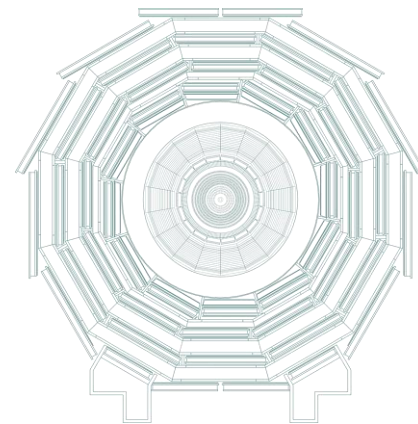




Participation in Accelerator Projects

Andris Ratkus

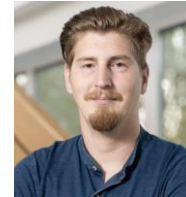
13.12.2024



- 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



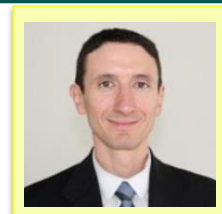
- Dairis Rihards Irbe Master student

- Aurēlija Viņķe Bachelor student
- Ilze Baumgarte Bachelor student

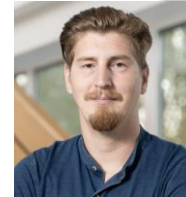


* RTU/UL Particle Physics and Accelerator Technologies study programme

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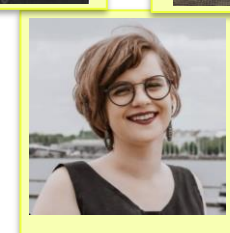
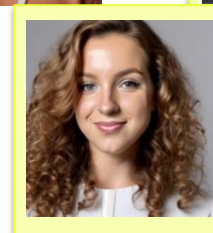


- Tobia Romano (PoliMi/ RTU) PhD student*
- Vincenzo Alberto Sansipersico PhD student



- Dairis Rihards Irbe Master student

- Aurēlija Viņķe Bachelor student
- Ilze Baumgarte Bachelor student



* RTU/UL Particle Physics and Accelerator Technologies study programme

5 newcomers since the last meeting

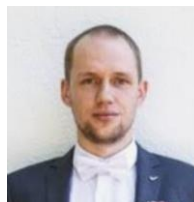
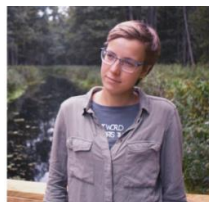
Graduates

- ✓ 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



Projects with significant contribution

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



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)





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)

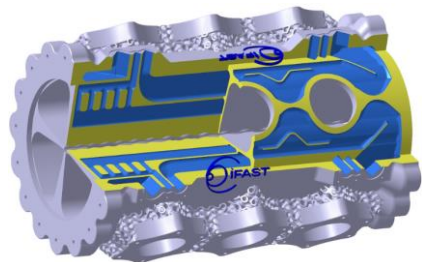
WP12: Societal Applications

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

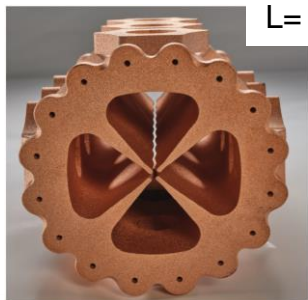


WP10: Advanced Accelerator Technologies (Coordinator RTU)

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



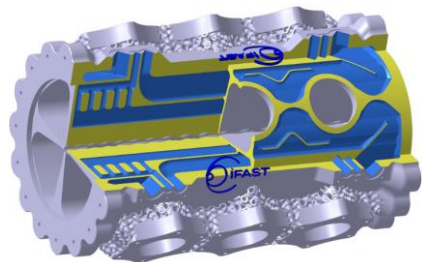
Post-processed and machined



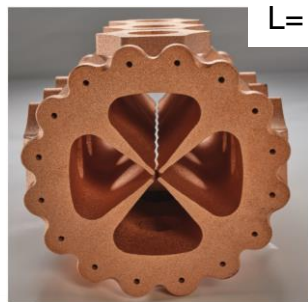
L= 250 mm

WP10: Advanced Accelerator Technologies (Coordinator RTU)

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



Post-processed and machined



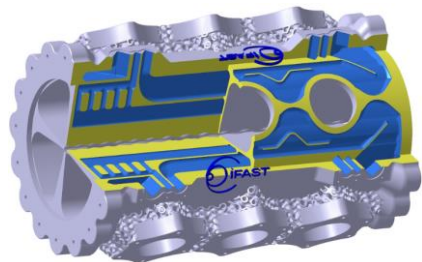
L= 250 mm

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

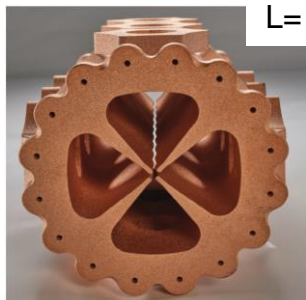


WP10: Advanced Accelerator Technologies (Coordinator RTU)

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



Post-processed and machined



L= 250 mm

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



Low-power RF tests and bead-pull measurements



WP10: Advanced Accelerator Technologies (Coordinator RTU)

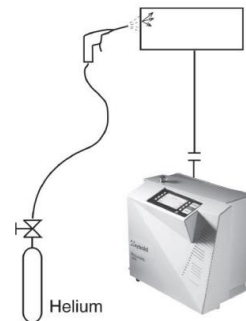
- Activities closely related with CERN teams

SY-RF
Walter WUENSCH



HV holding tests

TE-VSC
Cedric GARION



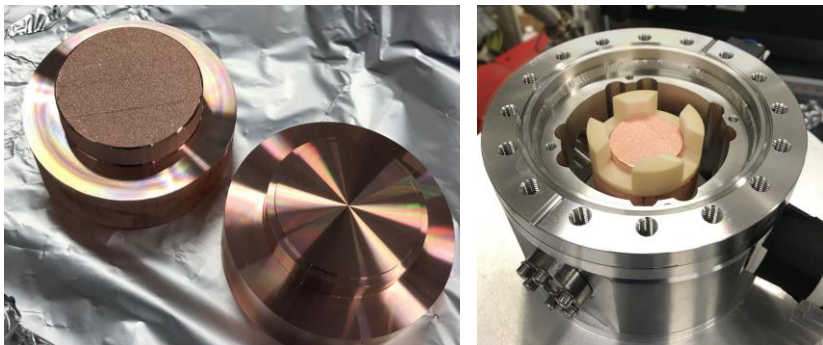
He leak test (UHV)



WP10: Advanced Accelerator Technologies (Coordinator RTU)

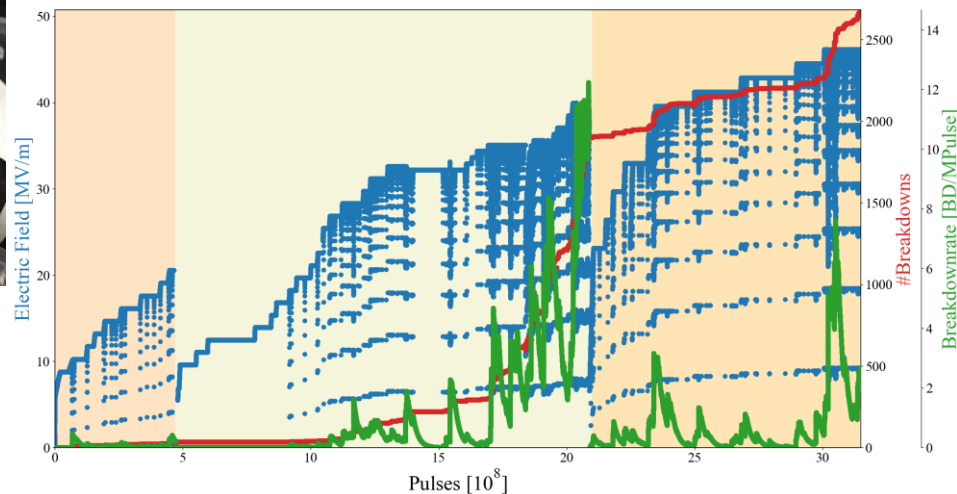
- Activities closely related with CERN teams

SY-RF
Walter WUENSCH



HV holding tests

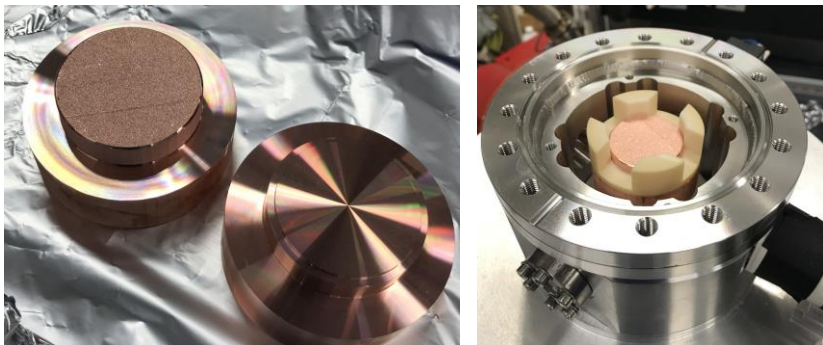
42MV/m was reached with 94 μm gap
for unmachined AM cathode



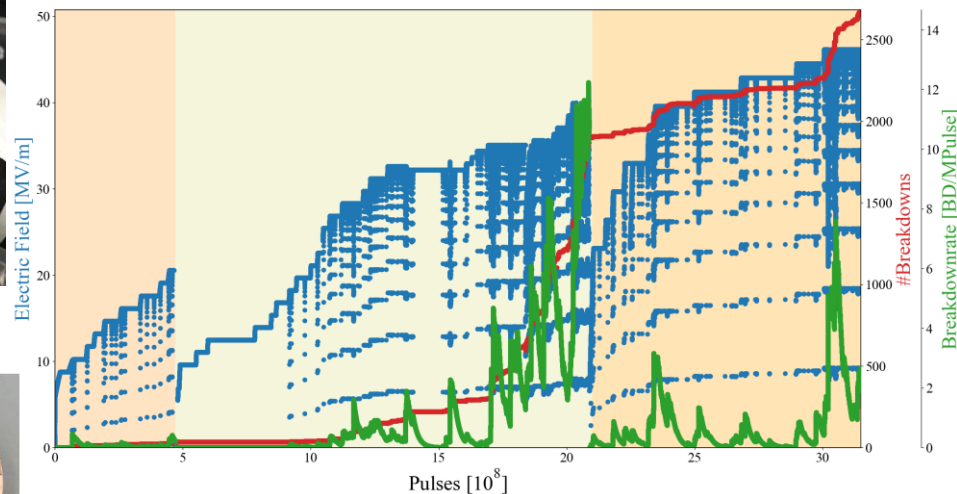
WP10: Advanced Accelerator Technologies (Coordinator RTU)

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SY-RF
Walter WUENSCH



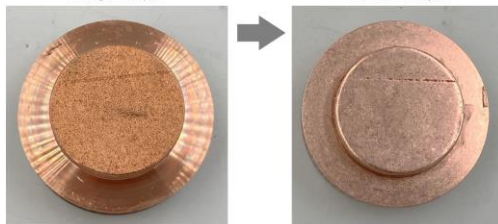
42MV/m was reached with 94 μm gap
for unmachined AM cathode



HV holding tests

Rough sample

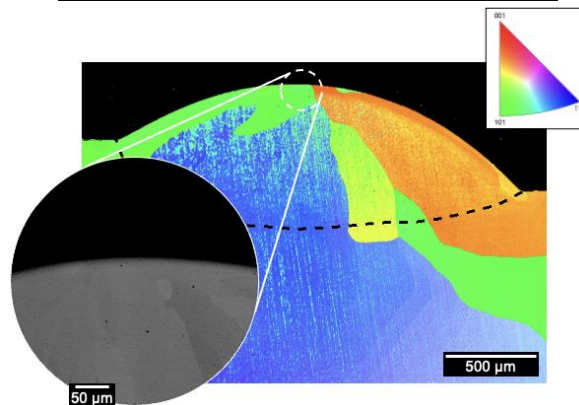
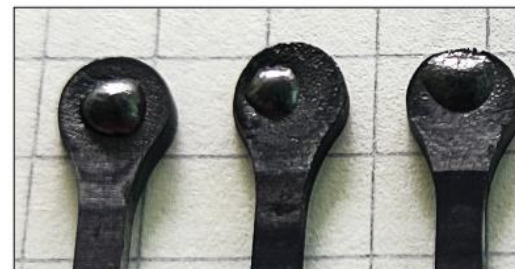
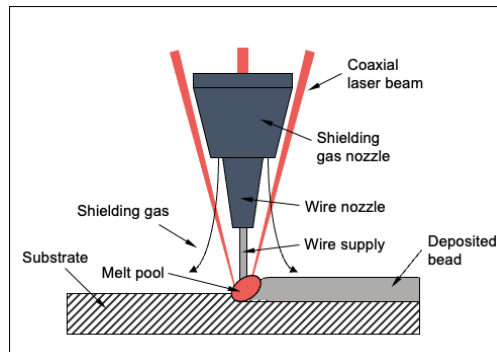
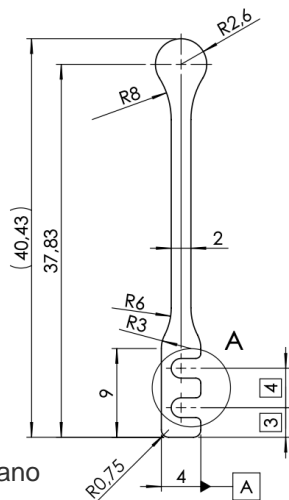
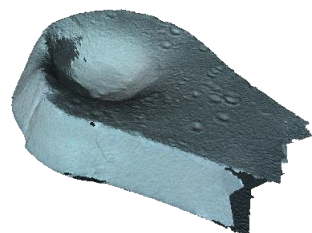
Treated sample



Test continuation with post-processed cathode

WP10: Advanced Accelerator Technologies (Coordinator RTU)

- AM repair demonstration for the Ta cathode



Courtesy: T. Romano

	POLITECNICO MILANO 1863		Fraunhofer IWS
	TANI OBIS inspiring metal evolution		1862 RIGA TECHNICAL UNIVERSITY
	GOBIERNO DE ESPAÑA		MINISTERIO DE CIENCIA, INNOVACION Y UNIVERSIDADES
			Ciemat Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

Posters: 6pc. Publication: 9pc.

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



DEVELOPMENT AND TESTS OF A FULL-SIZE ADDITIVE MANUFACTURED RADIO FREQUENCY QUADRUPOLE RESONATOR

1. Summary: A full-size radio frequency quadrupole resonator (RFQ) was developed and tested for the European XFEL. The resonator was manufactured using laser powder bed fusion (LPBF) and tested at the European XFEL. The resonator was designed to operate at 100 MHz and 100 kV. The resonator was tested at the European XFEL and the results were compared with the design. The resonator was found to be suitable for the European XFEL.

Outline: Introduction, Design, Manufacturing, Testing, Results, Conclusions.

Methods: LPBF, RF testing, Mechanical testing.

Results: The resonator was tested at the European XFEL and the results were compared with the design. The resonator was found to be suitable for the European XFEL.

Conclusions: The resonator was found to be suitable for the European XFEL.

PERSPECTIVES AND RECENT ACHIEVEMENTS IN ADDITIVE MANUFACTURING TECHNOLOGIES FOR ACCELERATORS

1. Summary: Additive manufacturing (AM) technologies are becoming increasingly important for the development and production of accelerator components. This poster discusses the latest developments in AM technologies for accelerators, including laser powder bed fusion (LPBF), electron beam powder bed fusion (EB-PBF), and direct metal laser sintering (DMLS).

Outline: Introduction, AM technologies, Applications, Challenges, Conclusions.

Methods: LPBF, EB-PBF, DMLS.

Results: The poster presents the latest developments in AM technologies for accelerators, including LPBF, EB-PBF, and DMLS.

Conclusions: AM technologies are becoming increasingly important for the development and production of accelerator components.

Surface finishing of additive manufacturing parts for particle accelerators

1. Summary: The surface finish of additive manufacturing (AM) parts is critical for the performance of particle accelerators. This poster discusses the latest developments in surface finishing technologies for AM parts, including laser polishing, electrochemical polishing (ECP), and mechanical polishing.

Outline: Introduction, Surface finishing technologies, Applications, Challenges, Conclusions.

Methods: Laser polishing, ECP, Mechanical polishing.

Results: The poster presents the latest developments in surface finishing technologies for AM parts, including laser polishing, ECP, and mechanical polishing.

Conclusions: Surface finishing technologies are becoming increasingly important for the performance of particle accelerators.

Development of additively manufactured 750 MHz RFQ

1. Summary: A 750 MHz radio frequency quadrupole (RFQ) resonator was developed and manufactured using laser powder bed fusion (LPBF). The resonator was tested at the European XFEL and the results were compared with the design. The resonator was found to be suitable for the European XFEL.

Outline: Introduction, Design, Manufacturing, Testing, Results, Conclusions.

Methods: LPBF, RF testing, Mechanical testing.

Results: The resonator was tested at the European XFEL and the results were compared with the design. The resonator was found to be suitable for the European XFEL.

Conclusions: The resonator was found to be suitable for the European XFEL.

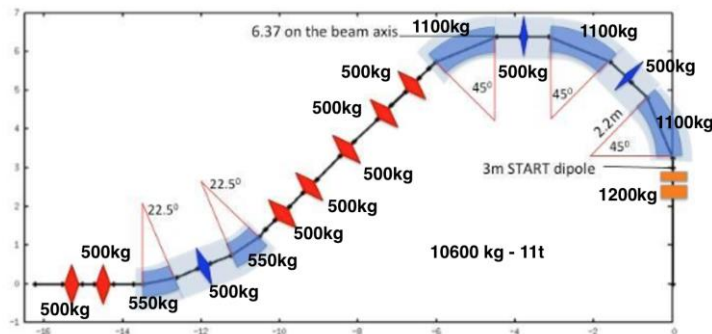
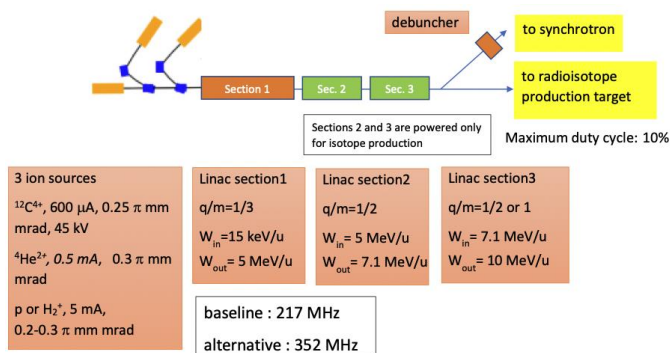
- Heavy Ion Therapy Research Integration Plus





WP 7: Advanced accelerator and gantry design

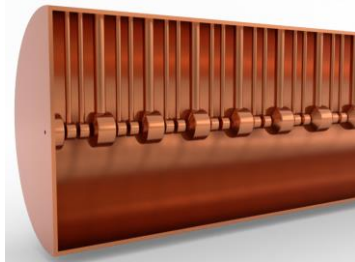
- **Task 7.4:** Injector Linac Design
- **Task 7.5:** Integration of an innovative superconducting gantry: optics, mechanics, beam delivery



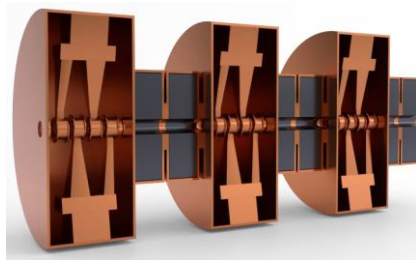
WP 7: Advanced accelerator and gantry design

- Task 7.4: Injector Linac Design**

Quasi-Alvarez Drift Tube LINAC (QA-DTL)

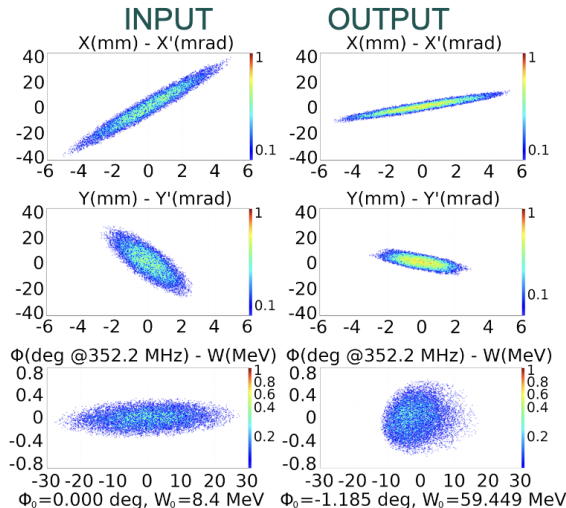


Separated Interdigital H-mode DTL (S-IH-DTI)

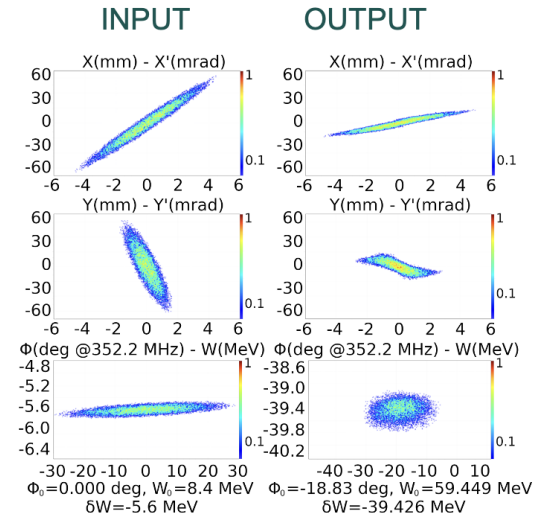


Beam Dynamics - TraceWin

¹²C⁴⁺ ions



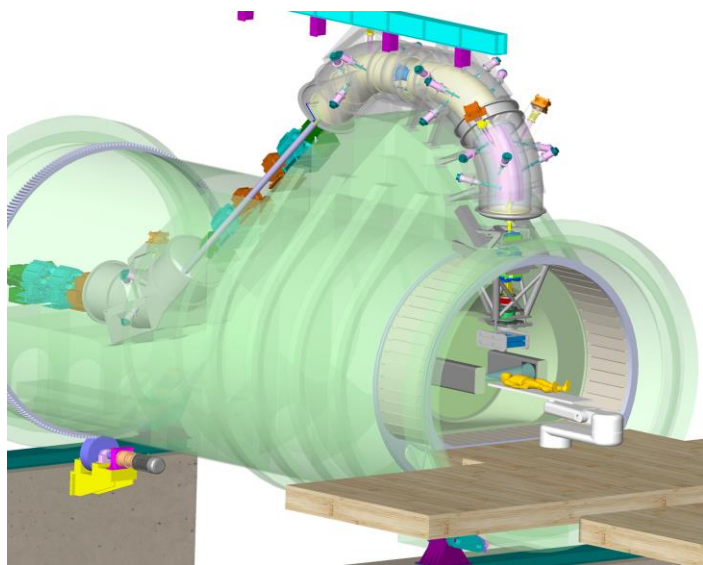
⁴He²⁺ ions



Courtesy: L. Nikitovic

WP 7: Advanced accelerator and gantry design

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

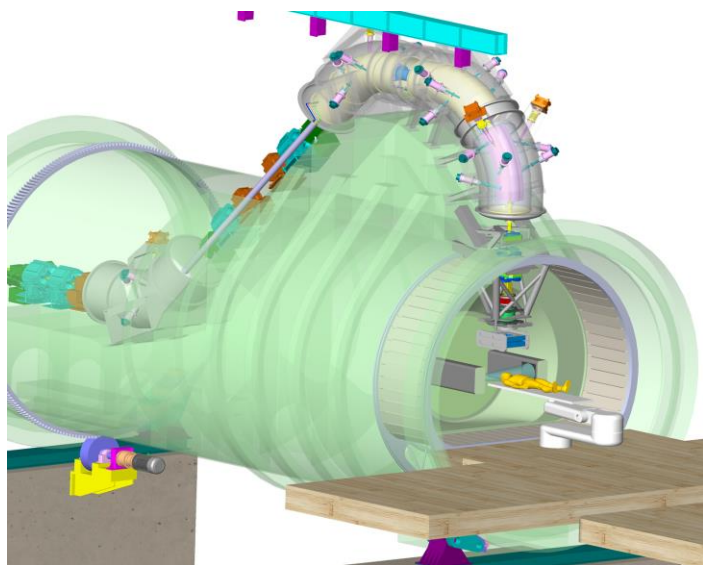


~220t

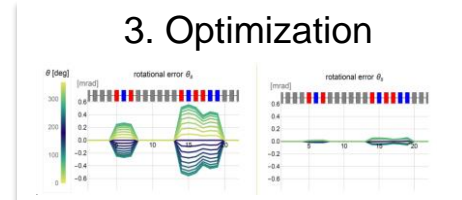
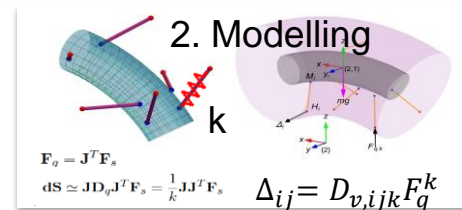
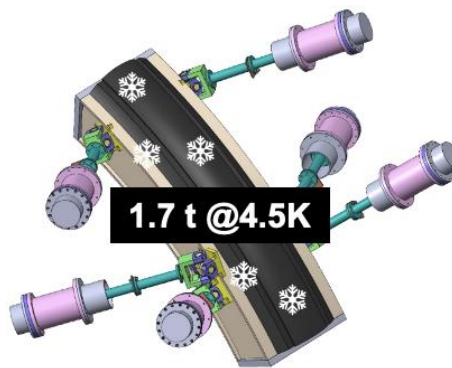
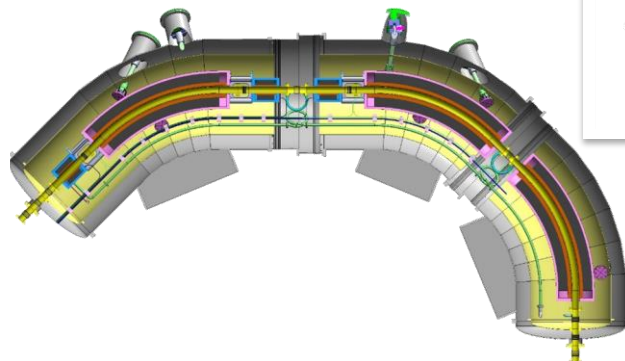
Courtesy: L. Piacentini

WP 7: Advanced accelerator and gantry design

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



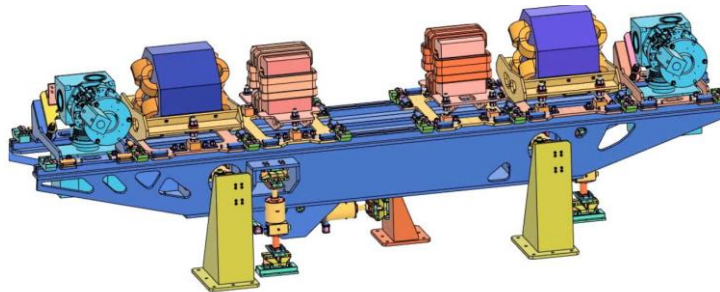
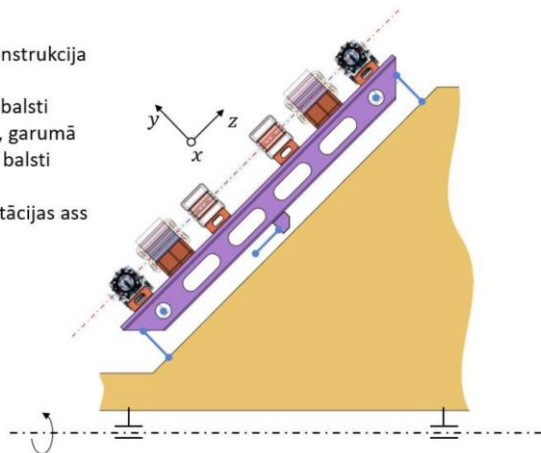
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WP 7: Advanced accelerator and gantry design

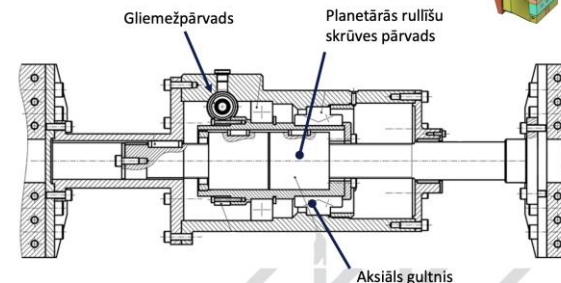
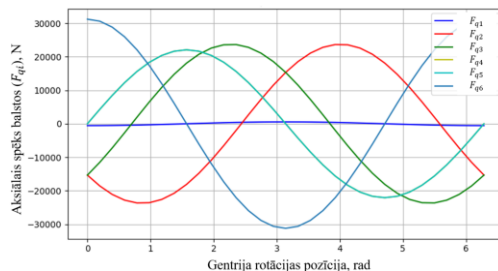
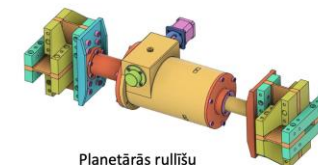
- Task 7.5:** Integration of an innovative superconducting gantry: optics, mechanics, beam delivery

- Gentrīja konstrukcija
- Statne
- Individuāli balsti
- Ortogonāli, garumā regulējami balsti
- - - Stara ass
- - - Gentrīja rotācijas ass



Statnes balstu aktuators

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





Accelerator projects - HITRIplus



Posters: 4pc

Publication: 7pc.

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



COMPARISON OF 352 MHz LINAC STRUCTURES FOR INJECTION INTO AN ION THERAPY ACCELERATOR

Authors: L. Nikitovic, T. Torima, M. Vretenar

AIMS OF STUDY

- Design and compare different structures for comparison of their characteristics.
- Compare the structures in terms of their physical and technical characteristics.
- Compare the structures in terms of their economic characteristics.
- Compare the structures in terms of their environmental characteristics.

WHY DO WE NEED A NEW DESIGN?

- Current design of the accelerator is based on a single structure.
- Current design is not optimal for the injection into an ion therapy accelerator.
- Current design is not optimal for the injection into an ion therapy accelerator.

RESULTS

GA-DTL	GA-DTL	GA-DTL	GA-DTL
Structure	Structure	Structure	Structure
Length	Length	Length	Length
Cost	Cost	Cost	Cost

CONCLUSIONS

Which LINAC structure is the "best"?

- GA-DTL is the best structure for the injection into an ion therapy accelerator.
- GA-DTL is the best structure for the injection into an ion therapy accelerator.

Cold Mass Suspension System of a Rotating Gantry for Medical Applications.

Authors: Luca Piccinetti, Luca Dussa, Diego Pini, Andris Ratkus, Tomis Torima, Stefano Uberti

Problem description

The design of a suspension system for a rotating gantry for medical applications is a complex task. The main challenge is to design a suspension system that is able to support the weight of the gantry and its components, while also allowing for the rotation of the gantry around a vertical axis.

Support material and dimension comparison

Material	Young's Modulus (GPa)	Density (kg/m³)	Strength (MPa)
Aluminum	70	2700	300
Steel	210	7850	500
Carbon Fiber	140	1600	1000

Supervision system design

The suspension system design is based on a combination of structural and mechanical analysis. The main components of the suspension system are the support structure, the suspension elements, and the gantry itself.

Trade-off analysis comparison between architecture "A" and "B"

Architecture	Weight (kg)	Cost (€)	Strength (MPa)
A	1000	10000	300
B	1200	12000	400

References

1. Piccinetti, L., Dussa, L., Pini, D., Ratkus, A., Torima, T., Uberti, S. (2024). Cold Mass Suspension System of a Rotating Gantry for Medical Applications. *ICEC/ICMC 2024*.

Authors: Luca Piccinetti, Luca Dussa, Diego Pini, Andris Ratkus, Tomis Torima, Stefano Uberti

DESCRIPTION

The main challenge in designing suspension systems for superconducting elements is finding a balance between minimizing the load on the cold mass (superconducting) and ensuring sufficient mechanical resistance and stiffness. The trade-off leads engineers to choose from a limited set of materials and supporting architectures known to work when rationally loaded. An initial analysis of literature highlighted the lack of documented studies about a suspension architecture capable of positioning accurately the cold mass while withstanding variable loads. A superconducting ion gantry falls exactly in this multidisciplinary study region. The possible benefits that the research can bring to the ion therapy technological field could be interesting for industries, by transferring knowledge, and most importantly for society in large. Objectives: Evaluate the design process of a cold mass suspension system, its architecture, geometry and materials.

METHODS

The main methods used in this study are: Finite Element Analysis (FEA), Structural Analysis, and Mechanical Simulation. The study also includes a comparison between different suspension architectures.

REQUIREMENTS

- Structural integrity
- Stiffness
- Weight
- Cost

PROPOSAL OF ARCHITECTURES

Two different suspension architectures are proposed: Architecture A and Architecture B. Architecture A is based on a central support structure, while Architecture B is based on a distributed support structure.

GEOMETRIC OPTIMIZATION (of "A")

The geometric optimization of Architecture A is performed using a genetic algorithm. The results show that the optimized structure is able to support the load with a minimum weight and maximum stiffness.

CONCLUSIONS

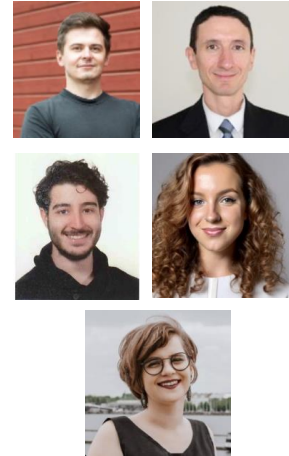
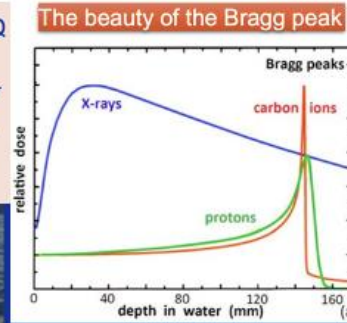
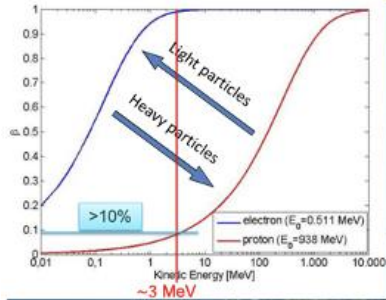
The study shows that the proposed suspension architectures are able to support the load with a minimum weight and maximum stiffness. The optimized structure is able to support the load with a minimum weight and maximum stiffness.

- Next Ion Medical Machine Study

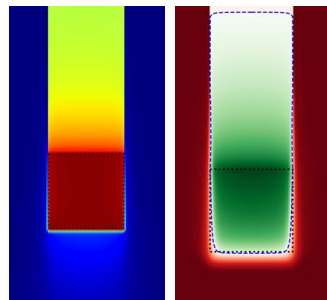


Next Ion Medical Machine Study

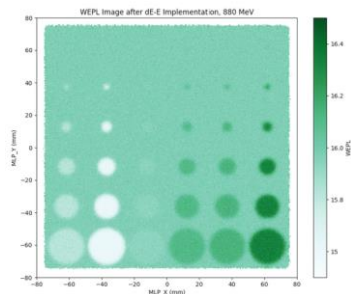
- Developing new technologies for the future generation of accelerators for cancer therapy



Ion FLASH therapy



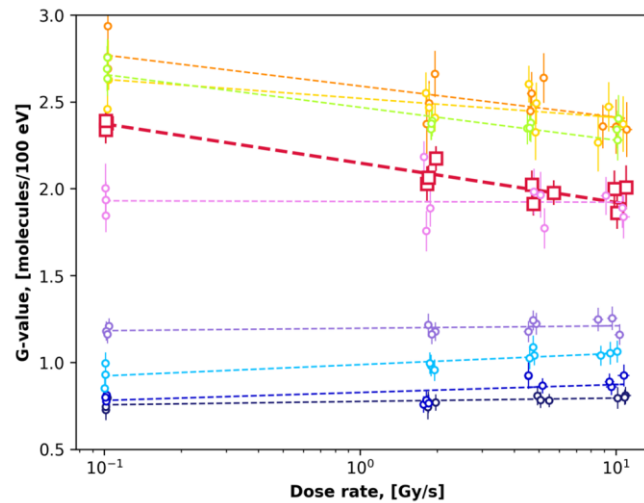
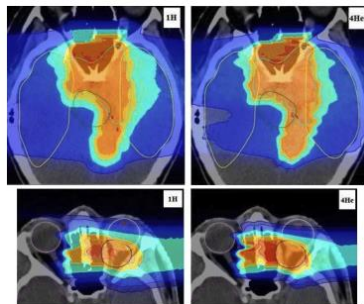
Radiography



Courtesy: I.Baumgarte



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



- Aerated water
- ◆ 1 M sodium nitrate
- ◆ 300 mM sodium nitrate
- ◆ 10 mM sodium nitrate
- ◆ 1 mM sodium nitrate
- ◆ 250 μM sodium nitrate
- ◆ 100 μM sodium nitrate
- ◆ 10 μM sodium nitrate
- ◆ 1 μM sodium nitrate

Courtesy: K.Pajškis

Posters: 5pc

Publication: 4pc.

ASSESSING PARTICLE FLASH-RT EFFECTIVENESS BY MODELLING SOLVATE ELECTRON PRODUCTION DEPENDENCY ON PARTICLE LET

K. Pałski*, M. Szymanski*, T. Tomini*, M. Szymanski*, J. Szymanski*

Background: Particle Flash-RT (FRT) is a novel radiation therapy modality that uses ultra-short, high-dose-rate electron beams. The effectiveness of FRT is highly dependent on the particle linear energy transfer (LET), which influences the production of solvate electrons (SEs) in the target tissue. This study aims to assess the effectiveness of FRT by modelling the dependency of SE production on particle LET.

Methods (cont.): Monte Carlo simulations were performed using the Geant4 framework to model the production of SEs in water. The particle LET was varied from 0.1 to 100 keV/μm. The SE production yield was calculated as a function of particle LET and compared with experimental data.

Results: The SE production yield increases significantly with increasing particle LET. The yield is approximately 10²¹ SEs/kg for 0.1 keV/μm and reaches 10²³ SEs/kg for 100 keV/μm. The experimental data shows a similar trend, with a yield of approximately 10²¹ SEs/kg at 0.1 keV/μm and 10²³ SEs/kg at 100 keV/μm.

Conclusions, future outlooks: The study demonstrates that the effectiveness of FRT is highly dependent on the particle LET. The modelling results are in good agreement with the experimental data. Future work will focus on the optimization of FRT parameters for clinical applications.

FLASH-RT DOSE THRESHOLD EFFECT ESTIMATION FOR PARTICLE BEAMS BY MODELLING SOLVATE ELECTRON PRODUCTION DEPENDENCY ON PARTICLE LET DOSE DISTRIBUTION

K. Pałski*, M. Szymanski*, T. Tomini*, M. Szymanski*, J. Szymanski*

BACKGROUND: Particle Flash-RT (FRT) is a novel radiation therapy modality that uses ultra-short, high-dose-rate electron beams. The effectiveness of FRT is highly dependent on the particle linear energy transfer (LET), which influences the production of solvate electrons (SEs) in the target tissue. This study aims to estimate the dose threshold effect of FRT by modelling the dependency of SE production on particle LET and dose distribution.

AIMS OF THE STUDY: To estimate the dose threshold effect of FRT by modelling the dependency of SE production on particle LET and dose distribution.

METHODS: Monte Carlo simulations were performed using the Geant4 framework to model the production of SEs in water. The particle LET was varied from 0.1 to 100 keV/μm. The SE production yield was calculated as a function of particle LET and compared with experimental data.

RESULTS: The SE production yield increases significantly with increasing particle LET. The yield is approximately 10²¹ SEs/kg for 0.1 keV/μm and reaches 10²³ SEs/kg for 100 keV/μm. The experimental data shows a similar trend, with a yield of approximately 10²¹ SEs/kg at 0.1 keV/μm and 10²³ SEs/kg at 100 keV/μm.

CONCLUSIONS: The study demonstrates that the effectiveness of FRT is highly dependent on the particle LET. The modelling results are in good agreement with the experimental data. Future work will focus on the optimization of FRT parameters for clinical applications.

THE BEST PARTICLE FOR ION-BEAM BASED FLASH: Investigating the comparative behavior of threshold dose effect and dose conformity

K. Pałski*, M. Szymanski*, T. Tomini*, M. Szymanski*, J. Szymanski*

BACKGROUND: Particle Flash-RT (FRT) is a novel radiation therapy modality that uses ultra-short, high-dose-rate electron beams. The effectiveness of FRT is highly dependent on the particle linear energy transfer (LET), which influences the production of solvate electrons (SEs) in the target tissue. This study aims to investigate the comparative behavior of threshold dose effect and dose conformity for different particle types.

AIMS OF THE STUDY: To investigate the comparative behavior of threshold dose effect and dose conformity for different particle types.

METHODS: Monte Carlo simulations were performed using the Geant4 framework to model the production of SEs in water. The particle LET was varied from 0.1 to 100 keV/μm. The SE production yield was calculated as a function of particle LET and compared with experimental data.

RESULTS: The SE production yield increases significantly with increasing particle LET. The yield is approximately 10²¹ SEs/kg for 0.1 keV/μm and reaches 10²³ SEs/kg for 100 keV/μm. The experimental data shows a similar trend, with a yield of approximately 10²¹ SEs/kg at 0.1 keV/μm and 10²³ SEs/kg at 100 keV/μm.

CONCLUSIONS AND FUTURE OUTLOOK: The study demonstrates that the effectiveness of FRT is highly dependent on the particle LET. The modelling results are in good agreement with the experimental data. Future work will focus on the optimization of FRT parameters for clinical applications.

Simulation-Based Assessment of Proton Radiography Across Energy Levels: Investigations on optimum imaging energy

I. Baompang*, K. Pałski*, M. Szymanski*

Background: Proton radiography is a novel imaging modality that uses proton beams to generate contrast in the target tissue. The effectiveness of proton radiography is highly dependent on the proton energy level. This study aims to assess the optimum imaging energy for proton radiography.

AIMS OF THE STUDY: To assess the optimum imaging energy for proton radiography.

METHODS: Monte Carlo simulations were performed using the Geant4 framework to model the production of secondary electrons in water. The proton energy level was varied from 100 MeV to 200 MeV. The secondary electron production yield was calculated as a function of proton energy level and compared with experimental data.

RESULTS: The secondary electron production yield increases significantly with increasing proton energy level. The yield is approximately 10²¹ SEs/kg for 100 MeV and reaches 10²³ SEs/kg for 200 MeV. The experimental data shows a similar trend, with a yield of approximately 10²¹ SEs/kg at 100 MeV and 10²³ SEs/kg at 200 MeV.

CONCLUSIONS: The study demonstrates that the optimum imaging energy for proton radiography is approximately 150 MeV. The modelling results are in good agreement with the experimental data. Future work will focus on the optimization of proton radiography parameters for clinical applications.

Investigation of Helium-3 Usage in Radiography for Patient Position Verification in Particle Therapy

I. Baompang*, K. Pałski*, M. Szymanski*

Background: Helium-3 (He-3) is a rare gas that is used in radiography for patient position verification in particle therapy. The effectiveness of He-3 radiography is highly dependent on the He-3 concentration in the target tissue. This study aims to investigate the usage of He-3 in radiography for patient position verification.

AIMS OF THE STUDY: To investigate the usage of He-3 in radiography for patient position verification.

METHODS: Monte Carlo simulations were performed using the Geant4 framework to model the production of secondary electrons in water. The He-3 concentration was varied from 0.1 to 100 ppm. The secondary electron production yield was calculated as a function of He-3 concentration and compared with experimental data.

RESULTS: The secondary electron production yield increases significantly with increasing He-3 concentration. The yield is approximately 10²¹ SEs/kg for 0.1 ppm and reaches 10²³ SEs/kg for 100 ppm. The experimental data shows a similar trend, with a yield of approximately 10²¹ SEs/kg at 0.1 ppm and 10²³ SEs/kg at 100 ppm.

CONCLUSIONS: The study demonstrates that the usage of He-3 in radiography for patient position verification is highly dependent on the He-3 concentration. The modelling results are in good agreement with the experimental data. Future work will focus on the optimization of He-3 radiography parameters for clinical applications.

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

Overall Concept



Overview of the initiative: Milestones of the initiative

End of 2021
Idea and
 first discussions

Aug 2022
Baltic Assembly
support – letter
 to 3 prime
 ministers

Oct 2022
Resolution of
Baltic Assembly

May 2023
Baltic
implementation
 – part of IPAC
 paper by NIMMS

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



CERN Baltic Group

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

Apr 2022
Conceptual
design paper and
working group
 establishment

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

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

Courtesy: K. Paļskis



Future of the initiative: Feasibility Study

Advanced Particle Therapy center for the Baltic States

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**



**Scientific
 research
 institution**

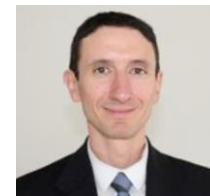


**Clinical cancer
 treatment
 facility**
*Particle therapy and
 nuclear medicine*



Future of the initiative: Feasibility Study

CLINICAL AND EPIDEMIOLOGY	TECHNOLOGY AND IMPLEMENTATION	ECONOMICS AND INNOVATION
<ul style="list-style-type: none"> <input type="radio"/> Research programme in clinical sciences <input type="radio"/> Relevant medical statistics in the region <input type="radio"/> Eligibility criteria for proton therapy <input type="radio"/> Patient referral, connections with PT community 	<ul style="list-style-type: none"> <input type="radio"/> Research programme in natural and technical sciences <input type="radio"/> Technical requirements of the facility <input type="radio"/> Integration study and future upgradability <input type="radio"/> Basis of cost estimates for accelerator and facility 	<ul style="list-style-type: none"> <input type="radio"/> Research on long term funding, business engagement <input type="radio"/> Organizational structure and governance model <input type="radio"/> Full cost estimation and economic benefit analysis <input type="radio"/> Evaluation of revenue streams
TRANSVERSAL TASKS		
<ul style="list-style-type: none"> <input type="radio"/> Alternative solutions for the facility <input type="radio"/> Aspects on regulatory and legal approvals <input type="radio"/> Information flow between pillars for cost estimates <input type="radio"/> Risk analysis and evaluation <input type="radio"/> Education and training necessities 		



On-going development of the working plan

Courtesy: K.Paļskis

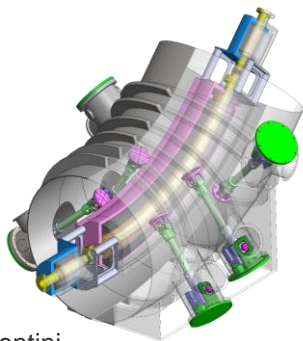
Feasibility Study Steering Group (FSSG) deputy convener - Kristaps Paļskis (RTU)

Project initiative: Advanced Particle Therapy center in the Baltic

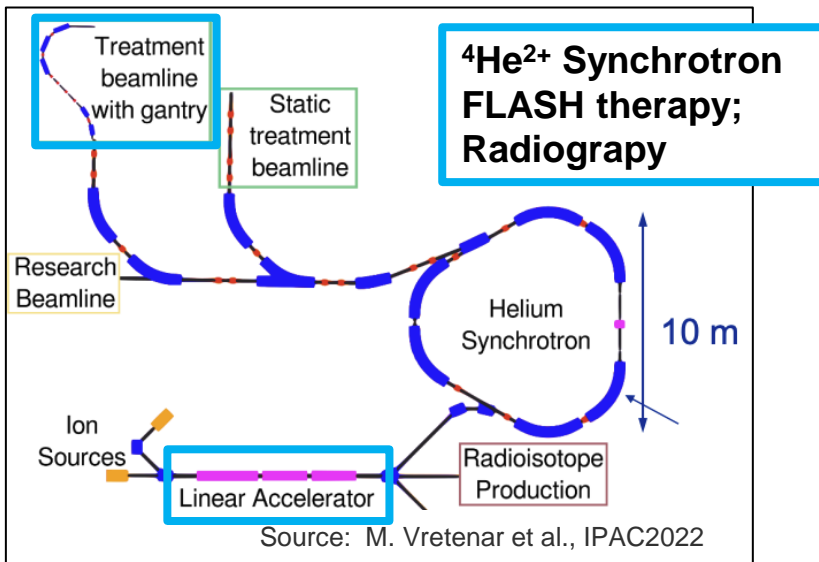


CERN Baltic Group

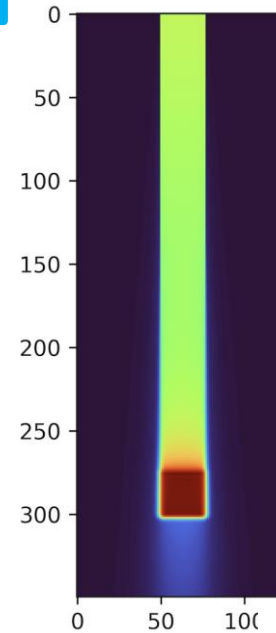
Gantry



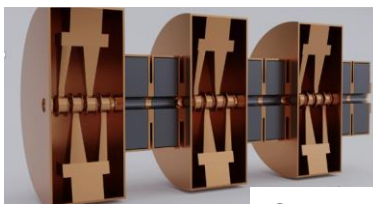
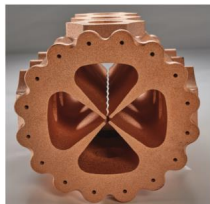
Courtesy: L. Piacentini



RFQ



Courtesy: K. Paļšis



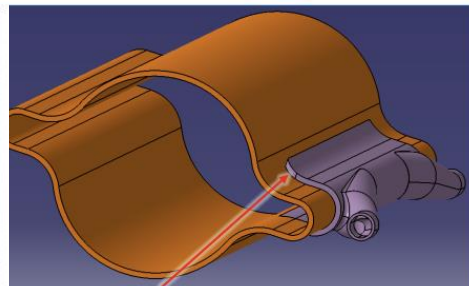
HF-LINAC

Courtesy: L. Nikitovic

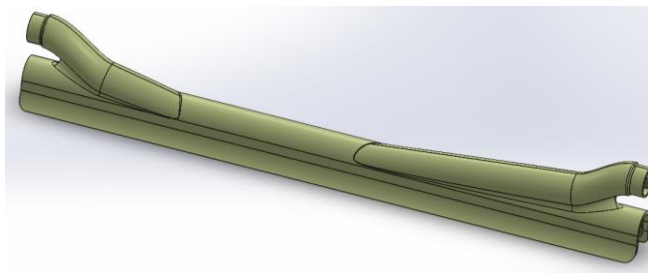


Project with minor contribution

- Future Circular Collider



SR Absorber to be laser welded along outer profile

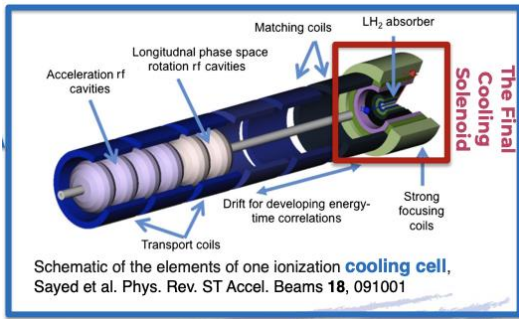


Collaboration in the development phase

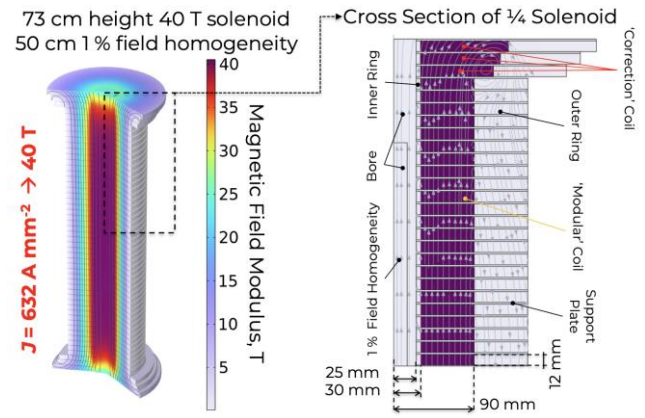
- International Muon Collider Collaboration

The Memorandum of Understanding has been signed by RTU

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



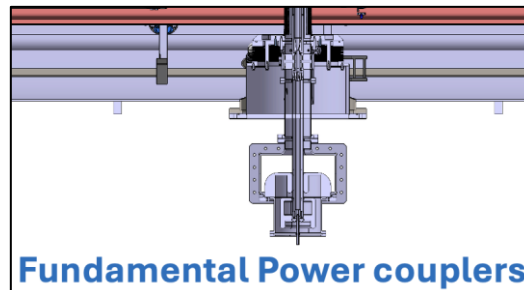
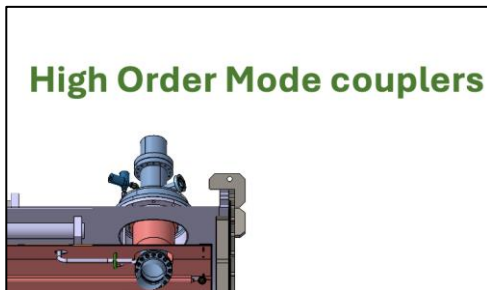
Courtesy: B.Bordini

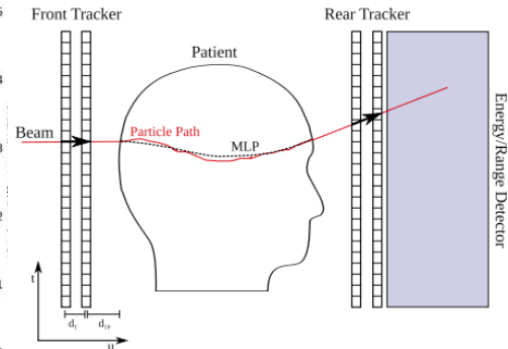
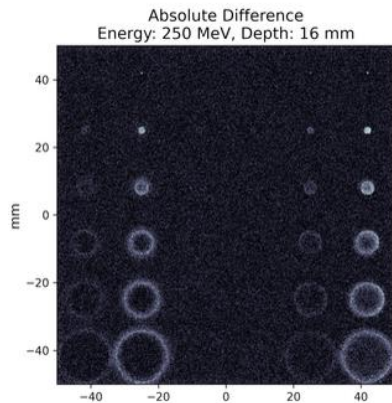
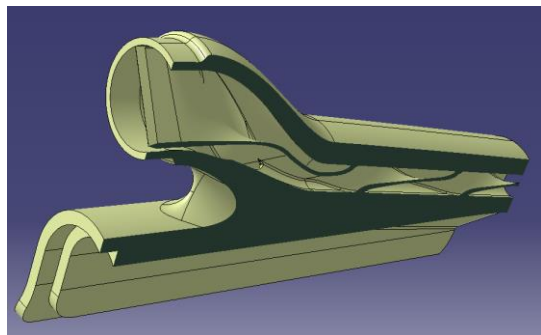
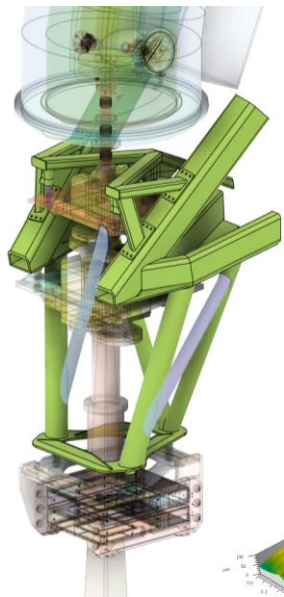


Collaboration in the initial phase

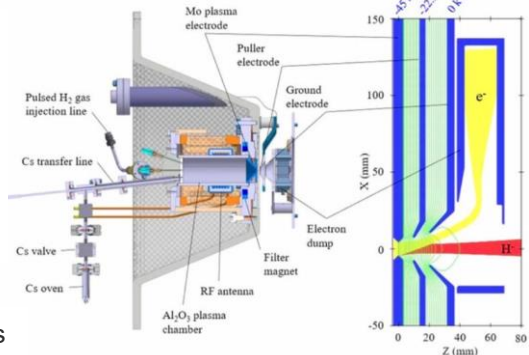
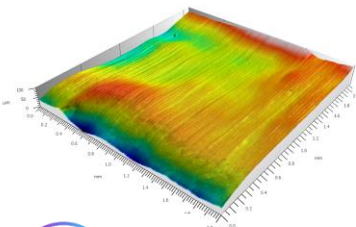
- Innovate for Sustainable Accelerating Systems (IJCLab)
- PERLE (IJCLab)

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

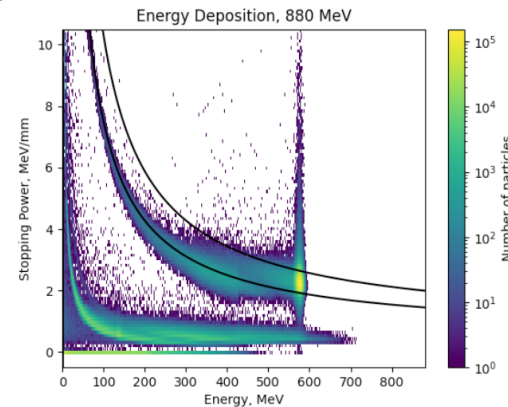




FUTURE CIRCULAR COLLIDER



Courtesy: A.Vinçe

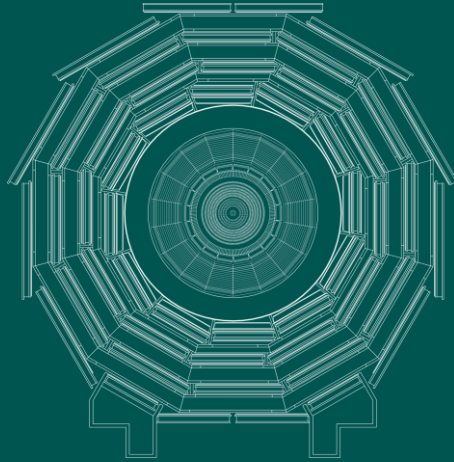


Courtesy: I.Baumgarte

Courtesy: D. Irbe



Courtesy: V.Lācis



Thank you