



**Innovative Facility for Isotope GENERation with Efficient Ion Accelerator**

# **GSI Helmholtzzentrum für Schwerionenforschung GmbH**

**Yiota Foka, GSI**

**Kick-off meeting**

3-4 March 2025

Thessaloniki, Greece





## **GSI Helmholtzzentrum für Schwerionenforschung**

GSI Helmholtzzentrum für Schwerionenforschung operates a unique accelerator for heavy ions. Researchers from around the world use this facility for experiments that help them make fascinating discoveries in basic research. In addition, they continually develop new and impressive applications.



IFIGENEIA

# Partner profile

## ■ Crossing new frontiers

Research at GSI has already achieved significant results, including the discovery of six new chemical elements and the development of a new type of tumor therapy using ion beams.

Currently the international accelerator center called FAIR – one of the largest research projects in the world – is being built adjacent to GSI.

## ■ Research



The research program of GSI covers the entire structure

of matter: from the visible range down to the elementary building blocks.

## ■ Accelerator facility



GSI operates one of the world's most powerful particle

accelerator facilities, accelerating ions of all naturally occurring chemical elements.

- [Research – Overview](#)
  - [Ion-beam therapy in the fight against cancer](#)
  - [New elements](#)
  - [HADES experiment](#)
  - [Nuclear- and particle physics](#)
  - [Atomic physics](#)
  - [Plasma physics](#)
  - [Biophysics and medical science](#)
  - [Materials research](#)
  - [Computing center Green IT Cube](#)
- [Accelerators – Overview](#)
  - [Ion sources](#)
  - [Linear accelerator](#)
  - [Ring accelerator](#)
  - [Storage ring](#)
  - [Fragment separator](#)
  - [Main control room](#)

## ■ FAIR – The universe in the lab



Currently the

international accelerator center FAIR – one of the largest research projects in the world – is being built at GSI.

- [FAIR – Overview](#)
- [Research at FAIR](#)
- [The accelerator facility](#)
- [FAIR civil construction](#)
- [High tech for FAIR](#)
- [Facts and figures](#)

## ■ Information for specialists



For more detailed

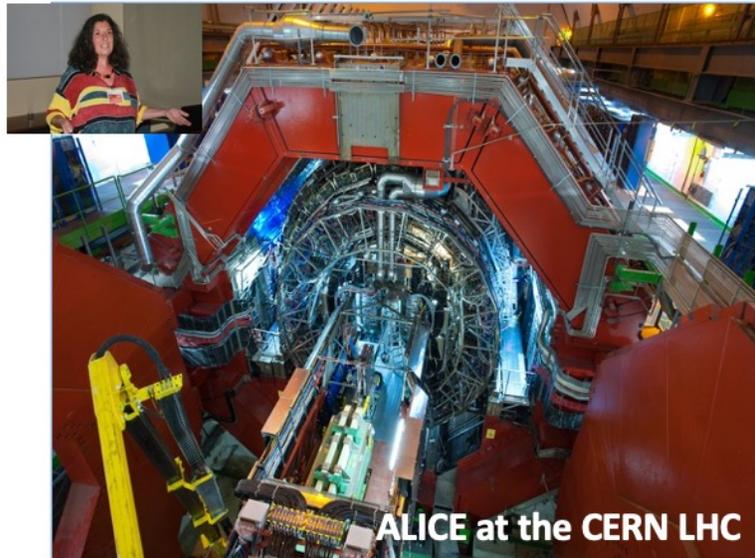
information, please also visit the websites of the specialist departments for research and accelerator operation:

- [GSI research, experiments and collaborations](#)
- [Accelerator specialist departments](#)
- [Publikations at GSI – the GSI Institutional Repository](#)

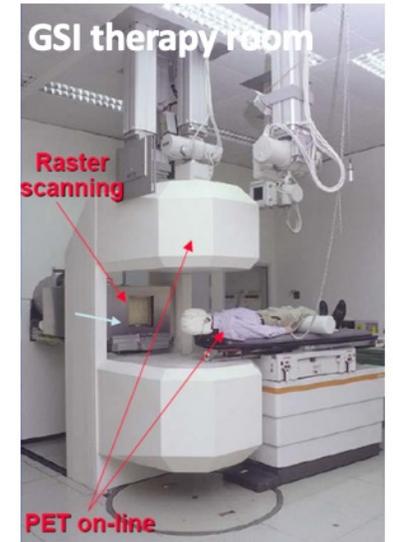
## Heavy-ion research and heavy-ion therapy

Heavy-ion Physicist, involved with medical applications of heavy-ions for cancer therapy

ALICE heavy-ion experiment at CERN



GSI, pioneering heavy-ion cancer therapy in the 90s



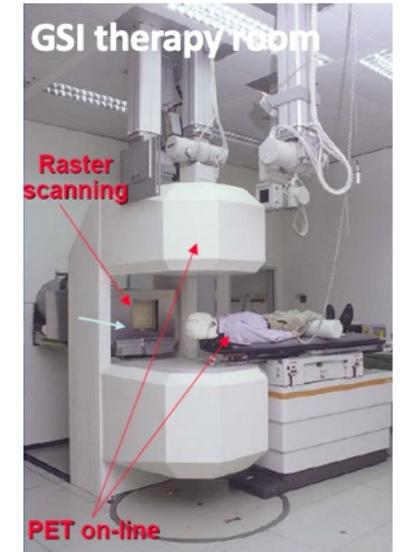
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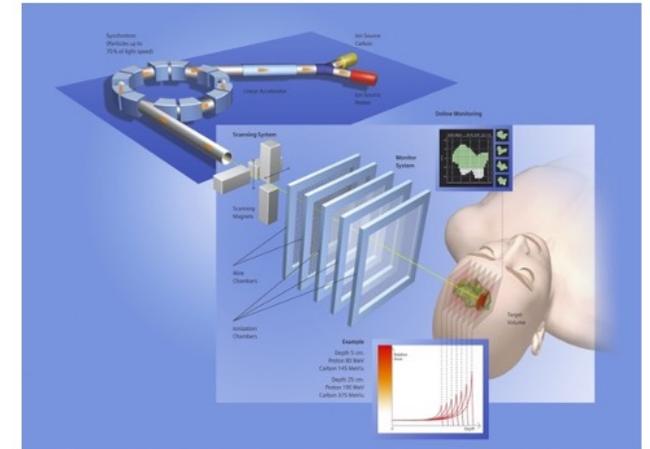
ALICE heavy-ion experiment at CERN



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Heidelberg Ion Therapy HIT centre



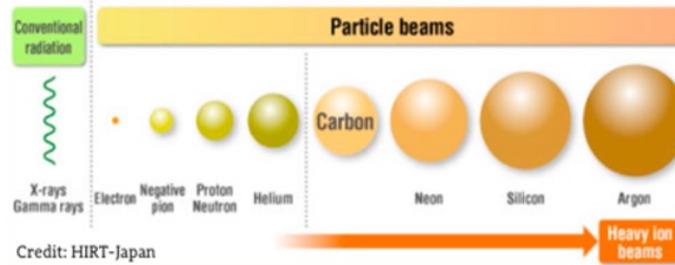
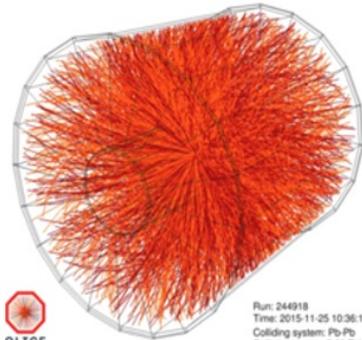
Implemented at HIT, Heidelberg Ion Therapy centre

## Heavy-ion research and heavy-ion therapy

Pb-Pb at 5.5 TeV  
pp at 14 TeV  
 fundamental science  
 QGP studies



Credit: CERN

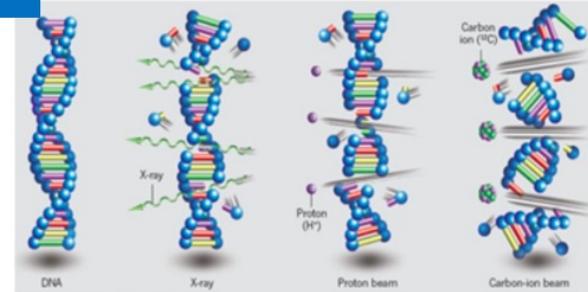
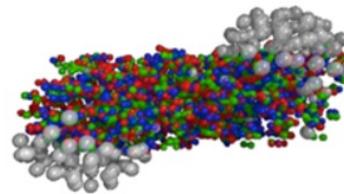


88-430 MeV/u carbon  
 50-221 MeV/u protons  
 applied science  
 medicine



Credit: HIT Heidelberg

What Physics  
 has to do  
 with Medicine?



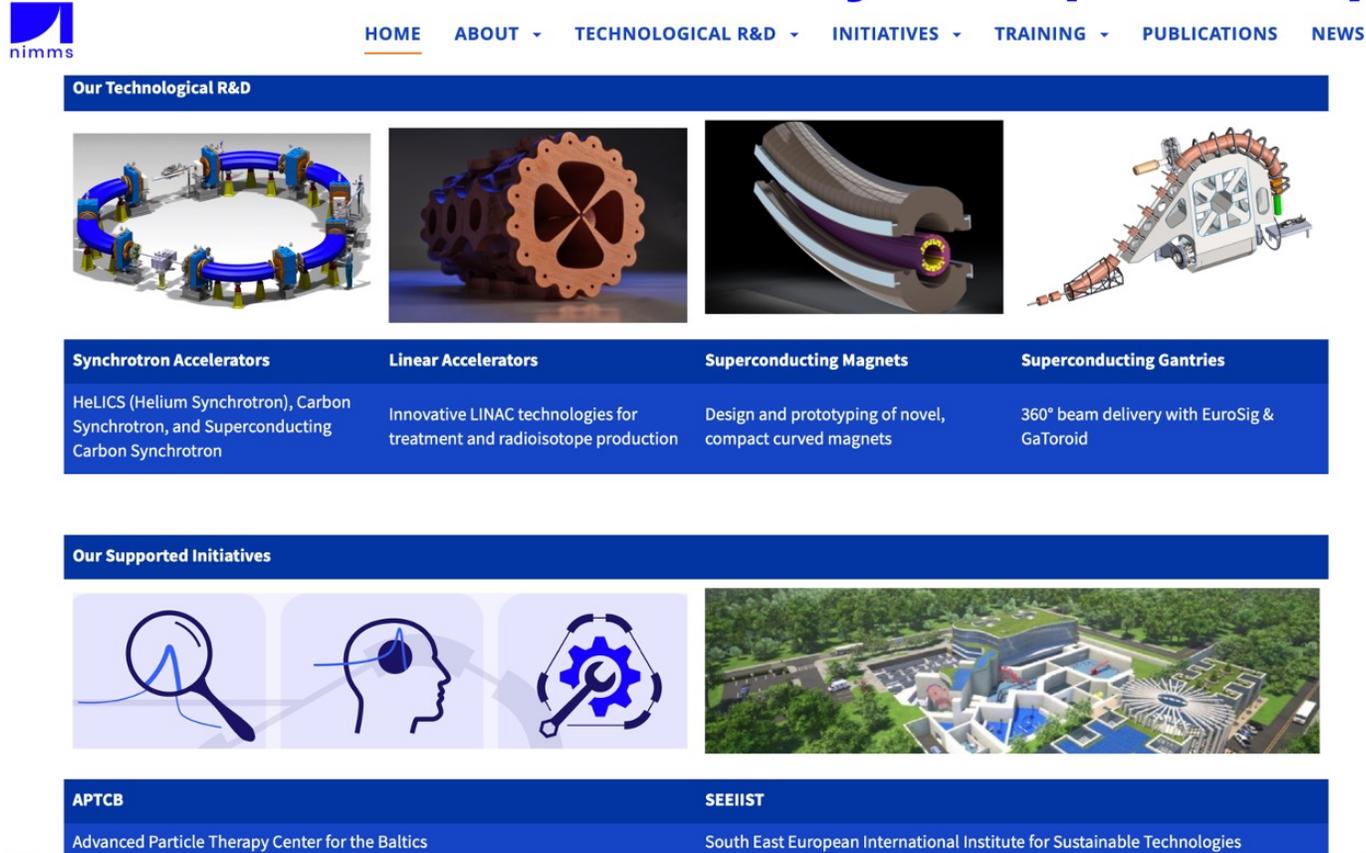
An example of applications of fundamental research for the benefit of society

# Main activities & competencies

## From the historic GSI therapy room Cave M



## Next Ion Medical Machine Study Group Developments



The screenshot shows the website for the Next Ion Medical Machine Study Group (nimms). The navigation menu includes: HOME, ABOUT, TECHNOLOGICAL R&D, INITIATIVES, TRAINING, PUBLICATIONS, and NEWS. The main content is divided into two sections: 'Our Technological R&D' and 'Our Supported Initiatives'.

**Our Technological R&D**

Synchrotron Accelerators	Linear Accelerators	Superconducting Magnets	Superconducting Gantries
HeLICS (Helium Synchrotron), Carbon Synchrotron, and Superconducting Carbon Synchrotron	Innovative LINAC technologies for treatment and radioisotope production	Design and prototyping of novel, compact curved magnets	360° beam delivery with EuroSig & GaToroid

**Our Supported Initiatives**

<p><b>APTCB</b></p> <p>Advanced Particle Therapy Center for the Baltics</p>	<p><b>SEEIIST</b></p> <p>South East European International Institute for Sustainable Technologies</p>
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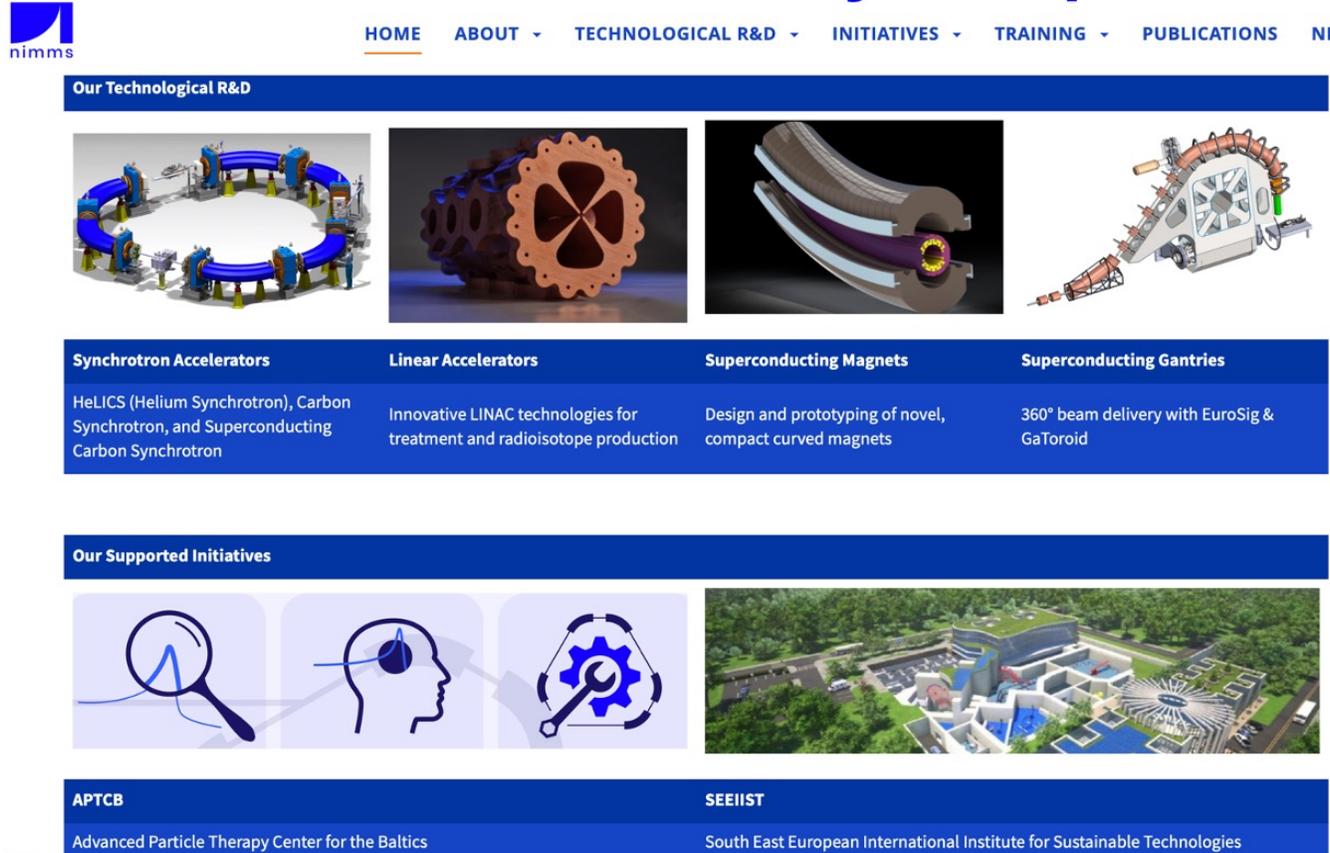
Participation in the EU funded projects I.FAST and HITRIplus

WP:

- management
- dissemination
- Education

NOTE: Dissemination via relevant channels

## Next Ion Medical Machine Study Group Developments



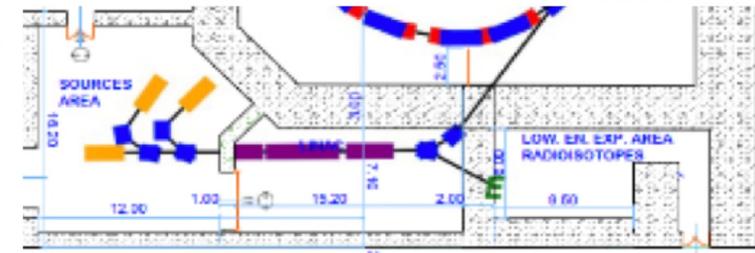
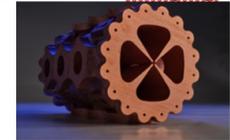
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- Synchrotron Accelerators**  
HeLICS (Helium Synchrotron), Carbon Synchrotron, and Superconducting Carbon Synchrotron
- Linear Accelerators**  
Innovative LINAC technologies for treatment and radioisotope production
- Superconducting Magnets**  
Design and prototyping of novel, compact curved magnets
- Superconducting Gantries**  
360° beam delivery with EuroSig & GaToroid

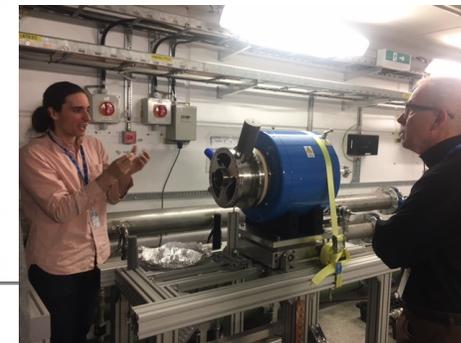
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- APTCB**  
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- SEEIIST**  
South East European International Institute for Sustainable Technologies

IPAC22: Vretenar, M., Mamaras, A., Bisoffi, G., Foka, P. (2022). "Production of radioisotopes for cancer imaging and treatment with compact linear accelerators."



Focus on Astatine: A.M. and Eirini Ksanthopoulou, AUTH



Collaboration with  
UNSA and  
Three Physicists Foundation

Participant	WP1	WP2	WP3	WP4	WP5	WP6	Total Person-Months
20 - GSI	1.00	6.00	1.00		2.00	6.00	16.00

Participation in the following WPs:

- WP1: Project Management (T1.4 Capacity Building UCY)
- WP2: Education, Dissemination, Inclusion and Diversity (T2.1 IJS, T2.2 TPOLIS, T2.3 GNP, T2.4 AUTH)
- WP3: LINAC design dedicated to radioisotope production and other societal applications (T3.2 CERN)
- WP5: Business plan for end users: From science to business including spinoffs (T5.3 RCM)
- WP6: Mentorship (T6.1 AUTH, T6.2 GSI, T6.3 CERTH)

Task Leader of T6.2 “Master Classes in Particle Therapy”



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