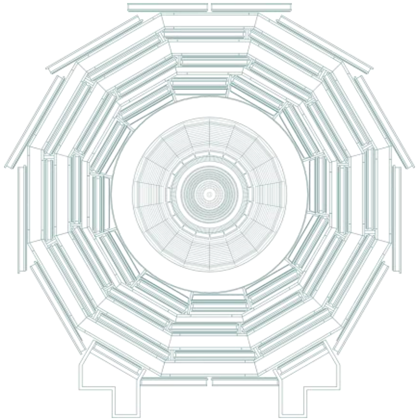
RIGA TECHNICAL UNIVERSITY
Institute of Particle Physics and Accelerator Technologies

VPP Valsts pētījumu programma

Participation in Accelerator Projects

Andris Ratkus

13.12.2024



Accelerator Technology Team

- Prof. Toms Torims
- Dr. Alberto Degiovanni
- Dr. Andris Ratkus

- Guntis Pikurs PhD student
- Luca Piacentini PhD student*
- Lazar Nikitović PhD student*
- Kristaps Paļskis PhD student*

- Tobia Romano (PoliMi/ RTU) PhD student*
- Vincenzo Alberto Sansipersico PhD student

- Dairis Rihards Irbe Master student

- Aurēlija Viņķe Bachelor student
- Ilze Baumgarte Bachelor student

* RTU/UL Particle Physics and Accelerator Technologies study programme

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* RTU/UL Particle Physics and Accelerator Technologies study programme

5 newcomers since the last meeting

Graduates

✓	Ekaterina Tskhay	MSc student	2021
✓	Dagnija Kroģere	MSc student	2022
✓	Viesturs Lācis	MSc student	2023
✓	Dairis Rihards Irbe	BSc student	2024




Graduates

✓	Ekaterina Tskhay	MSc student	2021
✓	Dagnija Kroģere	MSc student	2022
✓	Viesturs Lācis	MSc student	2023
✓	Dairis Rihards Irbe	BSc student	2024

4 PhD students are approaching for their defence

Accelerator projects

Projects with significant contribution

- Innovation Fostering in Accelerator Science and Technology
- Heavy Ion Therapy Research Integration Plus
- Next Ion Medical Machine Study

iFAST

HITRI plus
Heavy Ion Therapy Research Integration

nimms

Other accelerator projects

Project with minor contribution

- Future Circular Collider

Collaboration in the development phase

- International Muon Collider Collaboration

Collaboration in the initial phase

- Innovate for Sustainable Accelerating Systems (IJCLab)
- PERLE (IJCLab)

Accelerator projects

iFAST

Accelerator projects - I.FAST

Innovation Fostering in Accelerator Science and Technology




WP1: Management, coordination and dissemination

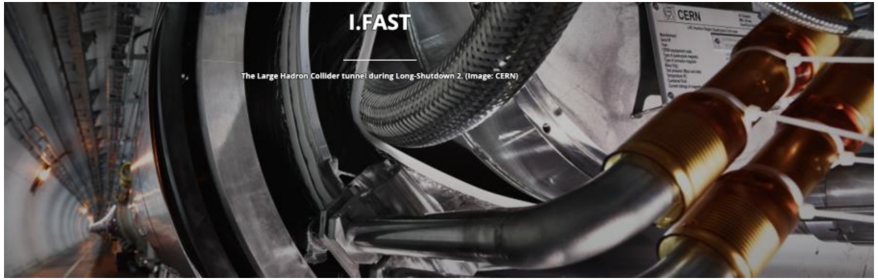
- Task 1.2: Information Flow Management and Cross-coordination (Task Leader RTU)

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

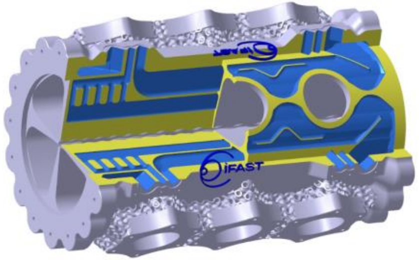
- Task 12.1 sub task 3: Environmental applications of electron beam

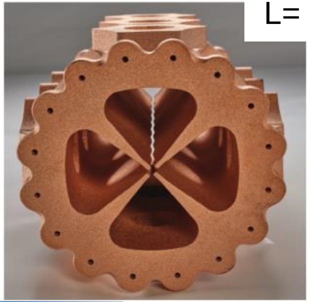


Accelerator projects - I.FAST

WP10: Advanced Accelerator Technologies (Coordinator RTU)

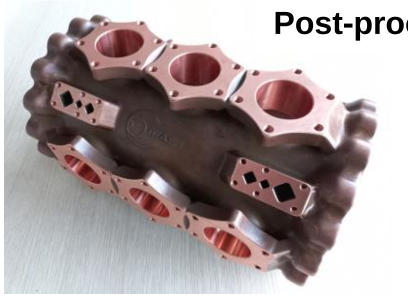
- Pure Cu (Cu-ETP) RFQ prototypes manufactured by AM





L= 250 mm

Post-procesed and machined



Accelerator projects - I.FAST

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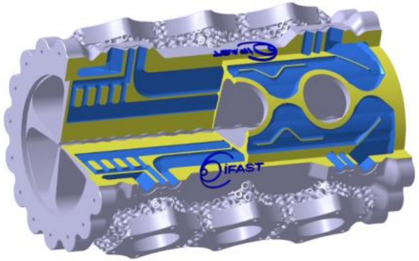

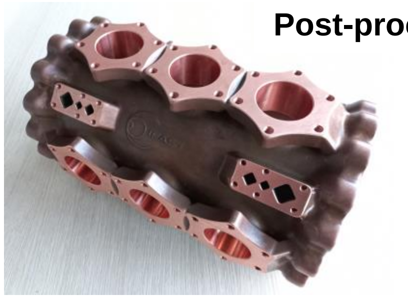

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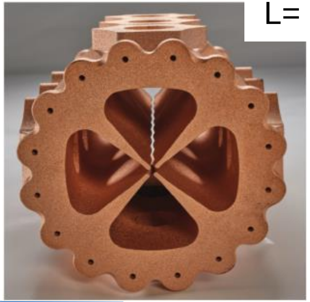
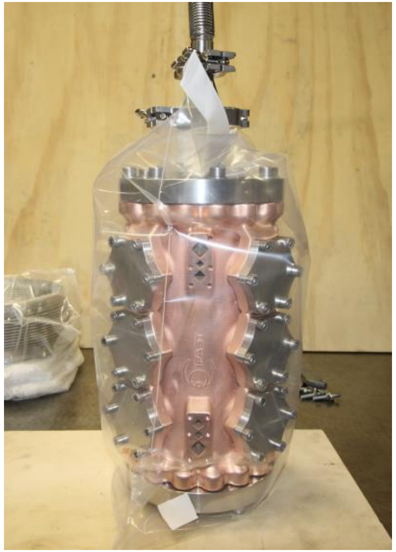


L= 250 mm

He leakage test: The leak detector threshold value was set at $\mathbf{1 \cdot 10^{-10} mbar \cdot l \cdot s^{-1}}$



Accelerator projects - I.FAST

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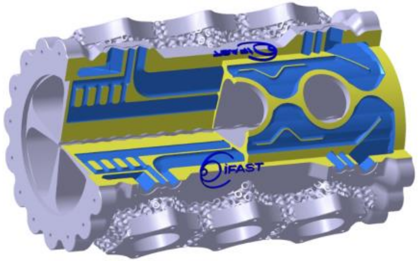

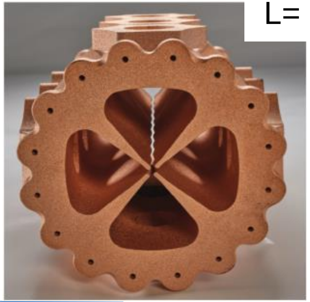

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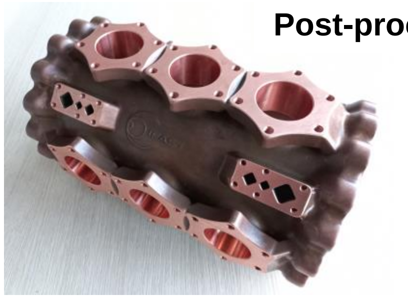

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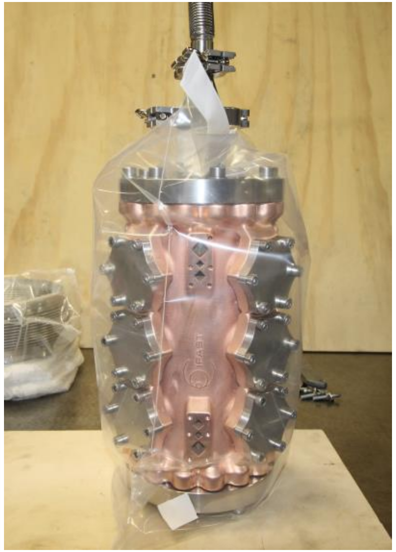
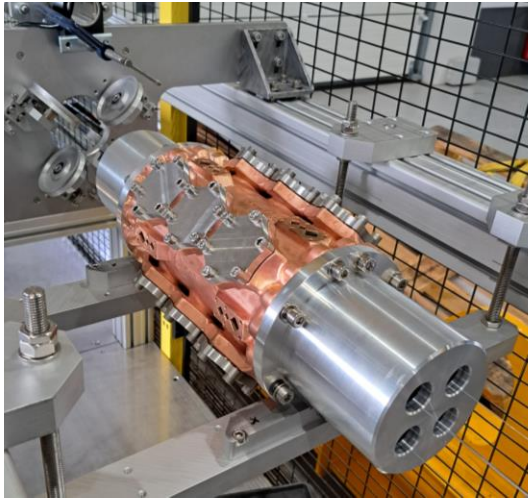


Low-power RF tests and bead-pull measurements

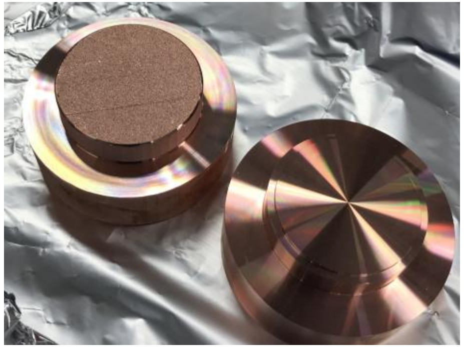


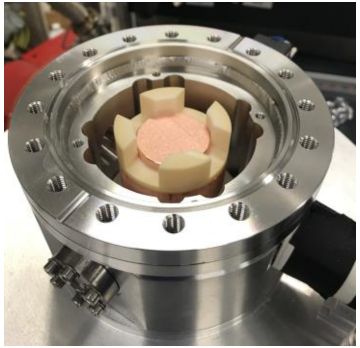
Accelerator projects - I.FAST

WP10: Advanced Accelerator Technologies (Coordinator RTU)

- Activities closly releted with CERN teams

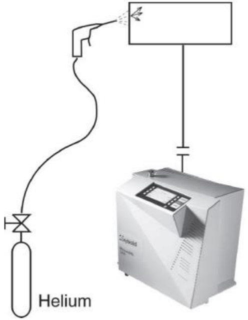
SY-RF
Walter WUENSCH





HV holding tests

TE-VSC
Cedric GARION



He leak test (UHV)

Accelerator projects - I.FAST

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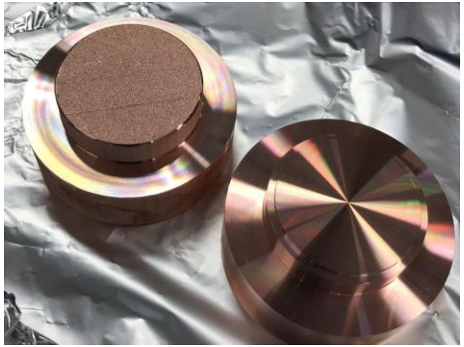
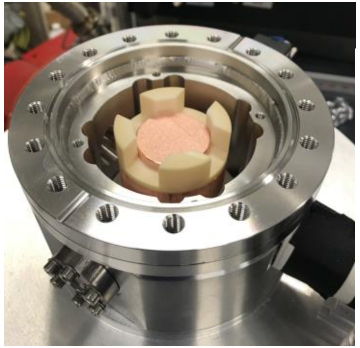
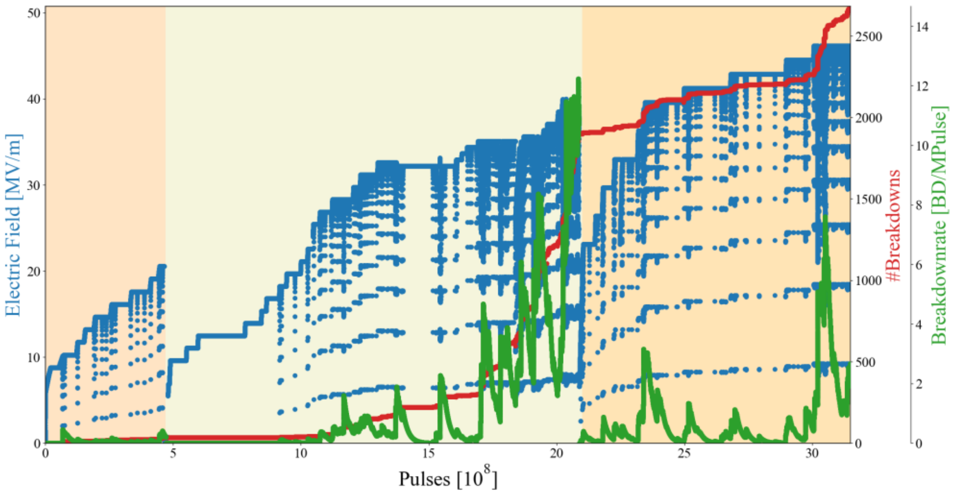




HV holding tests

42MV/m was reached with 94 µm gap for unmachined AM cathode



Accelerator projects - I.FAST

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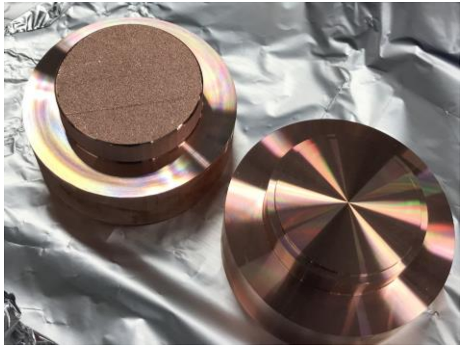

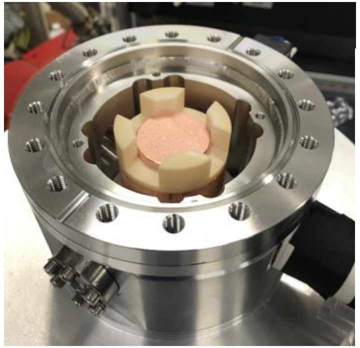

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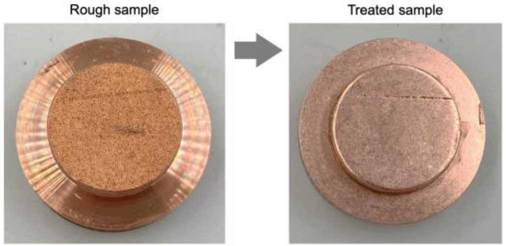

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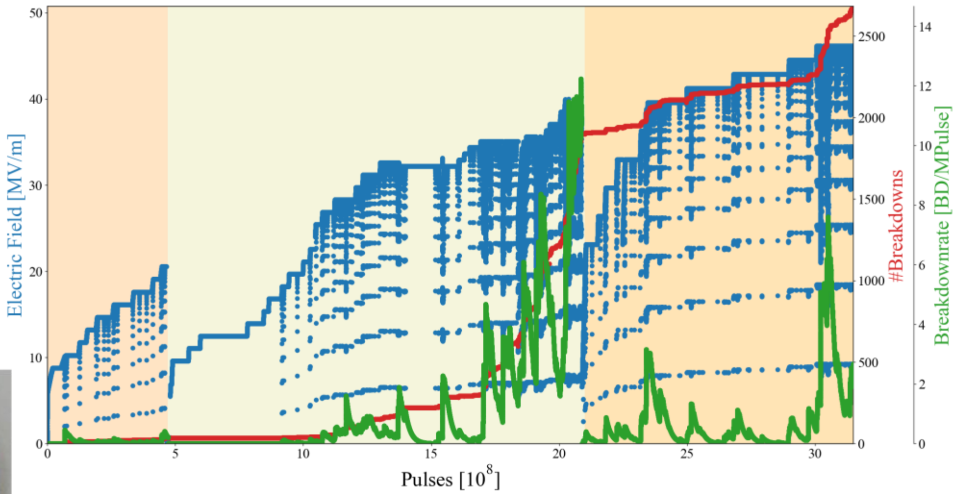
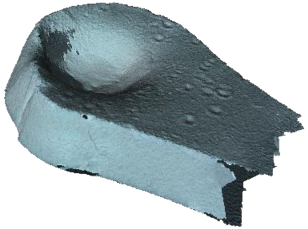
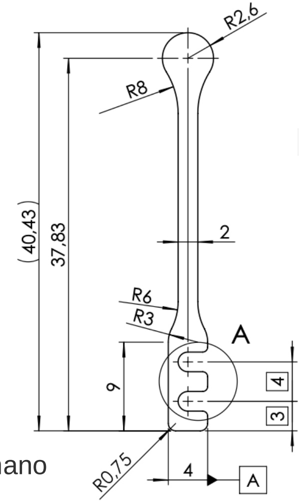


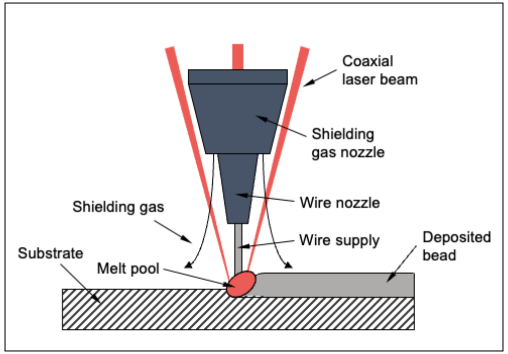
Test continuation with post-processed cathode

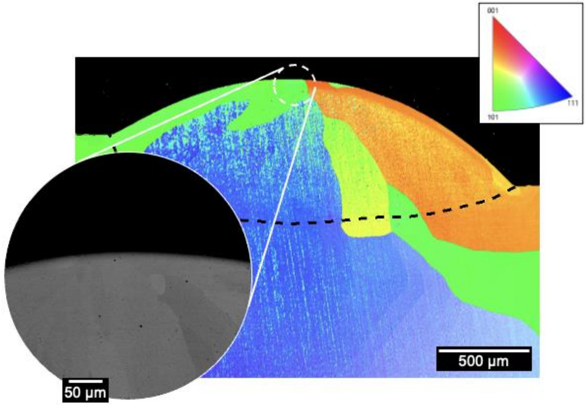
WP10: Advanced Accelerator Technologies (Coordinator RTU)

- AM repair demonstration for the Ta cathode







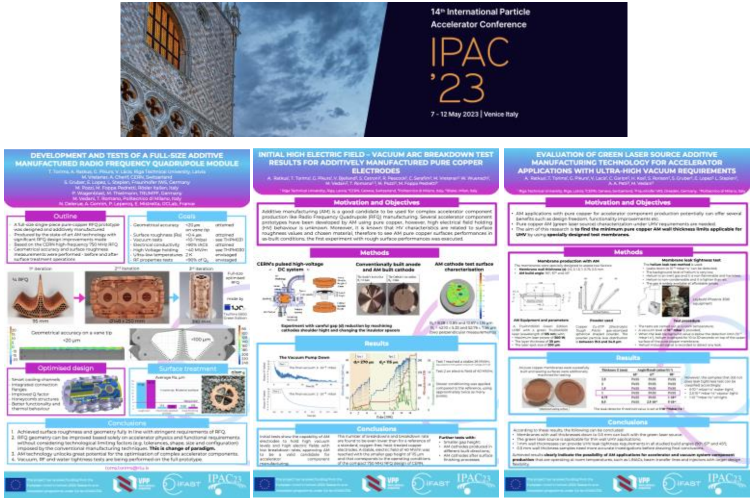


Courtesy: T. Romano

Accelerator projects - I.FAST

Posters: 6pc. **Publication: 9pc.**

Deliverables: 2pc. (task 10.2 and task 10.3.) submitted and approved



Accelerator projects

- Heavy Ion Therapy Research Integration Plus

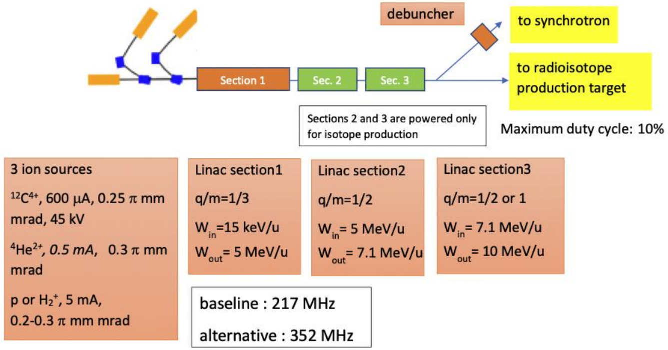
HITRI plus

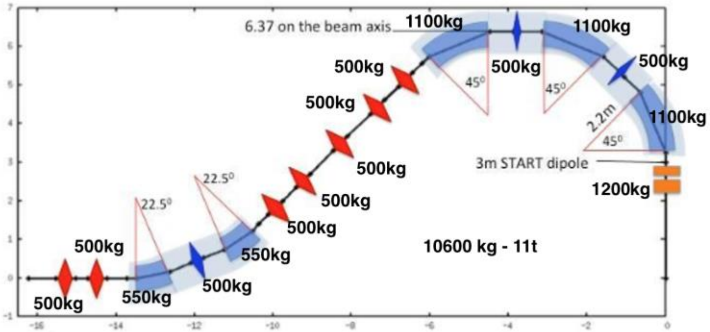
Heavy Ion Therapy Research Integration

Accelerator projects - HITRI*plus*

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



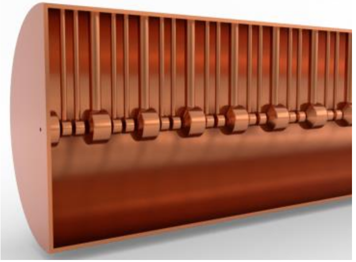


Accelerator projects - HITRI*plus*

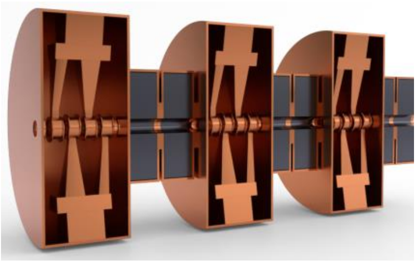
WP 7: Advanced accelerator and gantry design

- **Task 7.4:** Injector Linac Design

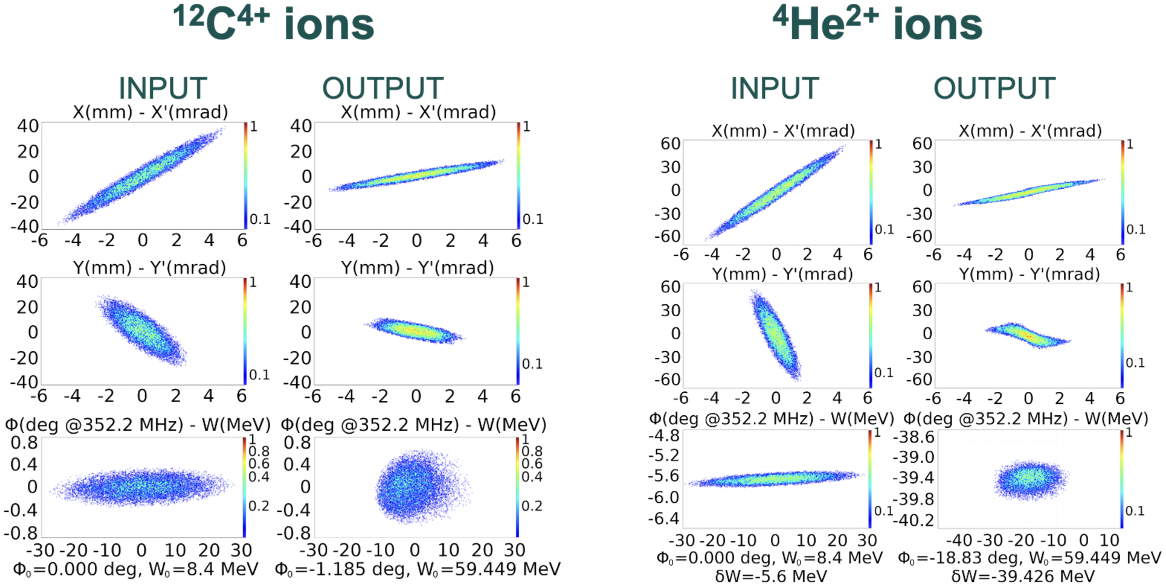
Quasi-Alvarez Drift Tube LINAC (QA-DTL)



Separated Interdigital H-mode DTL (S-IH-DTl



Beam Dynamics - TraceWin

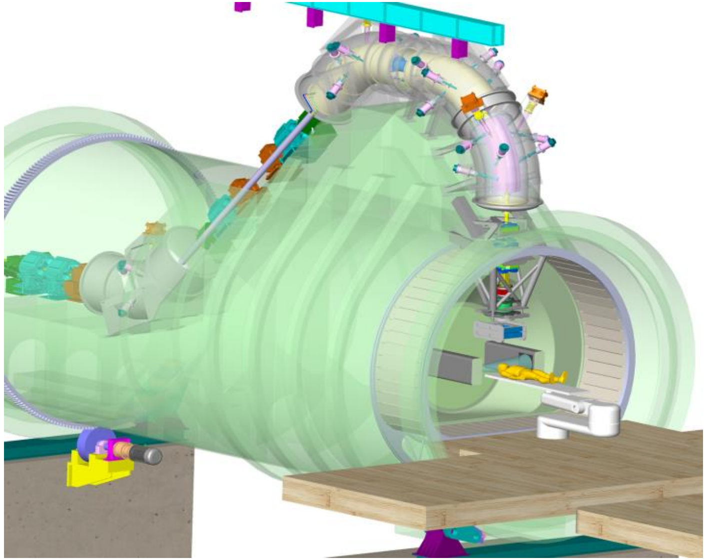


Courtesy: L. Nikitovic

Accelerator projects - HITRI*plus*

WP 7: Advanced accelerator and gantry design

- **Task 7.5:** Integration of an innovative superconducting gantry: optics, mechanics, beam delivery



~220t

Courtesy: L. Piacentini

Accelerator projects - HITRI*plus*

WP 7: Advanced accelerator and gantry design

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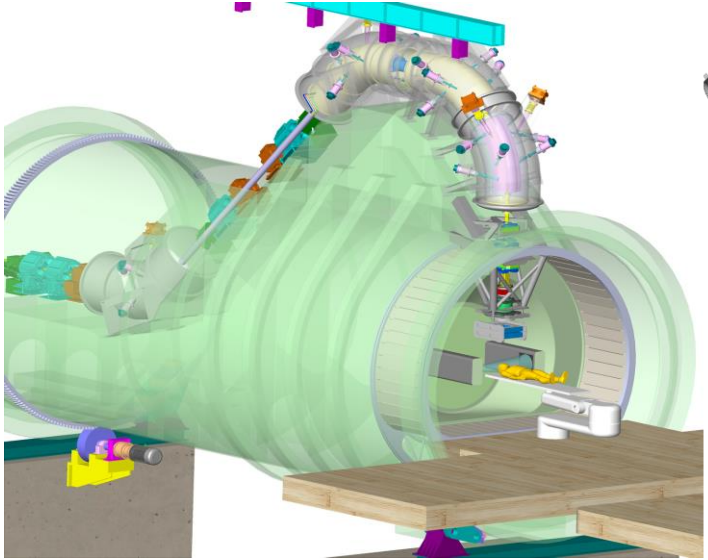

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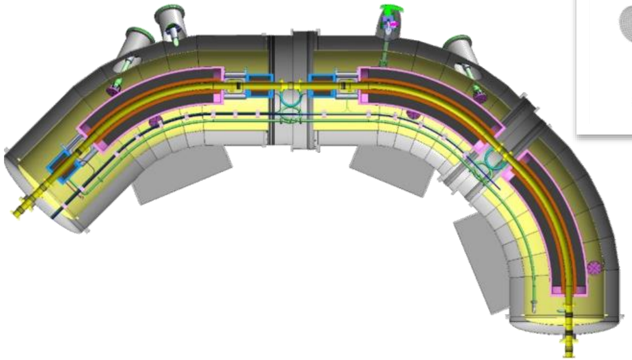
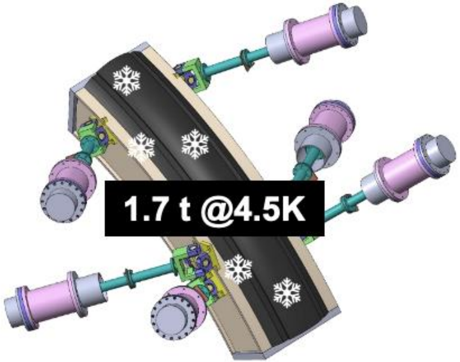
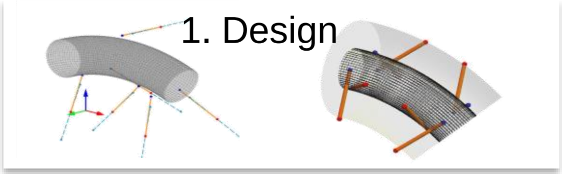
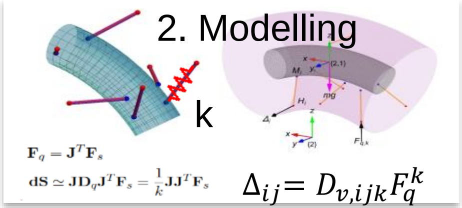
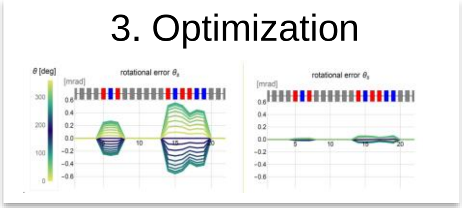
Courtesy: L. Piacentini

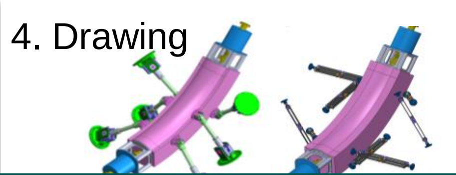












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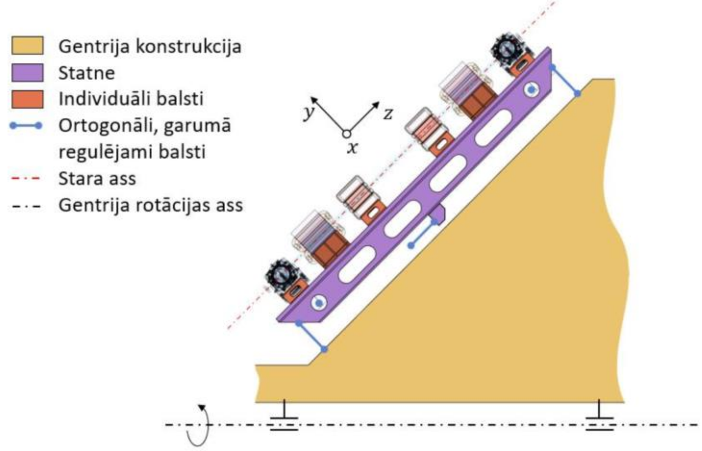
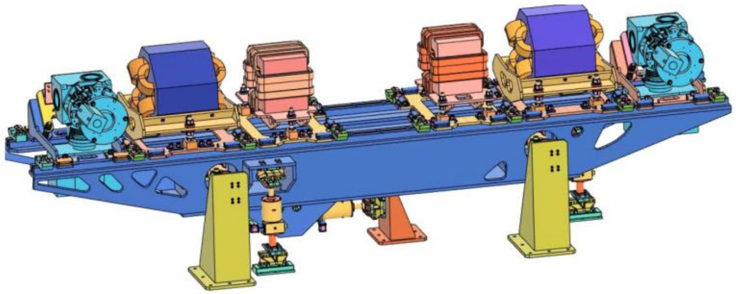
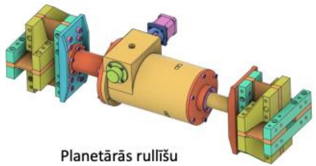
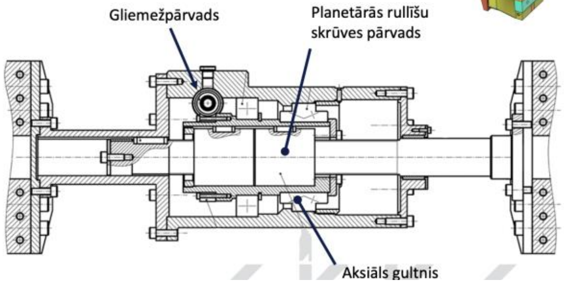




Statnes balstu aktuators

Slodze – 31.2 kN
Precizitāte – 0.1 μm
Gājiens - ± 30 mm



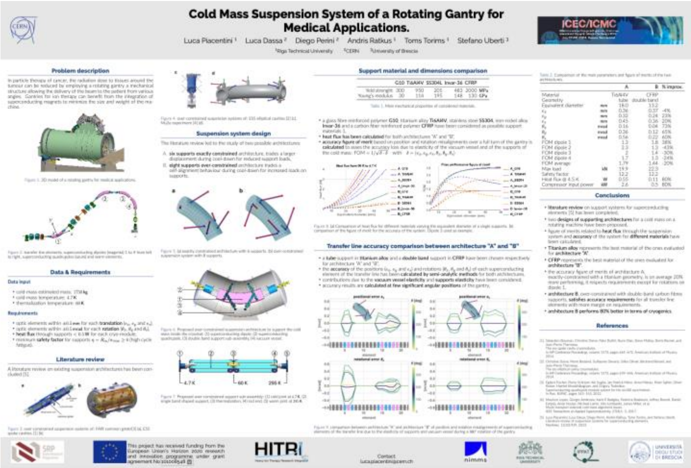


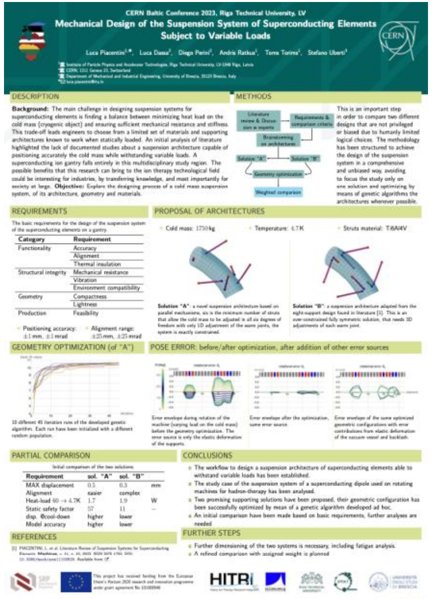
Courtesy: D. Irbe

Accelerator projects - HITRI*plus*

Posters: 4pc **Publication: 7pc.**

Deliverables: 2pc. (task 7.4 and task 7.5.) submitted and approved





HITRI*plus*
Heavy Ion Therapy Research Integration

Accelerator projects

- Next Ion Medical Machine Study

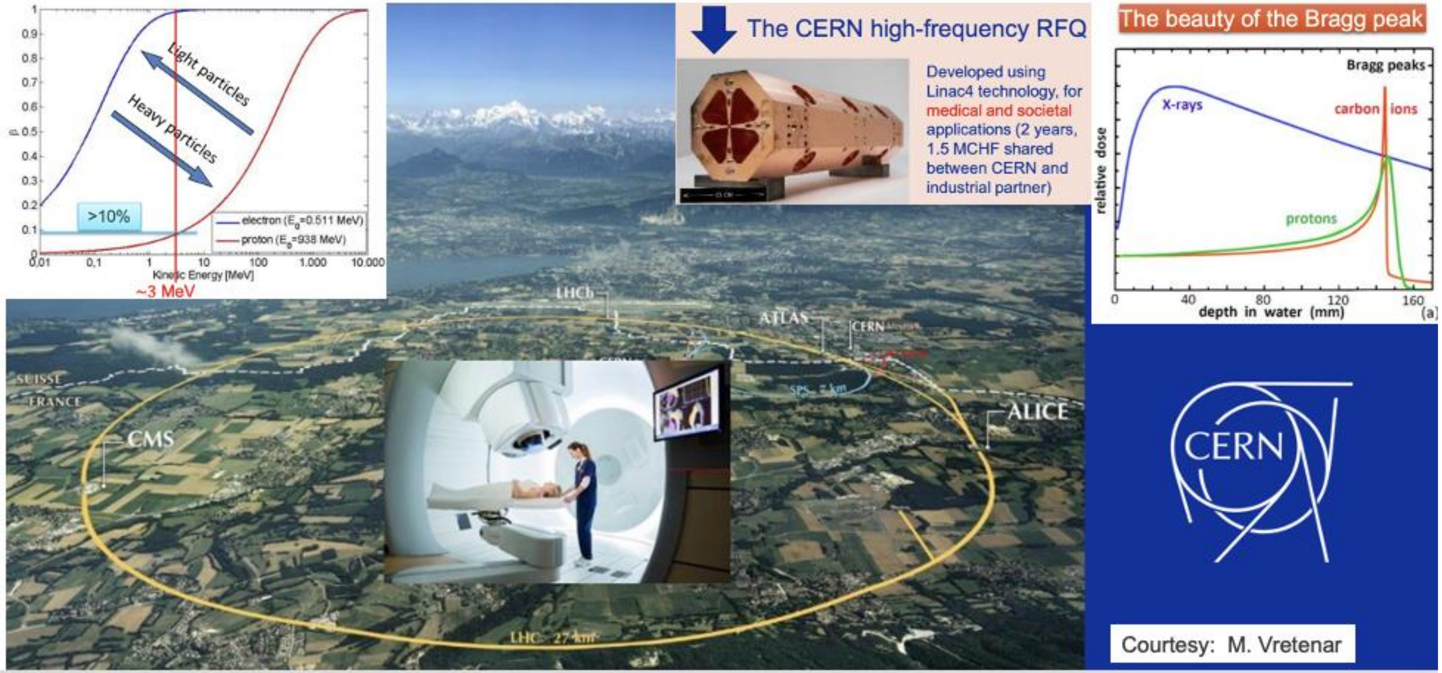
nimms

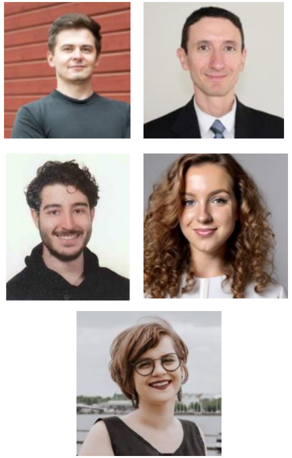
Accelerator projects - NIMMS

nimms

Next Ion Medical Machine Study

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

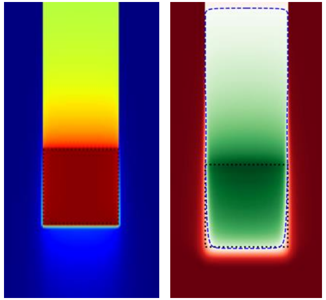




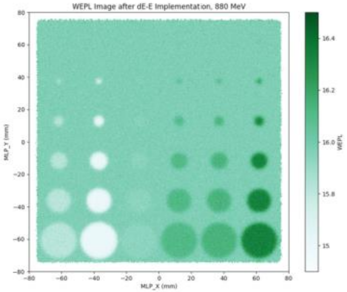
Accelerator projects - NIMMS

nimms

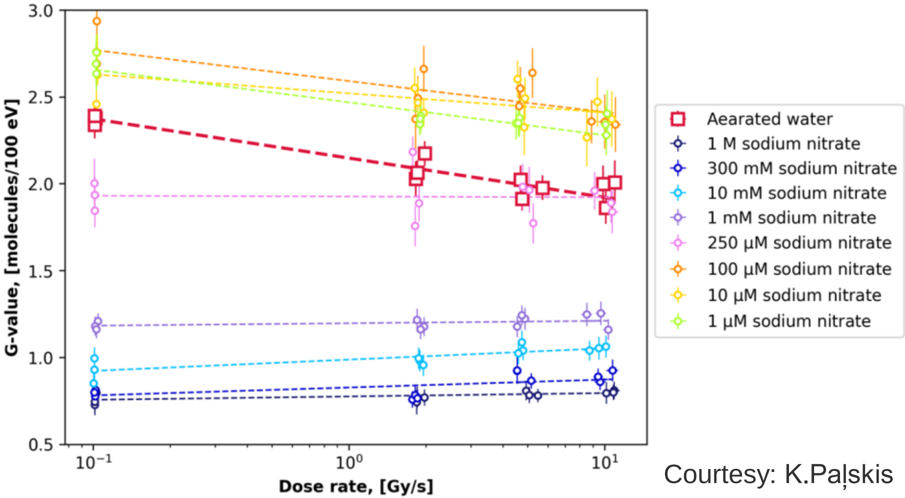
Ion FLASH therapy



Radiograpy

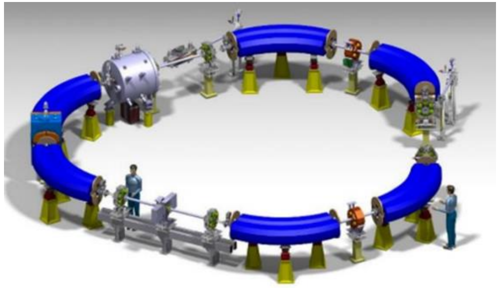


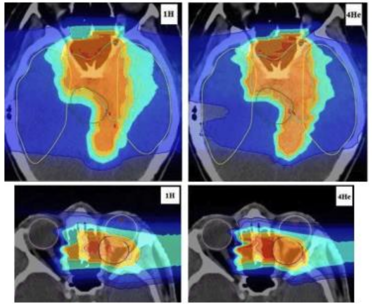
Courtesy: I.Baumgarte



Courtesy: K.Paļskis

Compact $^4He^{2+}$ Synchrotron studies

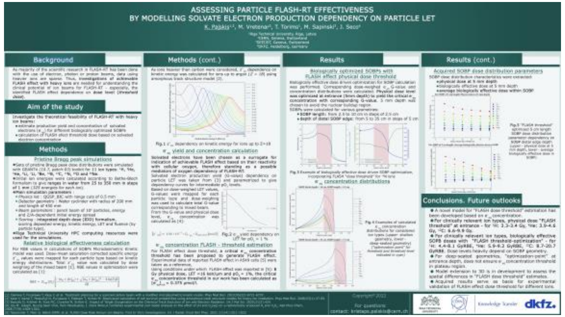


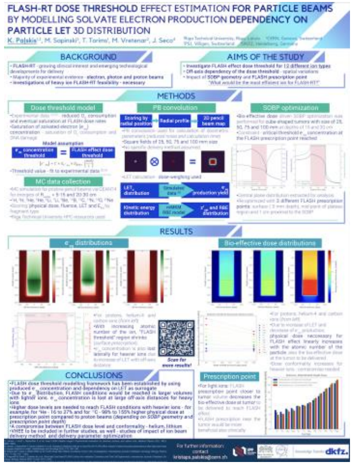


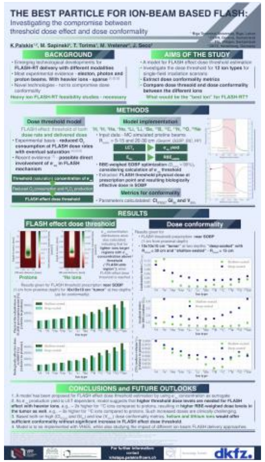
Accelerator projects - NIMMS

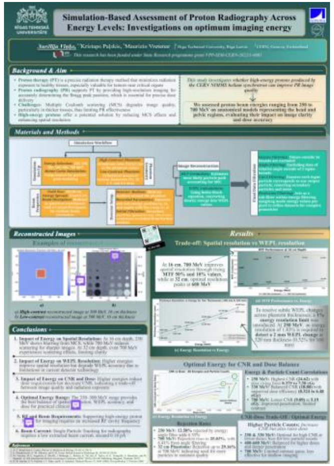
Posters: 5pc **Publication: 4pc.**

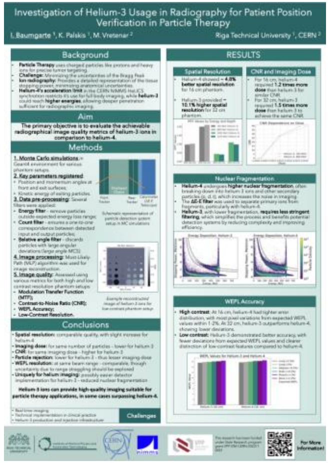
nimms











Courtesy: K.Paļskis

Project initiative: APTCB

Advanced Particle Therapy center in the Baltic States (APTCB)

NIMMS collaboration

Next Ion Medical Machine Study - a CERN based collaboration for development of **novel, next generation particle therapy technologies**

CERN Baltic group

Group of 13 Baltic universities and research institutions formed to coordinate joint activities with CERN and to strengthen the high-energy physics and accelerator technology communities

Courtesy: K.Paļskis

CERN Baltic Group

Overall Concept

Courtesy: K.Paļskis

Project initiative: APTCB

Overview of the initiative: Milestones of the initiative

End of 2021
Idea and first discussions

Apr 2022
Conceptual design paper and **working group** establishment

Aug 2022
Baltic Assembly support – letter to 3 prime ministers

Oct 2022
Resolution of Baltic Assembly

Oct-Nov 2022
Bi-lateral **discussions with stakeholders** in all 3 Baltic States

Presentations and discussions with relevant professional societies, scientific universities and political stakeholders

May 2023
Baltic implementation – part of IPAC paper by NIMMS

25th of May 2023
Workshop at CERN
Particle therapy - future for the Baltic States? State-of-play, synergies and challenges

Oct 2023
Report on the workshop findings approved by CERN Baltic Group

nimms

CERN Baltic Group

Courtesy: K.Paļskis

Project initiative: APTCB

Future of the initiative: Feasibility Study

Advanced Particle Therapy center for the Baltic States

Scientific research institution

To transform the initiative into a possible facility
a full-scale Feasibility Study is necessary

- Active work of CERN Baltic Group to develop a working plan of the Feasibility Study
- **Main goal:** provide a factual based Feasibility Study Report to be used as tool for the decision making in the project continuation
- Feasibility Study is to investigate:
  - scientific research programme opportunities
  - **cancer epidemiology and medical statistics in the Baltic States, clinical aspects of particle therapy**;
  - technical integration of the particle accelerator into a dedicated facility;
  - economical aspects as cost estimates, revenue streams and R&D potential

In collaboration with CERN –
a unique opportunity for the Baltic States

Clinical cancer treatment facility
Particle therapy and nuclear medicine

nimms

CERN Baltic Group

Courtesy: K.Paļskis

Project initiative: APTCB

Future of the initiative: Feasibility Study

CLINICAL AND EPIDEMIOLOGY	TECHNOLOGY AND IMPLEMENTATION	ECONOMICS AND INNOVATION
Research programme in clinical sciences	Research programme in natural and technical sciences	Research on long term funding, business engagement
Relevant medical statistics in the region	Technical requirements of the facility	Organizational structure and governance model
Eligibility criteria for proton therapy	Integration study and future upgradability	Full cost estimation and economic benefit analysis
Patient referral, connections with PT community	Basis of cost estimates for accelerator and facility	Evaluation of revenue streams

TRANSVERSAL TASKS

- Alternative solutions for the facility
- Aspects on regulatory and legal approvals
- Information flow between pillars for cost estimates
- Risk analysis and evaluation
- Education and training necessities

On-going development of the working plan

Courtesy: K.Paļskis

nimms

CERN Baltic Group

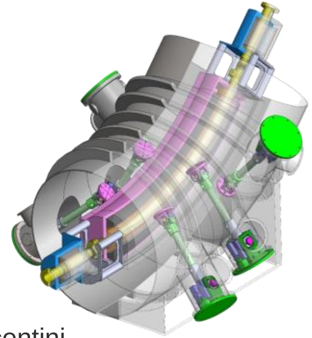
Feasibility Study Steering Group (FSSG) deputy convener - Kristaps Paļskis (RTU)

Building the expertise

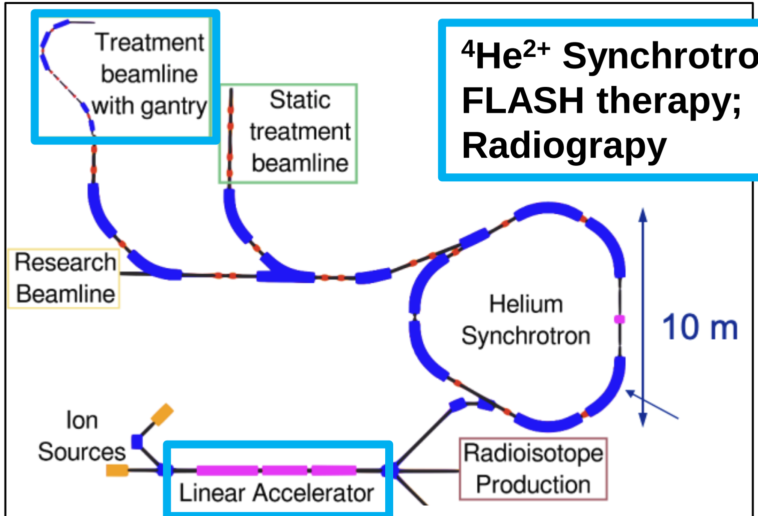
Project initiative: Advanced Particle Therapy center in the Baltic

CERN Baltic Group

Gantry



Courtesy: L. Piacentini

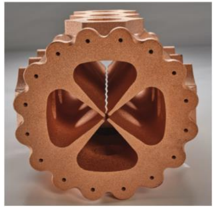


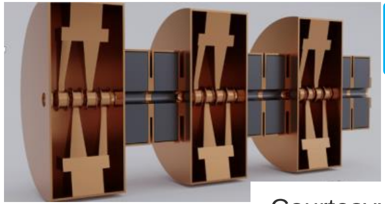
$^{4}He^{2+}$ Synchrotron FLASH therapy; Radiograpy

Source: M. Vretenar et al., IPAC2022

Heavy Ion Therapy Research Integration

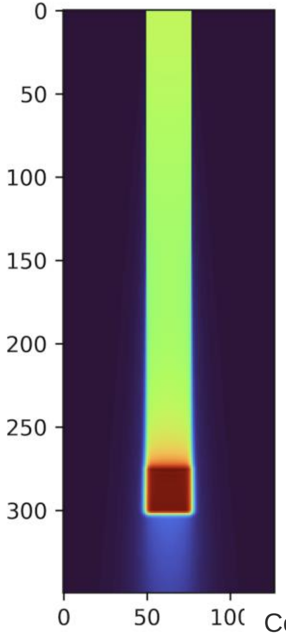
RFQ





HF-LINAC

Courtesy: L. Nikitovic



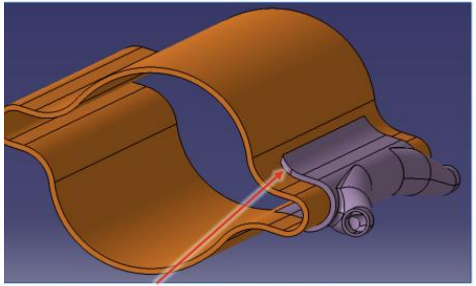
Courtesy: K.Paļskis

Other accelerator projects

Project with minor contribution

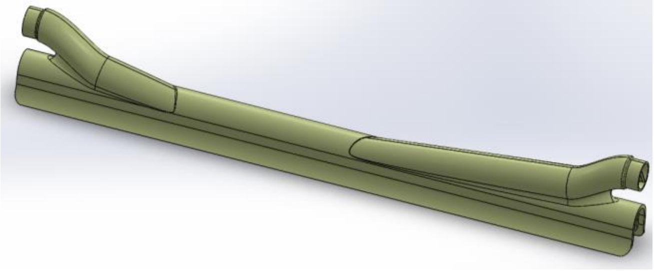
- Future Circular Collider

FUTURE CIRCULAR COLLIDER



SR Absorber to be laser welded along outer profile

Fraunhofer IWS

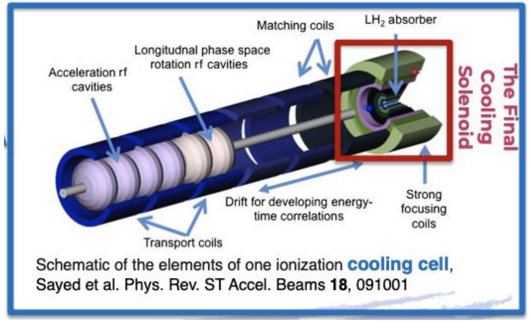


Collaboration in the development phase

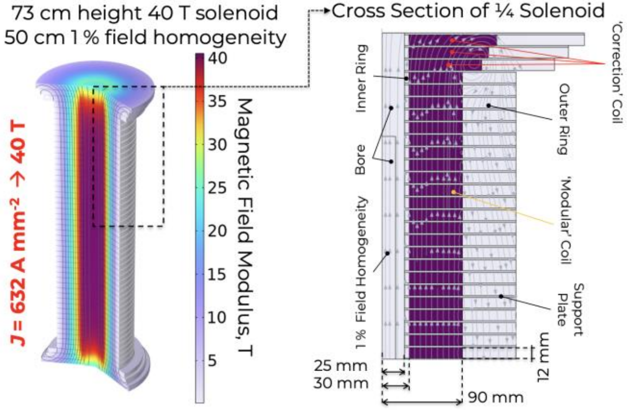
- International Muon Collider Collaboration

The Memorandum of Understanding has been signed by RTU

Research on the Final Cooling 40T Solenoid (Msc. Thesis)



Schematic of the elements of one ionization **cooling cell**, Sayed et al. Phys. Rev. ST Accel. Beams **18**, 091001



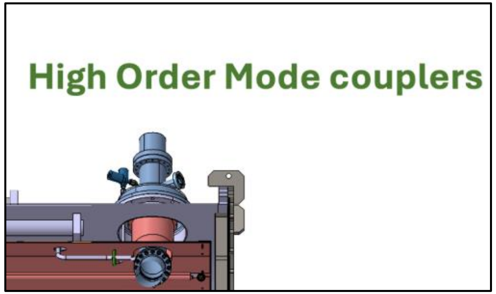
Courtesy: B.Bordini

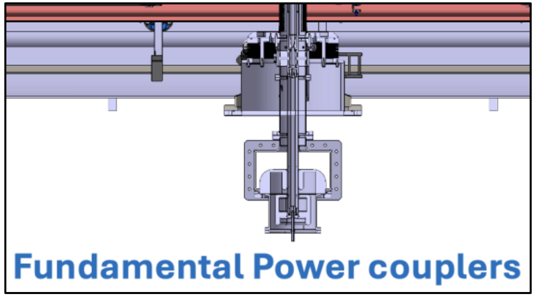
Other accelerator projects

Collaboration in the initial phase

- Innovate for Sustainable Accelerating Systems (IJCLab)
- PERLE (IJCLab)

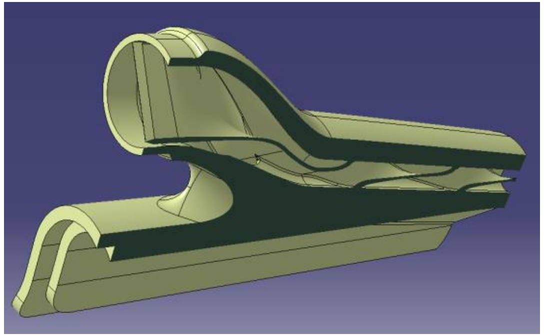
Probable contribution in High-Order Mode (HOM) damper and Fundamental Power coupler design and fabrication

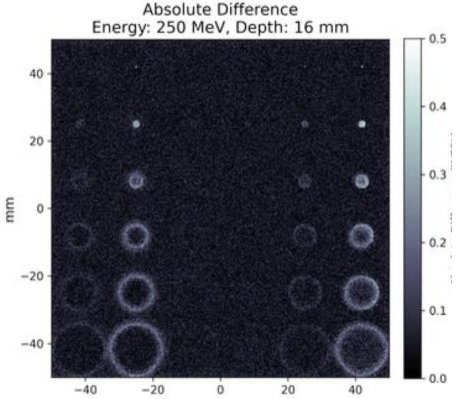


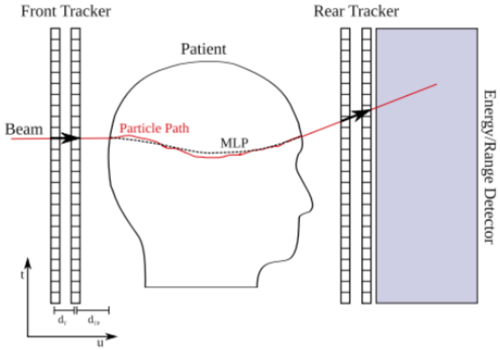


CERN Summer Student Program

Courtesy: D. Irbe

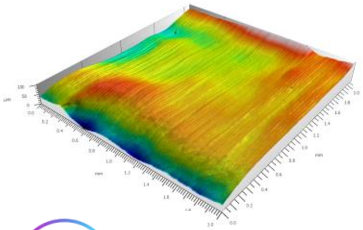


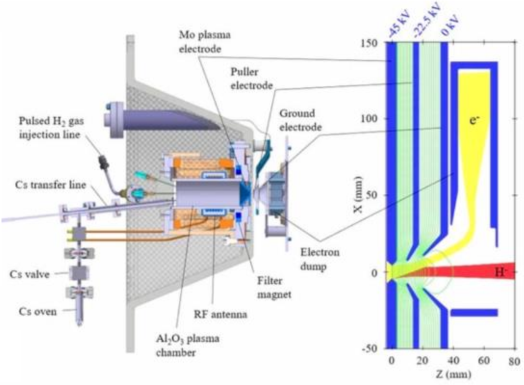




Courtesy: A.Viņķe

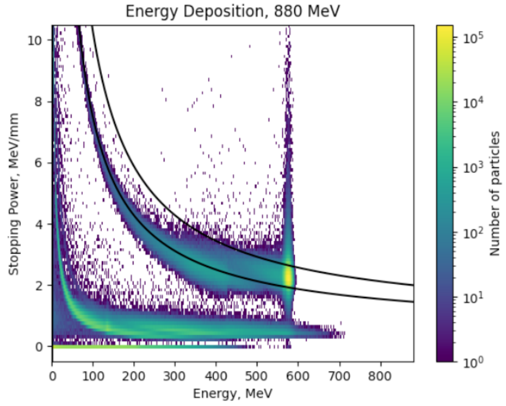
FUTURE CIRCULAR COLLIDER





CERN

nimms

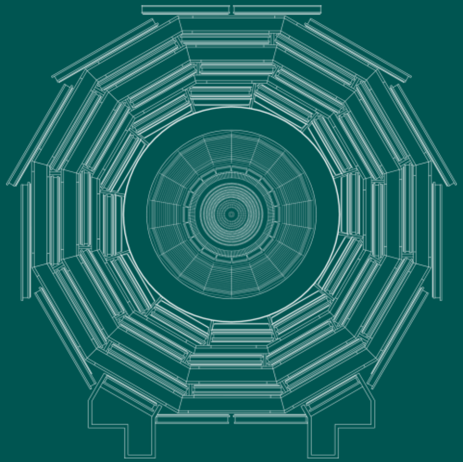


HITRI plus
Heavy Ion Therapy Research Integration

iFAST

Courtesy: V.Lācis

Courtesy: I.Baumgarte



Thank you