



# Project initiative “Advanced Particle Therapy center for the Baltic states”

On behalf of the  
CERN Baltic group’s *“Advanced Particle therapy center for the Baltic States”* working group

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## 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**

## NIMMS collaboration

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



# The “ why ? ” : Clinical perspective

**In 2018 – 4.23 million** new registered cancer cases in Europe

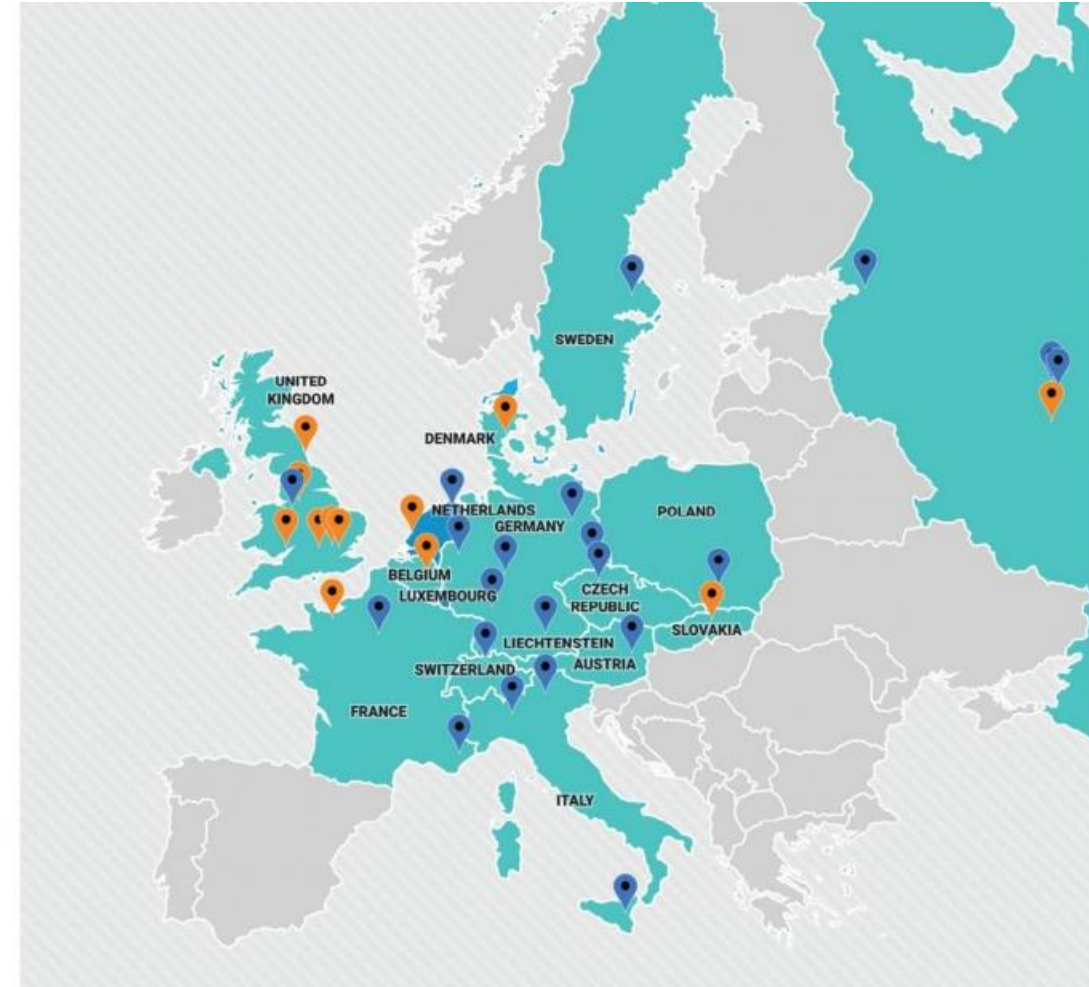
**By 2040 – estimated 5.2 million** new registered cases

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

**1 in 4 patients do not receive the treatment**

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

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



Particle therapy centre geography in Europe, ENLIGHT 2018



# The “ why ? ” : Scientific research

**The Baltic States are lacking a joint, large-scale multi-disciplinary scientific research infrastructure**

**Joint particle accelerator based research infrastructure would foster sustainable collaboration with the CERN**

# Road to the initiative



**April 12<sup>th</sup>, 2022**

“Advanced Particle Therapy center for the Baltic States” working group established within the CERN Baltic group (CBG)

**End of 2021**

CBG discussion with NIMMS collaboration on facility options

**February 2022**

NIMMS Helium synchrotron working group establishment with involvement of researchers from the CBG

**Spring 2022**

Development of a dedicated conceptual design report



# Possible routes for the initiative

## Development of a novel ion therapy system

### A circular particle accelerator in development by NIMMS collaboration

- Acceleration of protons and helium ions to treatment energies
- Higher energy protons for ion radiography purposes
- Possibility for heavy ion acceleration (carbon, oxygen) for biophysics research
- Possibility of ultra-fast dose rate delivery (*FLASH*)
- Possibility of parallel production of therapeutic and diagnostic radioisotopes

*On initial design:* M. Vretenar, E. Benedetto, M. Sapinski, M. E. Angoletta, G. Bisoffi, J. Borburgh, L. Bottura, K. Pałskis, R. Taylor, G. Tranquille: *A Compact Synchrotron for Advanced Cancer Therapy with Helium and Proton Beams*

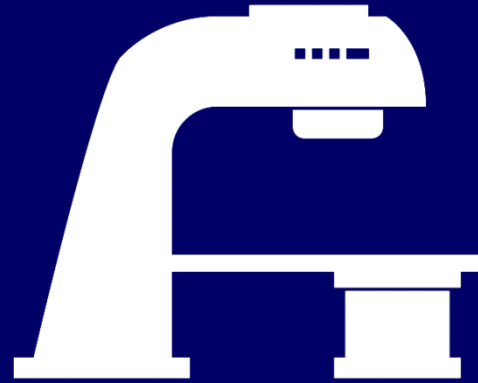
# HELIUM SYNCHROTRON



# Overall concept

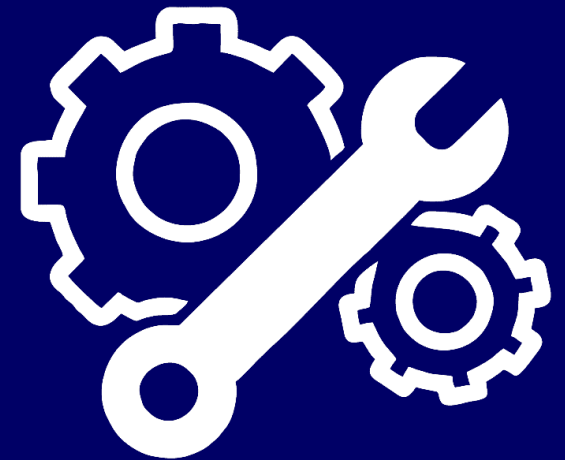


**Research  
institution**



**Clinical cancer  
treatment  
facility**

Particle therapy and  
nuclear medicine



**Industry  
involvement  
infrastructure**



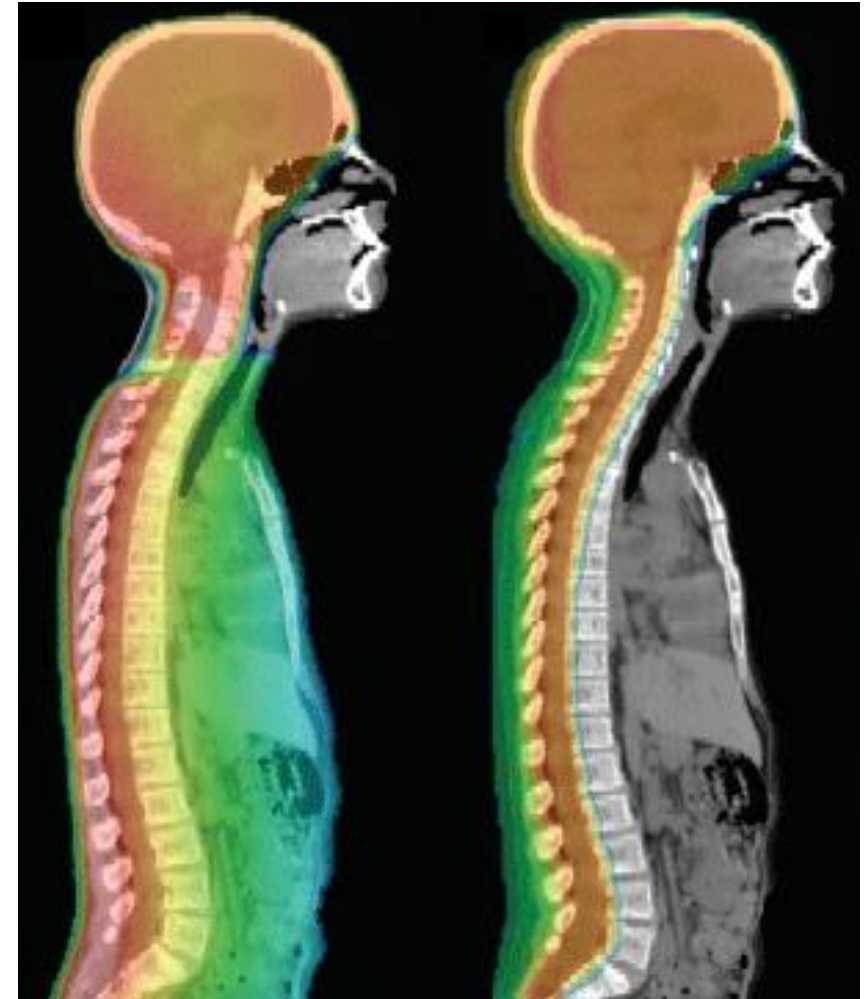
# Overall concept



## Clinical cancer treatment facility

- Helium synchrotron technology
- **Clinical use of proton therapy**
- **Research and future clinical translation of helium ion therapy**
- Technology could offer novel pathways in **nuclear medicine – diagnostics and theranostics**

**Treatment of complex tumors, recurrent cancers and pediatrics**



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





# Overall concept



Research institution

## Clinically necessary research

Clinical radiation oncology – pre-clinical and clinical research, radiobiology, medical physics, dosimetry . . .

Material science, nuclear physics, radiation chemistry, particle physics, accelerator physics and technologies . . .

## Embedded research fields



# Overall concept



Industry involvement  
infrastructure

## Involvement in construction

Involvement of local Baltic industrial companies in technical delivery of the accelerator complex **expanding the “know-how”**

Addressing the needs of particle therapy community globally – development of novel delivery techniques and equipment, particle detectors . . .

## Future technology developments



## Project in close partnership with the CERN NIMMS collaboration

- Strong future involvement of researchers from the Baltic States within the collaboration
- Expanding the knowledge and expertise in medical particle accelerators

**Partners involved in technology development can create their own, unique facility !**

**Success of the *predecessor* PIMMS -  
CNAO and MedAustron**



# Current status of the project

## Scientific communities

- NIMMS collaboration partners
- Baltic scientific community within the CBG
- TIARA Collaboration Council

## Political stakeholders

- Baltic Assembly – letters to Baltic prime ministers
- Baltic States ambassadors within EU COREPER I
- Innovation and investment agencies

**Involvement and support of medical community is crucial !**



# Current status of the project

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



therapeutic technology association in Latvia and Lithuania

Crucial:



# Current status of the project

**Baltic cancer statistics**

**Do we have enough patients?**

**Training and experience from other centers**

**Involvement of nuclear medicine**

**Clinical evidence of proton therapy**

**Radioisotope production**

**Cancer types eligible**

**Lack of specialists**

**How developed is the technology?**

**TRL of helium synchrotron**

## Main topics of the discussion. Conclusions

1. Particle therapy has a broad clinical perspective – it encompasses wide spectrum of oncological indications.
2. Particle therapy is especially effective for complex localizations and in cases where there is no adequate alternative treatment in Latvia for these cases.
3. In further development stages of the project it is crucial to perform a cost and benefit analysis within a regional scale. Clinical effectiveness must be clearly demonstrated, taking into account the need for particle therapy clinical oncological malignancy statistics and prognosis. Currently there are difficulties regarding this aspect in terms of acquiring reliable statistical data – extrapolation for the data of the Baltic States must be done.
4. In further development stages of the project a thorough cost and benefit analysis must be performed at a regional scale. Clinical effectiveness must be clearly demonstrated, taking into account the need for particle therapy clinical oncological malignancies eligible for particle therapy. Currently there are difficulties regarding this aspect in terms of acquiring reliable statistical data – extrapolation for the data of the Baltic States region must be done.
5. The choice on which technology to use can not be based only on emotional aspects. The criteria are chosen by the working group, taking into account the ministry representatives.
6. Criteria for the selection of eligible patients for such a treatment method should be considered.
7. Such a treatment method would definitely allow to reduce the risk of associated treatment complications.
8. Taking into consideration, that the use of helium ions in therapy is a novel, actively researched technology that is currently not certified for medical use yet, the technological configuration of the proposed facility would provide options to still do effective patient treatment in early stages, using the clinically established and certified proton therapy.
9. Taking into account the need for particle therapy clinical oncological malignancy statistics and prognosis, the technological configuration of the center would allow to still do effective cancer treatment therapy in the early stages of the center by using the already clinically established proton therapy.
10. Technological innovations in the fields of medical particle accelerators and other treatment related devices, answering the needs of the particle therapy community at large.
11. The president of Baltic Assembly confirmed the undivided support of this inter-parliamentary organization for the development of this innovative particle therapy center in the Baltic States and activities of CERN Baltic Group. A dedicated resolution of Baltic

## The main topics of discussion. Conclusions

1. The general idea of the flagship initiative to unite Baltic resources vis-a-vis CERN was strongly supported by radiation oncologists, medical physicists and academia representatives.
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5. Clear commitment from the top-level management of the CERN Baltic Group institutions is needed – clear indication of partners, who will be talking part in the project. CERN Baltic Group should clearly decide on the roles of each of the partners and stakeholders involved in the project.
6. The proposed project initiative has to be fully joint and by no-means fragmented.
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10. Specialised training will be needed for specialists involved in the proposed infrastructure and this aspect should be addressed and encompassed into the project strategy at very early stages.
11. Pragmatic reasoning is needed – clear criteria for the project should be established by the working group, subsequently the responsible governmental bodies and ministries should be consulted.
12. There is an opinion that existing particle therapy centres in Europe are rather expensive and that there is currently a lack of patients. From experience, it appears that well-established centres are able to treat a wide range of cancer types of tumors. However, treatment techniques in later stages of operation – the previous statement can't be generalised.
13. Furthermore, lack of the clinical data of long-term particle therapy effects and lack of reliable cancer statistics in the Baltic States must be addressed. Alternative extrapolation and data from other countries with similar experience of the other countries will be needed.
14. There is also lack of clinical data on the combined therapeutical approaches – mixing different treatment techniques (e.g. chemo-therapy + proton therapy).

## Main topics of the discussion. Conclusions

1. CERN Baltic Group was congratulated for the initiative and dedication as well as flexibility to take into account first Baltic level medical community feedback received during and after 8<sup>th</sup> Baltic Radiology Congress (Tallinn, 7 - 8 October 2022).
2. Role and potential future contributions of the Baltic nuclear medicine community specialists in the project shall be clearly defined in further dedicated discussion.
3. The project shall be clearly defined in further dedicated discussion.
4. In addition to the relatively grim cancer rates and predicted increase, cancer mortality statistics, and also the absence of the particle therapy centers in the Baltic region it was underlined that also financial contributions to the national health care systems is at relatively low level compared to other European states.
5. In further development stages of the project it is crucial to perform a cost and benefit analysis within a regional scale. Clinical effectiveness must be clearly demonstrated, taking into account the need for particle therapy clinical oncological malignancy statistics and prognosis. Currently there are difficulties regarding this aspect in terms of acquiring reliable statistical data – extrapolation for the data of the Baltic States region must be done.
6. There is currently a lack of the relevant specialists for operation of such a facility in the region. The necessary experts in the relevant fields should be identified and necessary to address in the relevant fields.
7. Overall idea and philosophy of the project is considered to be very good, attractive to the young generation of specialists and will boost the corresponding regional research to the new, competitive level.
8. Addressing the possibility of lack of patients in Baltic States region alone, potential extension of the project idea towards inclusion of Finland was discussed and considered as a viable option.
9. Lessons and experience from past Baltic level large scale cooperation projects such as oncological ophthalmology centre in Baltics and joint secondary standard dosimetry laboratory.
10. It would be very interesting to see what potential lessons could be learned from other experience. Such exchange of knowledge will be critical to success of the potential Baltic project.





# Current status of the project

## 25<sup>th</sup> of May: Workshop “Particle therapy - future for the Baltic States? State-of-play, synergies and challenges” at CERN

*Cancer statistics and indication profile in the Baltic States. Status of radiotherapy technologies in the Baltic States.*

*Clinical indications for proton and particle therapy. Existing clinical evidence and on-going clinical trials.*

*The technology of helium synchrotron: technology readiness level and research needed.*

*Current status of nuclear medicine in the Baltic States. Trends and research pathways going into the future.*

*Educational necessities and possible solution pathways for clinical and technical personnel training.*

**Medical communities – generally supportive and a lot of current state considerations are done.**

**Generally practical approach – more and more investigations on certain aspects are necessary, calling for an official feasibility study in the near future.**



**Report – to be finalized at beginning of July**



# Role of today's workshop

One of the key development areas indicated always in our discussions:  
**Training and education**

***Clinical aspects and rationales of particle therapy***

***Medical physics and quality assurance in particle therapy***

***Helium ion therapy. Heavy ion therapy research***

***Practical experience of setting up a treatment center***

Introduction to the key aspects and considerations for particle therapy for our Baltic clinical and research communities

**Learning from the European ion therapy center experts !**





# Final words . . .

- Visionary and long-term goals for the region from medical perspective, but even more – scientific research perspective
- Exciting opportunity and unifying project between the 3 States
- Flagship project for collaboration between CERN and the Baltic States
- Preventing *brain-drain* of professionals, researchers and young scientists in the corresponding fields
- Goes *hand in hand* with the development strategies of the Baltic States and overall European Union priorities

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



**Thank you and wishing  
a fruitful workshop!**