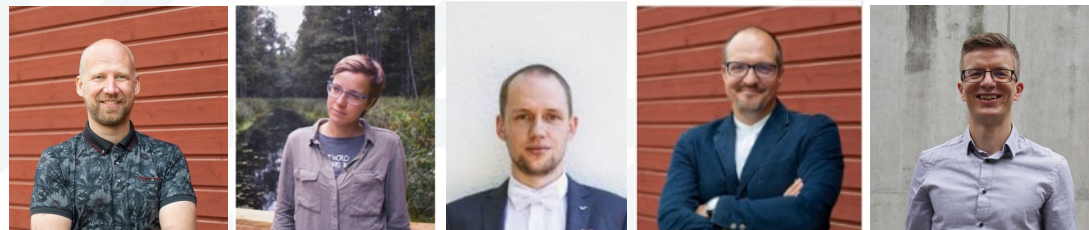
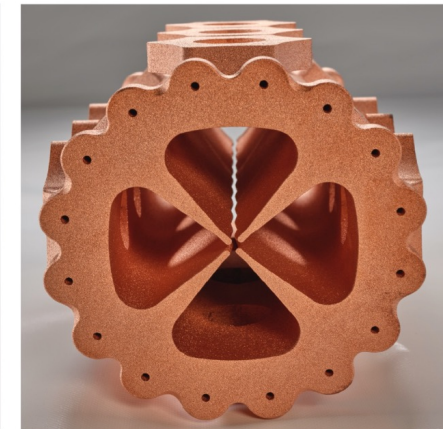
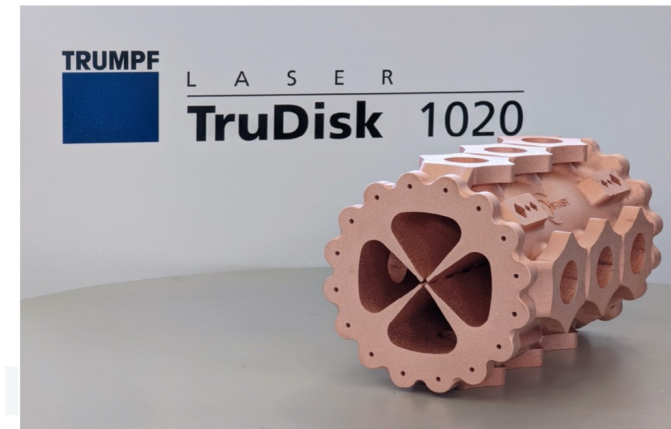
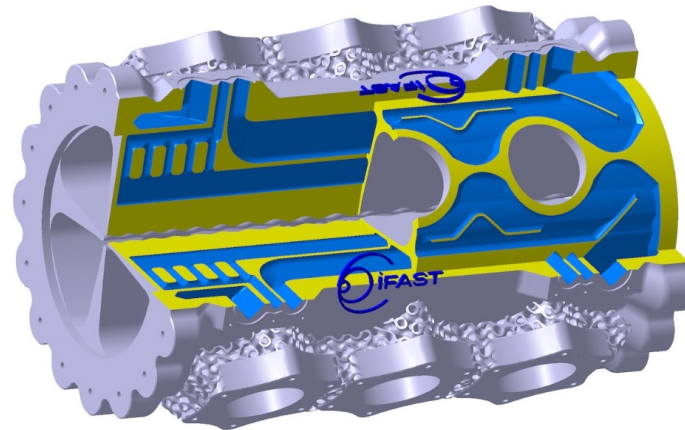
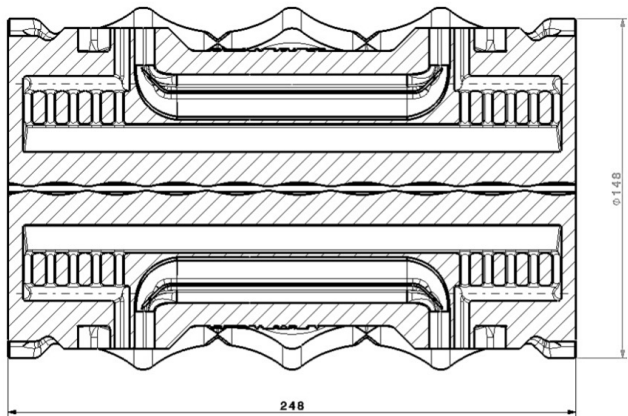
# I.FAST achievements

- Pure Cu (Cu-ETP) Full RFQ manufactured by AM



# I.FAST achievements

- Pure Cu (Cu-ETP) Full RFQ manufactured by AM



# Student thesis/contribution in 2<sup>nd</sup> CBC

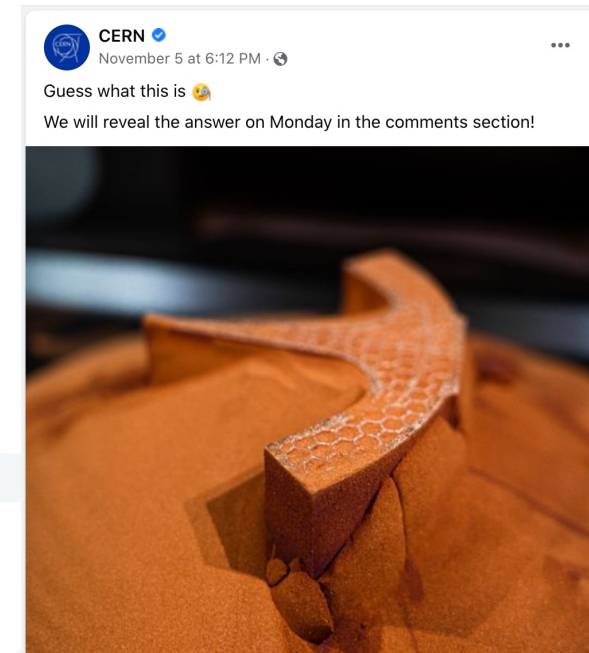


- **Guntis Pikurs PhD thesis/ [2<sup>nd</sup> CBC Presentation 12.10 @12:20:](#)**

Research on performance improvement of accelerator components by additive manufacturing

- **Viesturs Lācis MSc thesis/ [2<sup>nd</sup> CBC Presentation 12.10 @14:20:](#)**

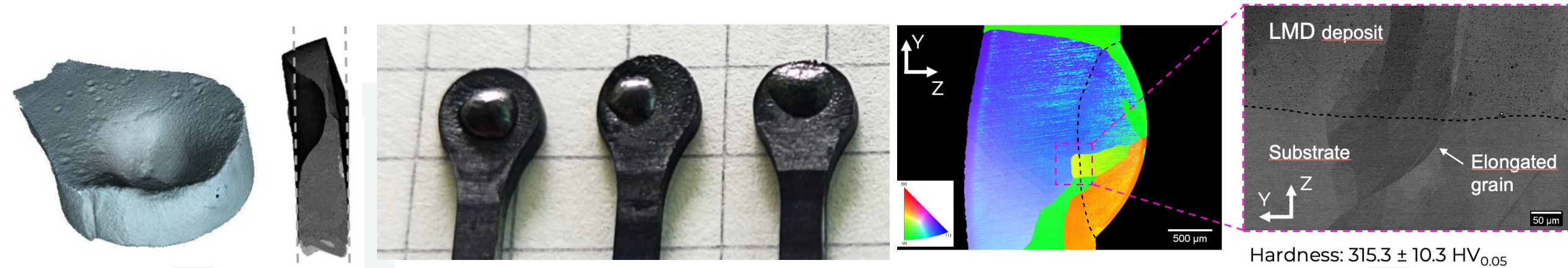
Laser Polishing of Additively Manufactured RFQ Prototype





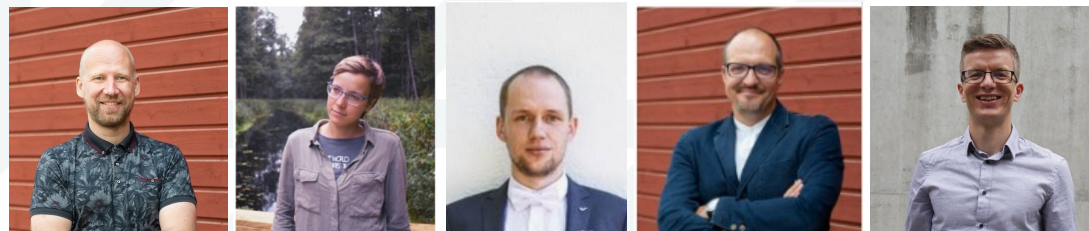
# I.FAST achievements

- Ta cathodes repair by two AM technologies



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

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



Riga Technical University



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



Based on promising results of the ARIES PoC (*Development of hybrid electron accelerator system for the treatment of marine diesel exhaust gases*)

**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

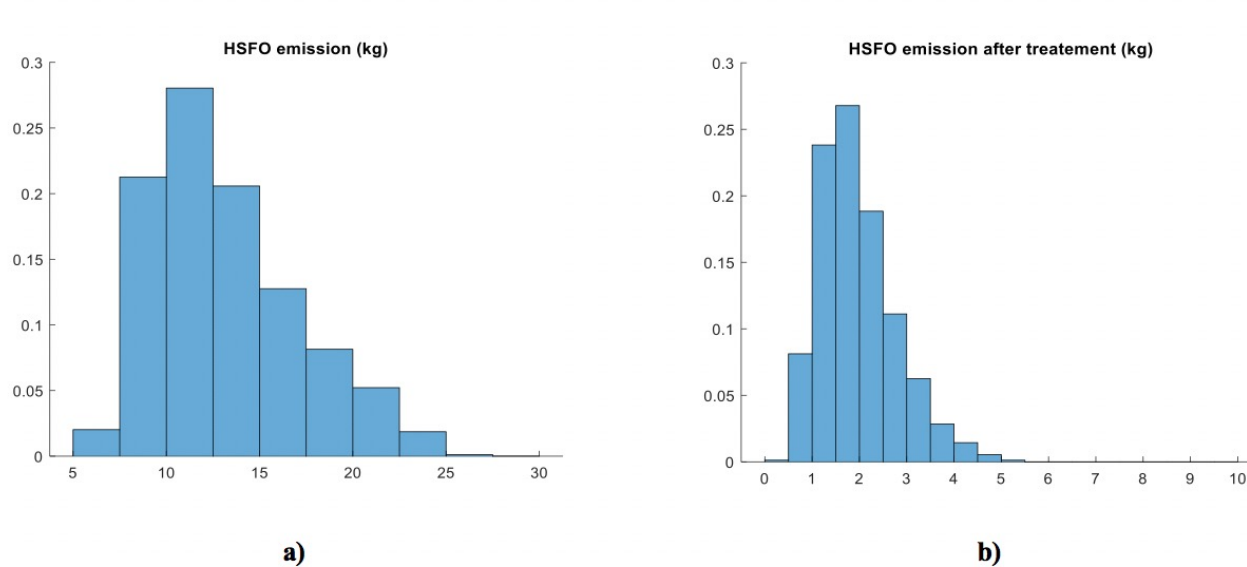
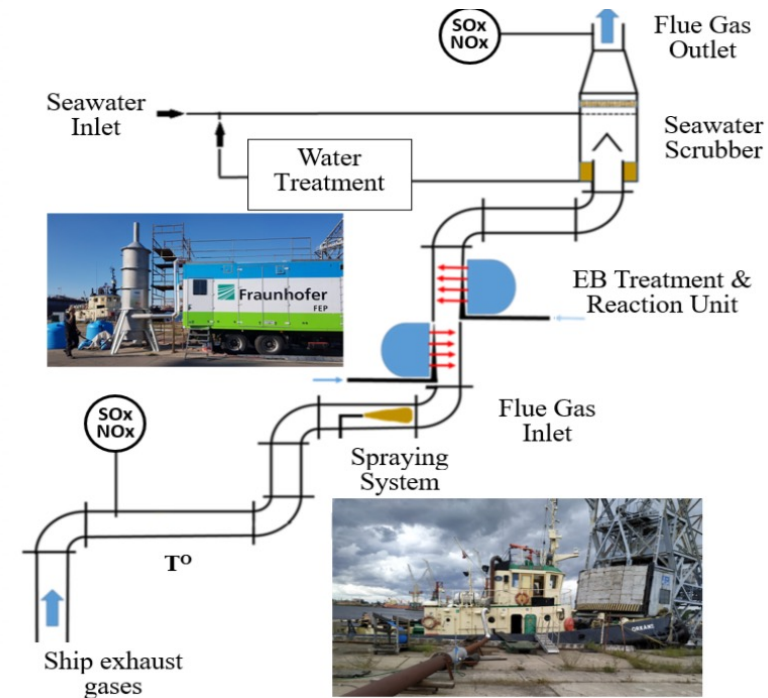


Fig. 6. a) mass of SOx emitted before implementation of proposed technology (scenario 1);  
b) mass of SOx emitted after implementation of proposed technology (scenario 2)

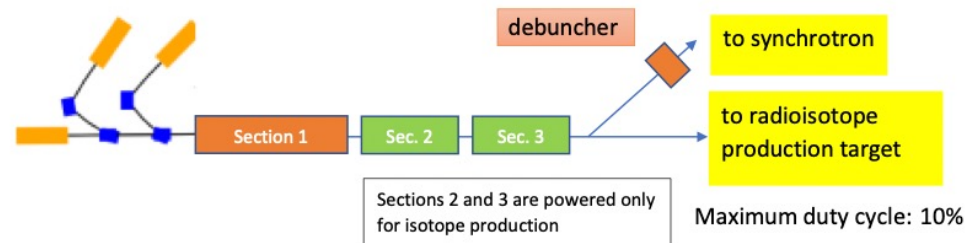


# Heavy Ion Therapy Research Integration

- **WP 7: Advanced accelerator and gantry design**
  - Task 7.4: Injector Linac Design

- **Lazar Nikitović PhD thesis/ [2<sup>nd</sup> CBC Presentation 12.10 @12:40:](#)**

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



3 ion sources  
 $^{12}\text{C}^{4+}$ , 600  $\mu\text{A}$ , 0.25  $\pi$  mm mrad, 45 kV  
 $^4\text{He}^{2+}$ , 0.5 mA, 0.3  $\pi$  mm mrad  
 p or  $\text{H}_2^+$ , 5 mA, 0.2-0.3  $\pi$  mm mrad

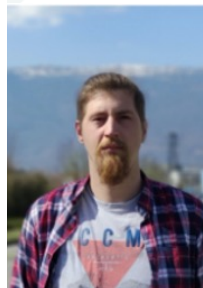
Linac section1  
 $q/m=1/3$   
 $W_{in}=15$  keV/u  
 $W_{out}=5$  MeV/u

Linac section2  
 $q/m=1/2$   
 $W_{in}=5$  MeV/u  
 $W_{out}=7.1$  MeV/u

Linac section3  
 $q/m=1/2$  or 1  
 $W_{in}=7.1$  MeV/u  
 $W_{out}=10$  MeV/u

baseline : 217 MHz  
 alternative : 352 MHz

Courtesy: M. Vretenar



# Heavy Ion Therapy Research Integration



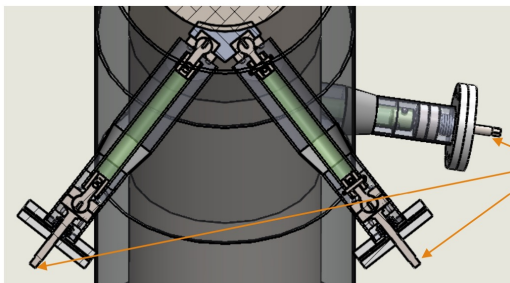
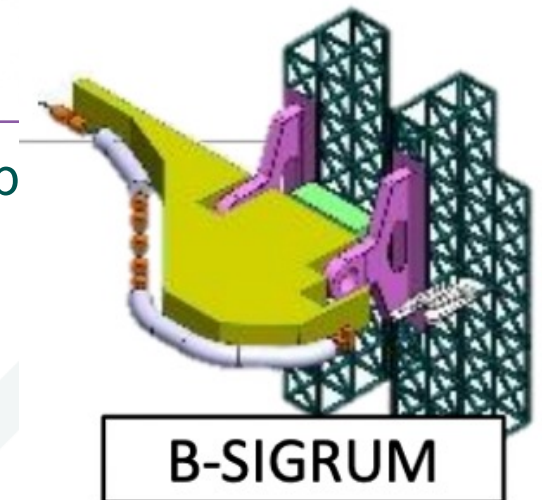
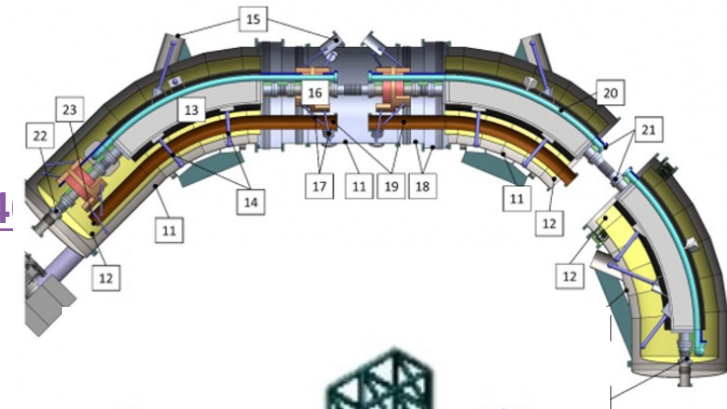
- **WP 7: Advanced accelerator and gantry design**
  - Task 7.5: Integration of an innovative superconducting gantry: optics, mechanics, beam delivery

- **Janis Vilcāns PhD thesis/** [2<sup>nd</sup> CBC Presentation 12.10 @11:4](#)

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

- **Luca Piacentini PhD thesis/** [2<sup>nd</sup> CBC Presentation 11.10 @1](#)

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



By turning the 6 screws we can adjust all 6 DOF (only passive adjustment is foreseen)

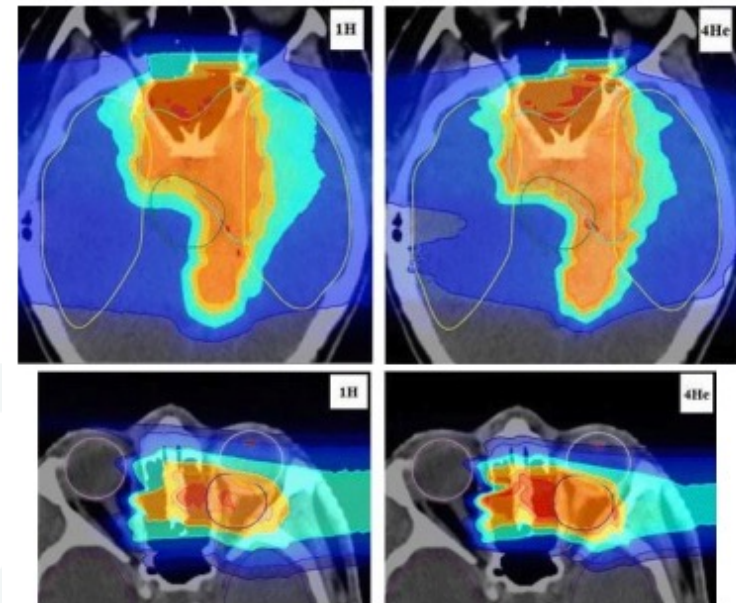
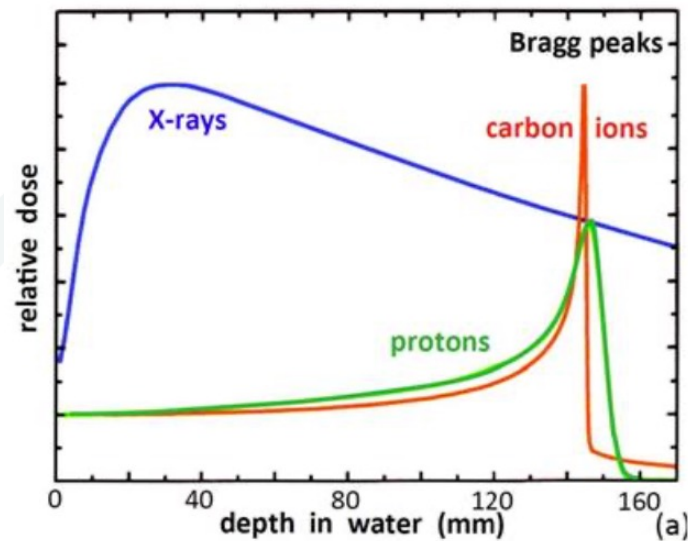
Courtesy: J. Vilcans



Courtesy: L. Piacentini

# Next Ion Medical Machine Study

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

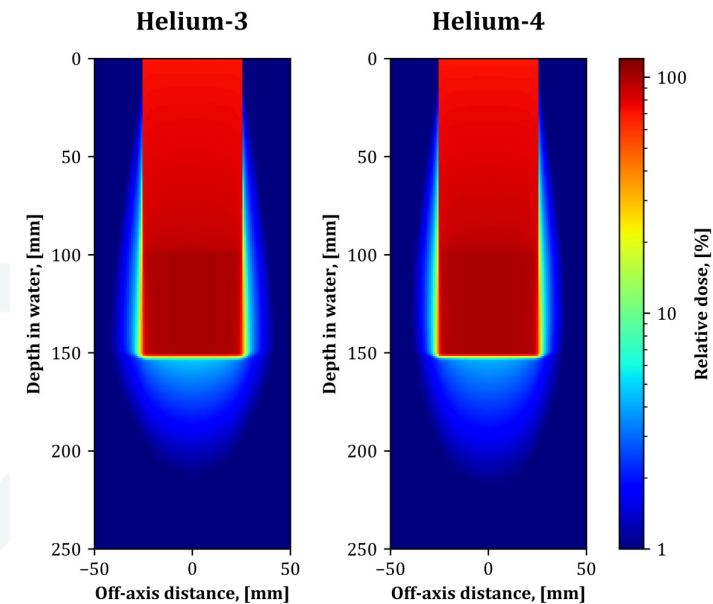
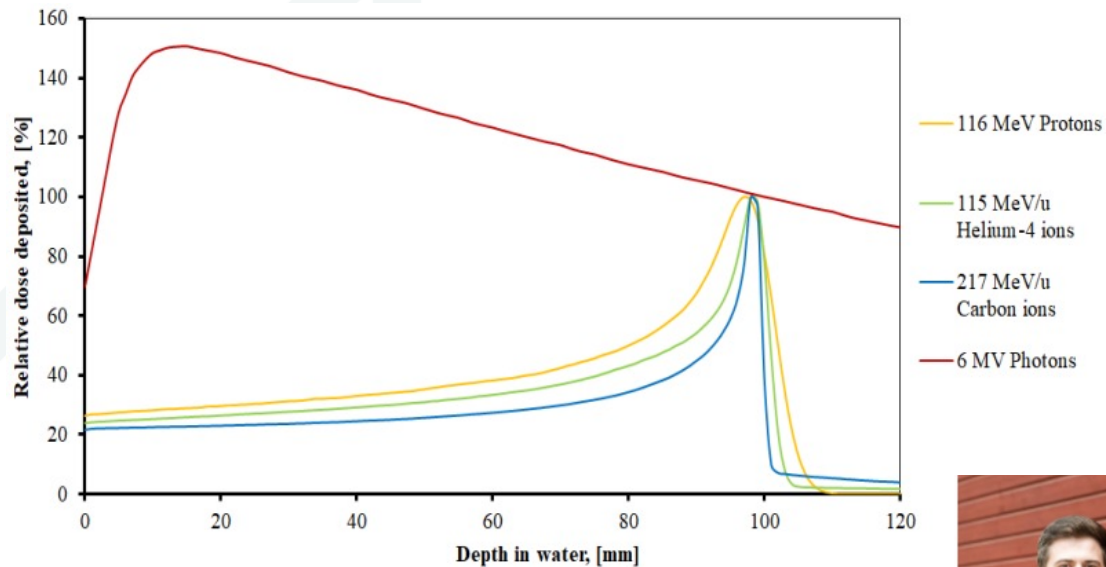


# Student thesis/ contribution in 2<sup>nd</sup> CBC



- **Kristaps Paļskis PhD thesis/ [2<sup>nd</sup> CBC Presentation 11.10@16:40:](#)**

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



# Advanced Particle Therapy center in the Baltic States

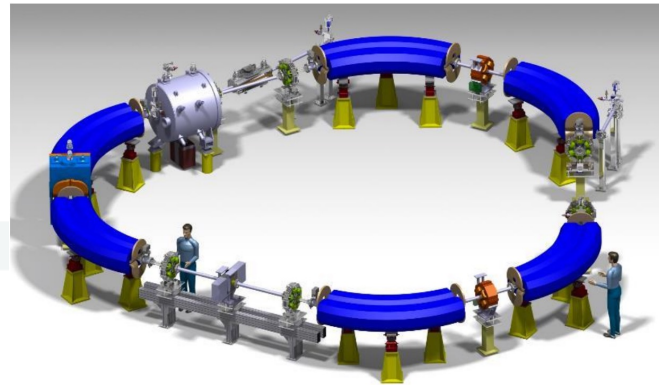
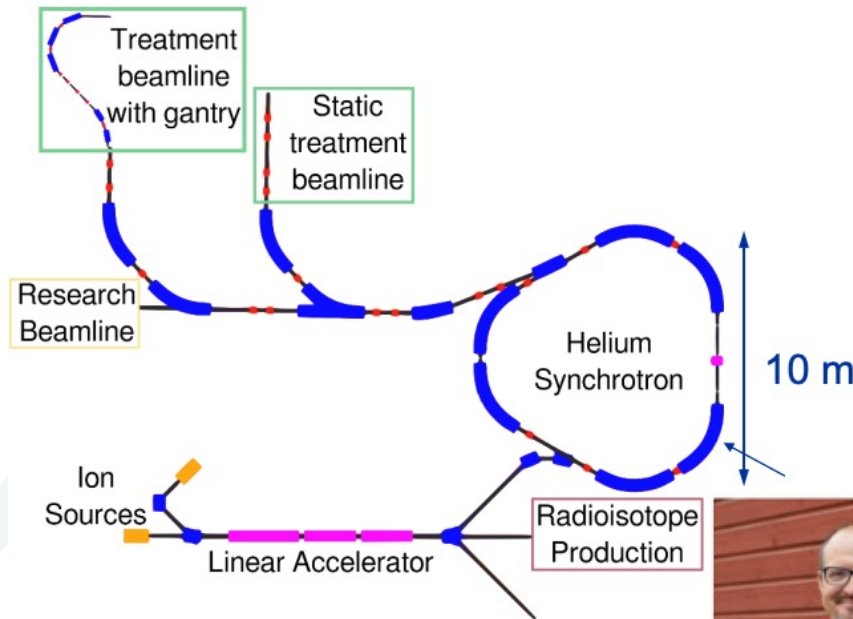
Prof. Toms Torims, Kristaps Paļskis/

2<sup>nd</sup> CBC Presentation 11.10@16:00 :

Advanced Particle Therapy center in the Baltic States

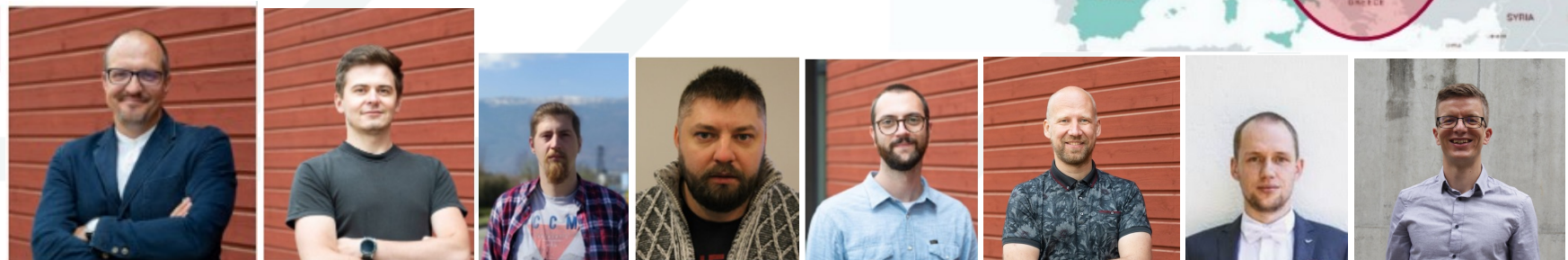


CERN Baltic Group



Riga Technical University

Source: M. Vretenar et al., IPAC2022





# Thank you!

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12.10.2022



VPP-IZM-CERN-2020/1-0002