

Particle Therapy MasterClass



<https://indico.cern.ch/event/840212/>

INTERNATIONAL MASTERCLASSES

Yiota Foka (GSI/CERN)

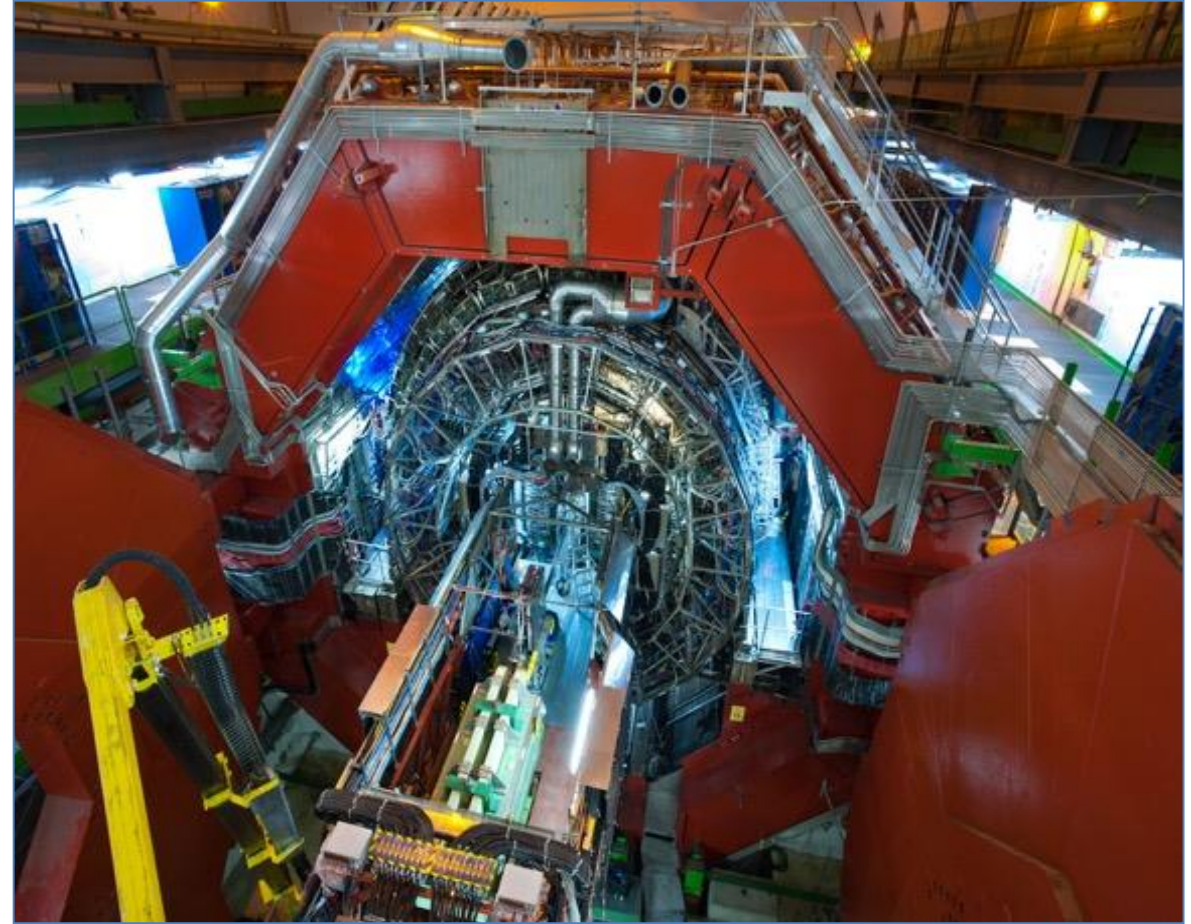
on behalf of

IPPOG and IMC Steering Group



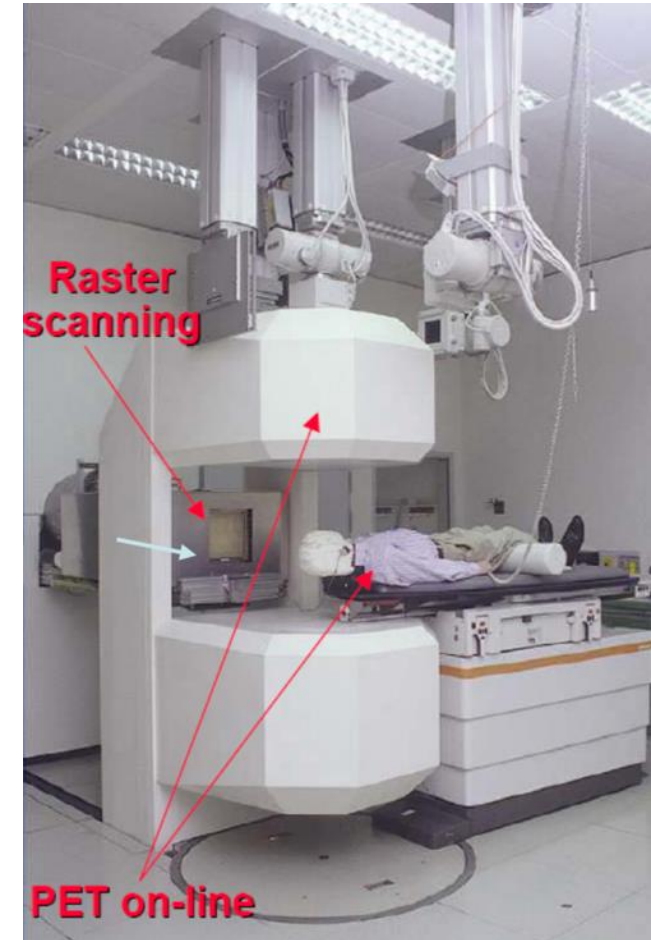
Heavy-ion research and heavy-ion therapy

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



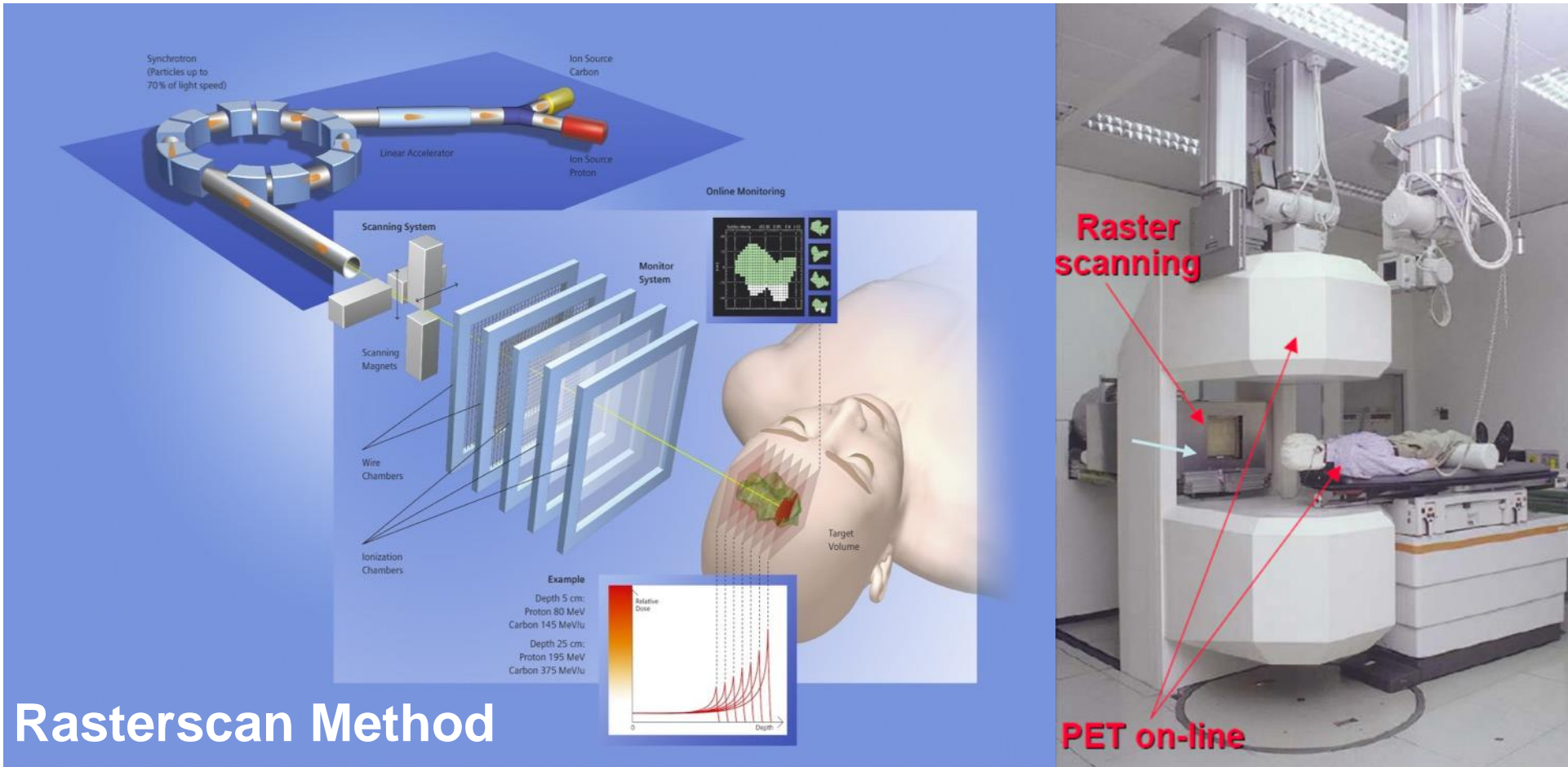
Visit at ALICE heavy-ion experiment at CERN and CNAO heavy-ion therapy center

Heavy-ion research and heavy-ion therapy at GSI



Pioneering heavy-ion (carbon) therapy for cancer tumours in Europe

Heavy-ion research and heavy-ion therapy at GSI

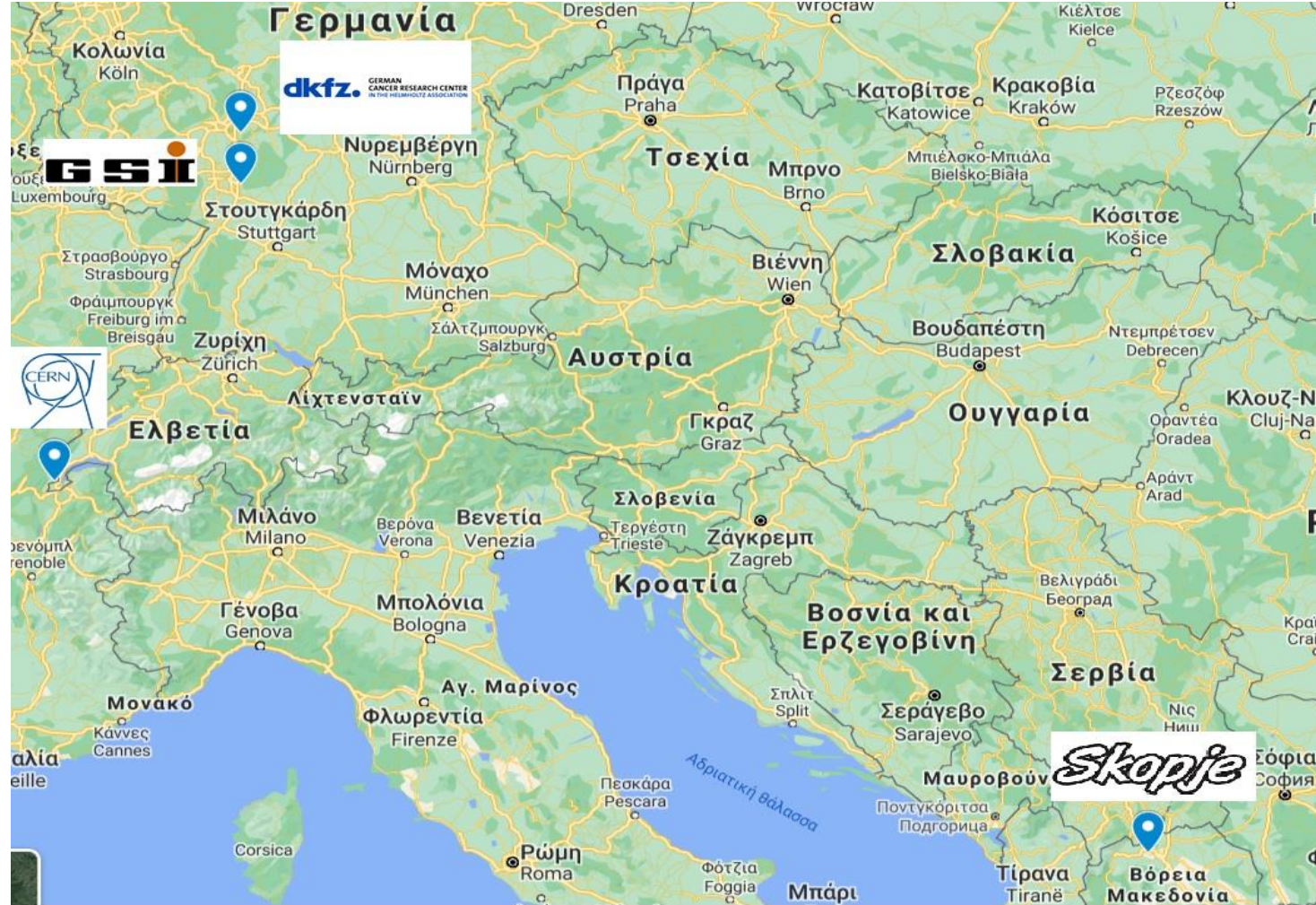


Rasterscan Method

Haberer et al., NIM A , 1993

Implemented in the Heidelberg and Marburg Ion Treatment centers (HIT and MIT) in Germany

PTMC Participants, 6 March 2021



International MasterClasses

<https://physicsmasterclasses.org/>

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 **Hands on Particle Physics Masterclasses**
SCHEDULE 2021

At the end of each Masterclass day a videoconference between the institutes and with moderators at CERN, at Fermilab, TRIUMF, KEK, or GSI is established. The schedules for 2021 will be created early in 2021.



© CERN



© Fermilab



IMC Statistics 2019

Motivate the next generations of scientists !



54 countries
255 institutes
15 000 students
5 weeks in 2019

IMC 2021 :
11.2.2021 – 27.3.2021



Brings scientific methods and real data to schools!

Coordination QuarkNet / TU Dresden

- 51 institutes (48)
- 54 LHC Masterclasses (50)
 - 22 ATLAS (19)
 - 32 CMS (31)
 (Incl. TRIUMF program)
- 12 MINERvA Masterclasses

- 188 institutes (177)
- 266 LHC Masterclasses (257)
 - 30 ATLAS W (35)
 - 101 ATLAS Z (104)
 - 64 CMS (58)
 - 41 LHCb (39)
 - 27 ALICE SP (18)
 - 3 ALICE R_AA (3)

Flagship project of IPPOG, the International Particle Physics Outreach Group

Concept and programme of an IMC day

Every year, during the months of February-March school-children (15-19 year old) are invited to an institute of their area.

Scientists for a day !!



2-5 institutes per day performing the same programme

LOCAL TIME: ACTIVITY

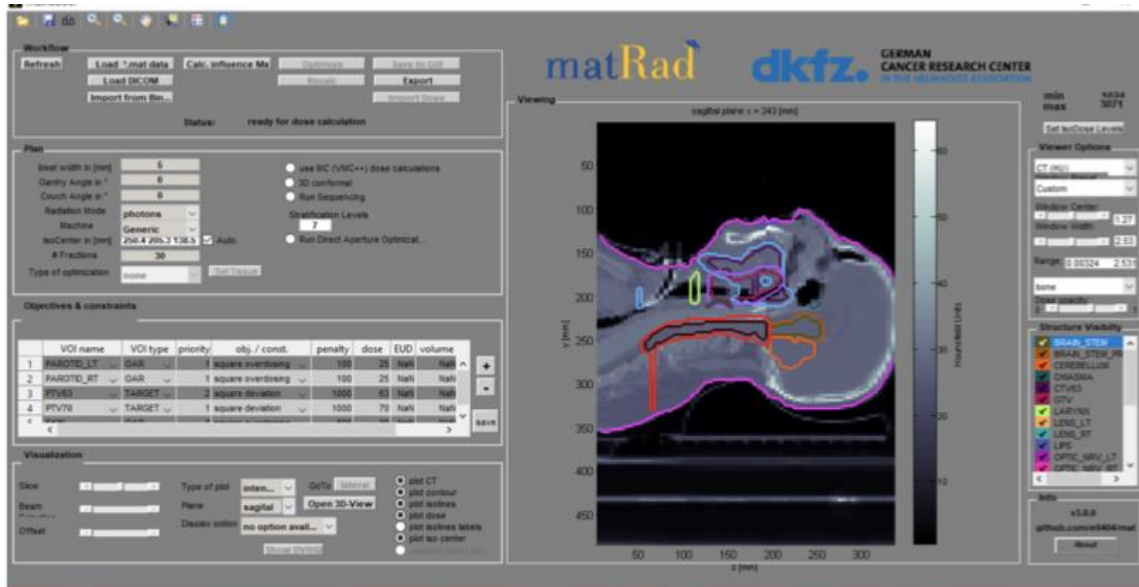
8:30 - 9:00	Registration and Welcome
9:00 - 10:00	Introductory lectures
10:30 - 11:30	Visit of a lab or experiment
12:00 - 13:00	Lunch
13:00 - 15:00	Hands-on session
15:00 - 16:00	Discuss results locally
16:00 - 17:00	Video conference



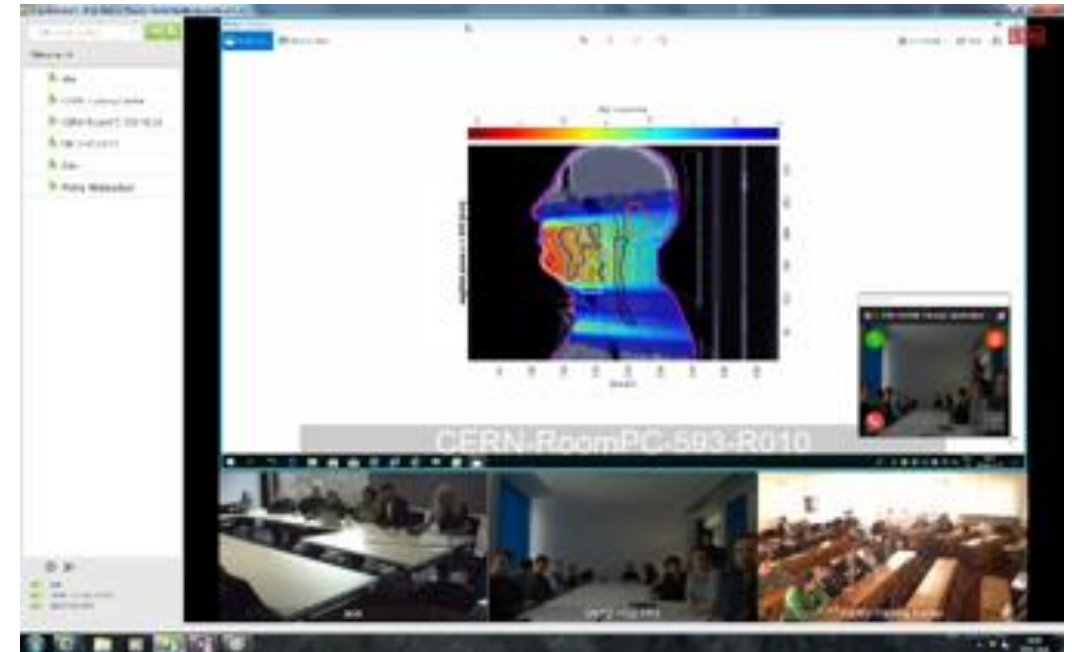
The aim is to get insight into topics and methods of research

New PTMC and Treatment Planning

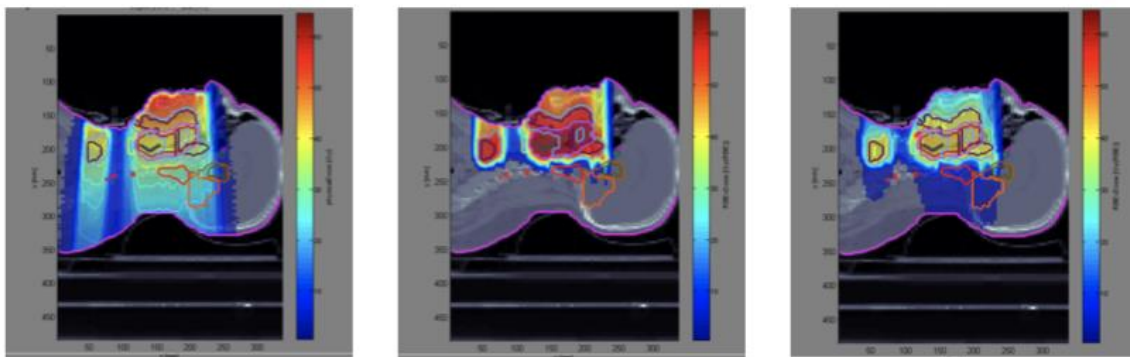
Based on professional open source treatment planning: matRad developed by Heidelberg DKFZ www.matrad.org



Simplified version for PTMC
Using photons, protons and carbon ions



Demo⁴ of the matRad software kit for Treatment Planning .



PTMC pilots in 2019



- First local test: GSI, 7th February 2019
- First international test: CERN, DKFZ, GSI, 5th April 2019

Participation of CURIEosity Team from Crete, Greece



CERN, DKFZ, GSI

Survey: positive results from students

**Hope and motivation to contribute
to the fight against cancer**

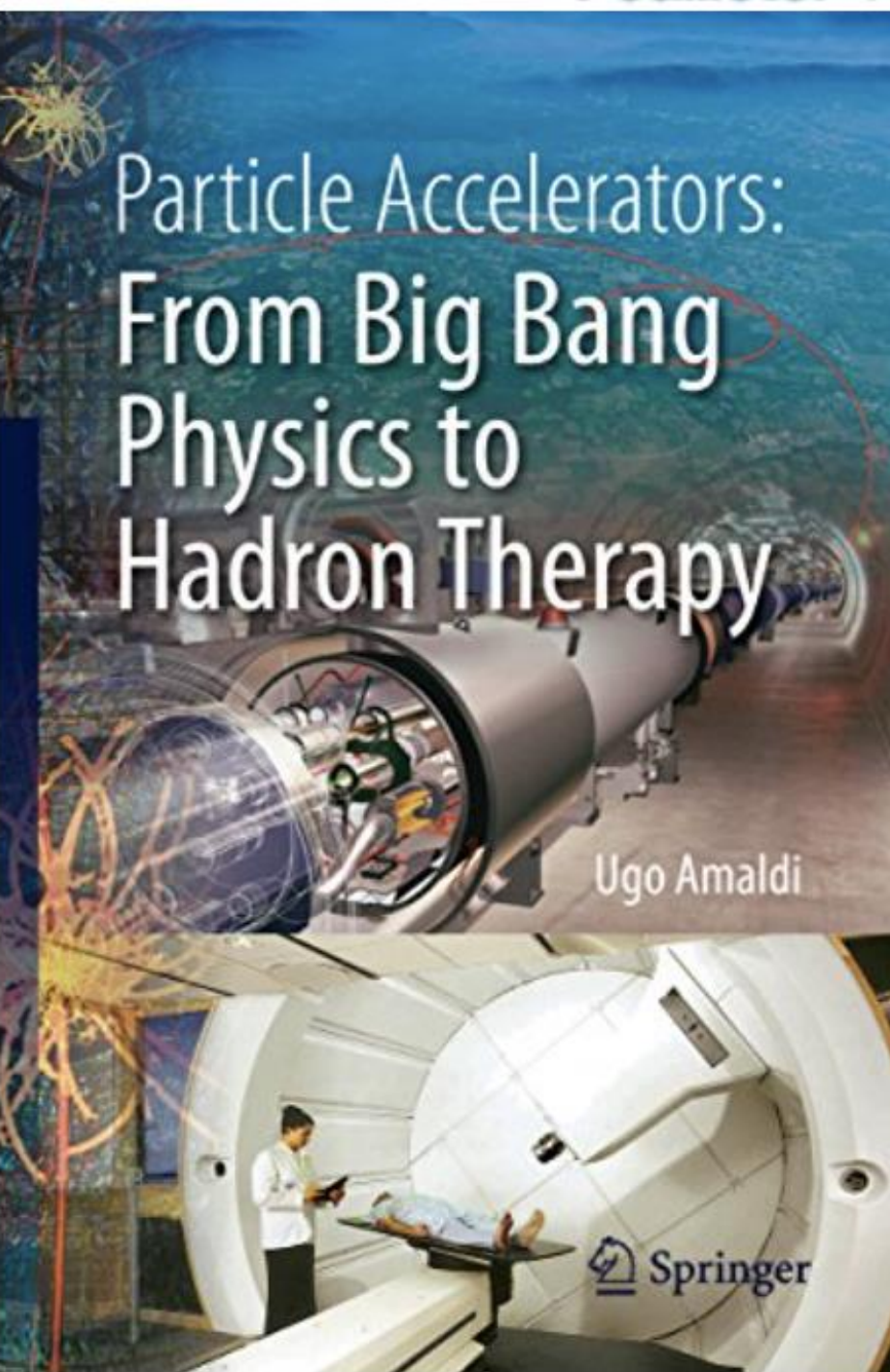
How is physics related to medicine?

What is particle therapy?

How one can use particles for cancer treatment?

Accelerators for research and accelerators for cancer treatment

One of the aims of PTMC: address such questions



Accelerator and Society

Over 30'000 particle accelerators are in operation world-wide.

Only ~1% are used for fundamental research.

Medicine is the largest application with more than 1/3 of all accelerators.

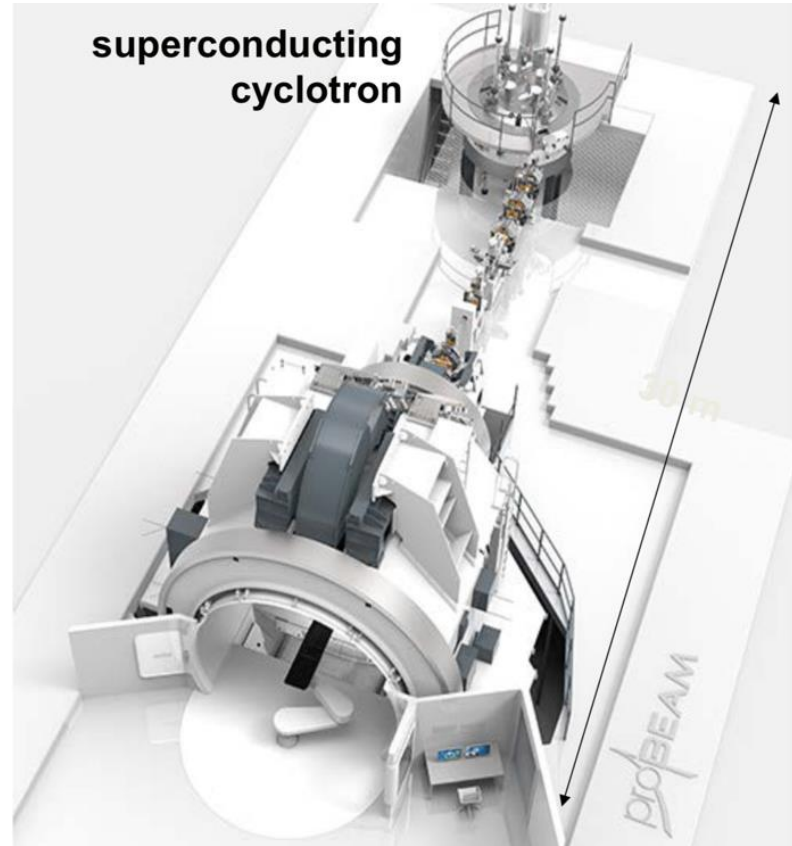
Research		6%
	<u>Particle Physics</u>	0,5%
	<u>Nuclear Physics, solid state, materials</u>	0,2 - 0,9%
	<u>Biology</u>	5%
Medical Applications		35%
	<u>Diagnostics/treatment with X-ray or electrons</u>	33%
	Radio-isotope production	2%
	<u>Proton or ion treatment</u>	0,1%
Industrial Applications		<60%
	Ion implantation	34%
	<u>Cutting and welding with electron beams</u>	16%
	<u>Polymerization</u>	7%
	<u>Neutron testing</u>	3.5%
	<u>Non destructive testing</u>	2,3%

Accelerators for health

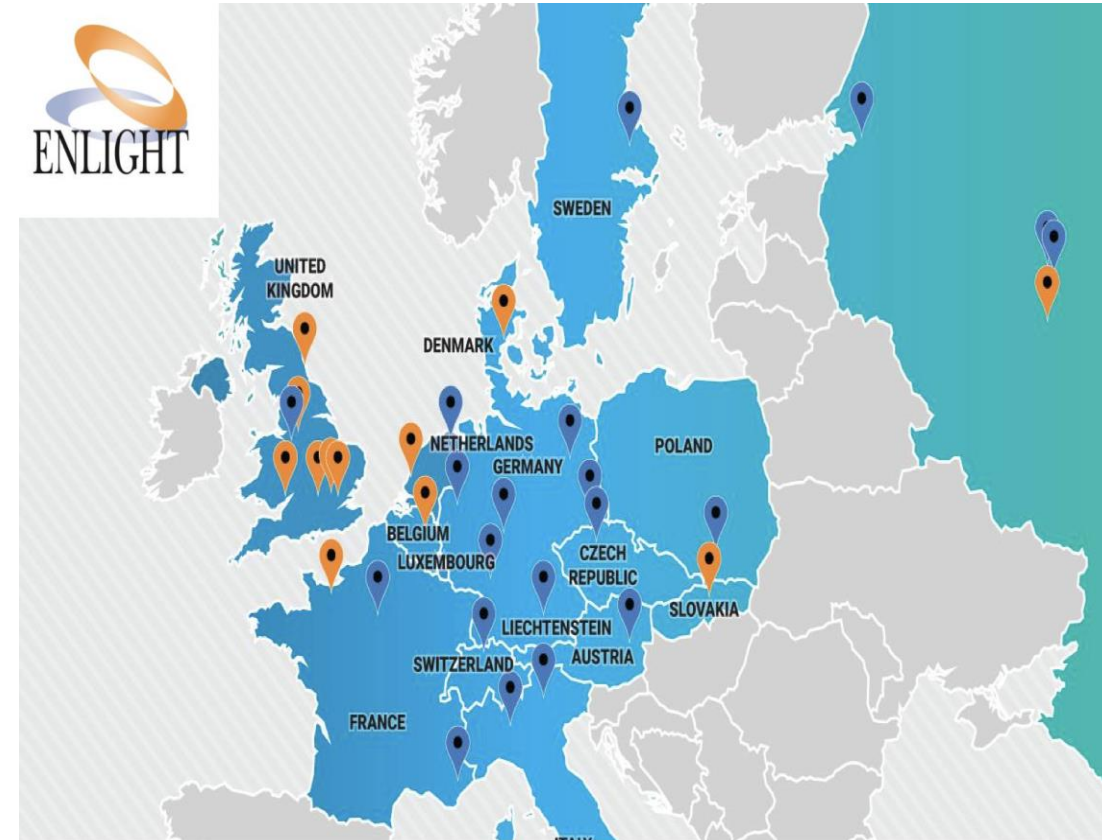
Conventional x-ray Radiotherapy



Particle/Hadron Therapy with protons



Hadron Therapy centers in Europe (2018)



Four carbon-ion cancer therapy centers in Europe

MedAustron, Austria



CNAO, Italy



HIT, Germany



MIT, Germany



Virtual Hadron Therapy Center



Basic concepts for a
**SOUTH-EAST EUROPE
INTERNATIONAL INSTITUTE FOR
SUSTAINABLE TECHNOLOGIES
(SEEIIST)**

Next generation facility for cancer tumour therapy and research with heavy-ion beams



January 15, 2018

Proposal for a facility in South East Europe: SEEIIST

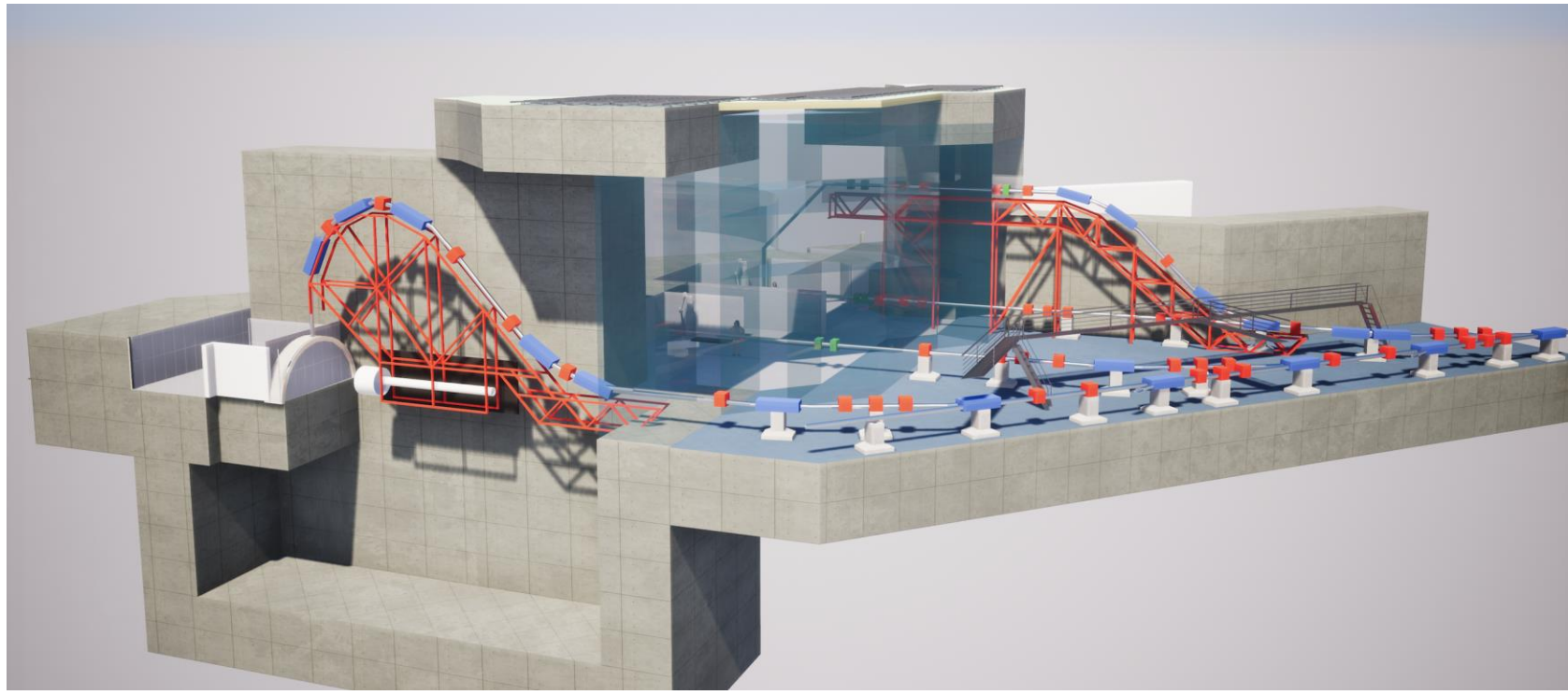
Beam Delivery

Gantry at HIT



600 tons

Gantry at SEEIIST



40 tons



Particle Therapy MasterClass

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- ✉ pt.mc@cern.ch

Presentations

<https://indico.cern.ch/event/840212/>

Presentation of MatRad



Particle Therapy Masterclass

Overview and Pilot Report



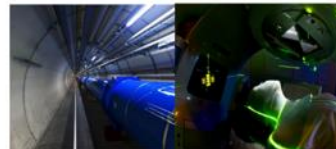
For ppt click [here](#).

Material in different languages

Animations

Presentation of Particle physics to medical applications

Particle physics to medical applications



Manjit Dosanjh, CERN

Introductory presentation in Greek



Δρ. Γ. Δείδης
Ludwig-Maximilians-University of Munich
Department of Medical Physics
27 Αυγούστου 2017, Χανιά

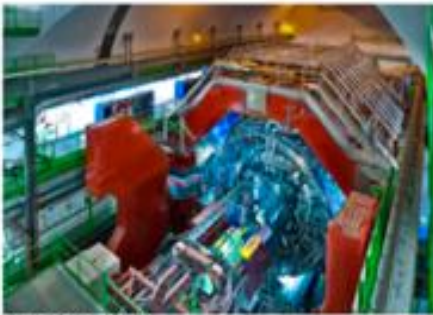
[Workflow Instructions](#)

[Workflow Instrukcije](#)

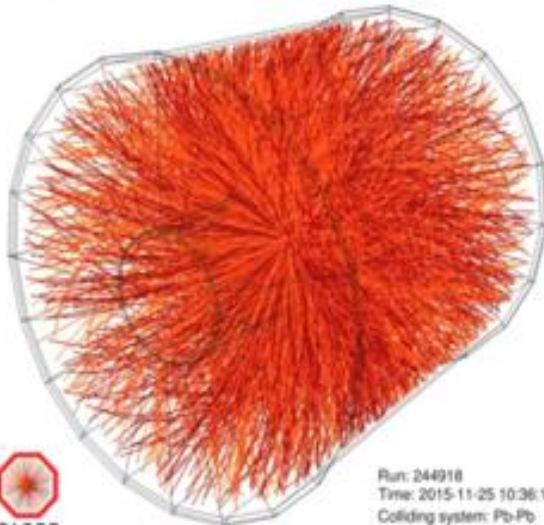
Heavy-ion research and heavy-ion therapy

Pb-Pb at 5.5 TeV
pp at 14 TeV

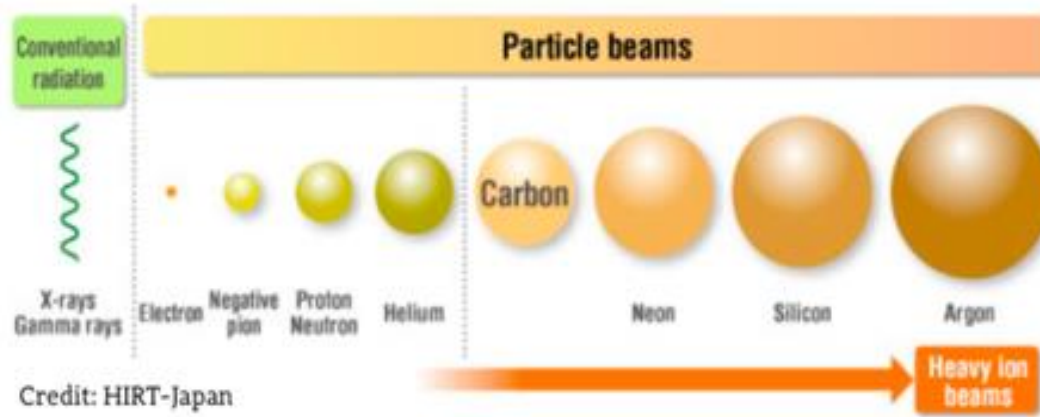
fundamental science
QGP studies



Credit: CERN



Run: 244918
Time: 2015-11-25 10:36:18
Colliding system: Pb-Pb
Collision energy: 5.02 TeV



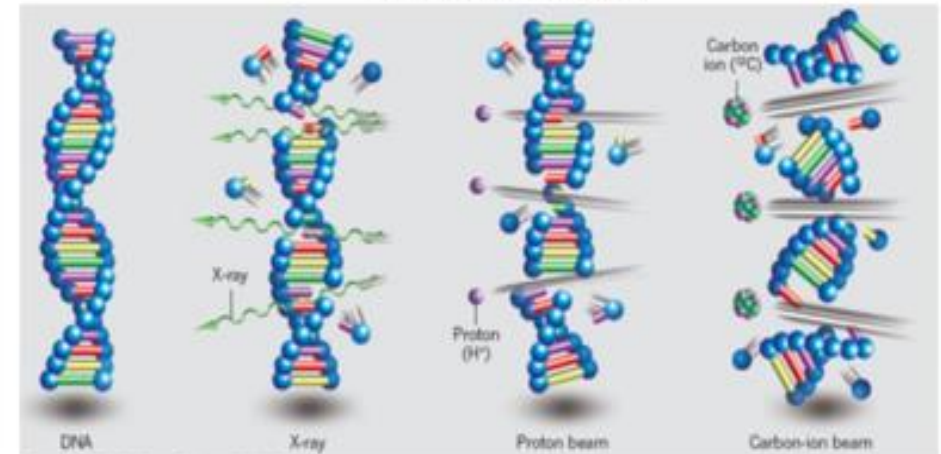
Credit: HIRT-Japan

88-430 MeV/u carbon
50-221 MeV/u protons

applied science
medicine



Credit: HIT Heidelberg



Credit: T. Nomiya, NIRS Japan



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