HITRI plus
Heavy Ion Therapy Research Integration

Discussion on the masterclass content

YIOTA FOKA (GSI)

ON BEHALF OF THE MASTERCLASS CORE TEAM

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101008548

HITPIplus Schools

In order to facilitate sustainability and spreading to the max the acquired knowledge all HITRIplus schools foresee **“Train the Trainer”** sessions: train tutors that could perform back at their home institutes the **Particle Therapy MasterClasses** that are one-day events addressing high-school students.

Next schools:

https://www.hitriplus.eu/event-calendar/

- 4-8 July 2022 https://indico.cern.ch/event/1160802/registrations/83367/
- in 2023

Heavy Ion Therapy Masterclass School in HITRIplus “Education and Training” addressing university students, starting from basics assuming no specialisation and up to early stage researchers

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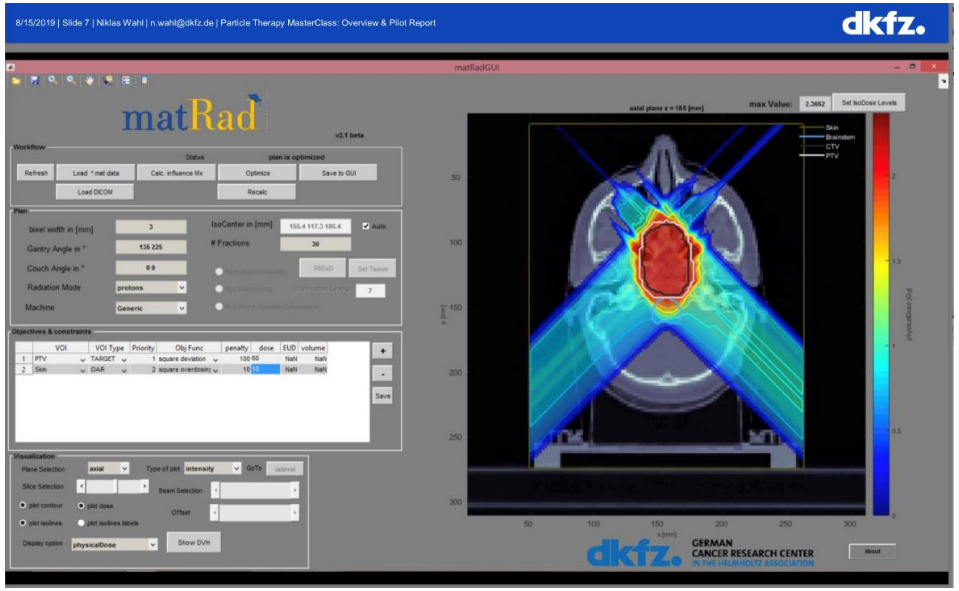
Hands-on Treatment Planning

Hands-on: based on professional open source treatment planning toolkit matRad, developed by Heidelberg DKFZ for research and training www.matrad.org



Please submit the results of the hands-on by email to: nicholas.sammut@um.edu.mt by 11 July 2022.

For any issues related to the Train the Trainers Hands-on Session please contact: yiota.foka@cern.ch and/or n.wahl@dkfz-heidelberg.de

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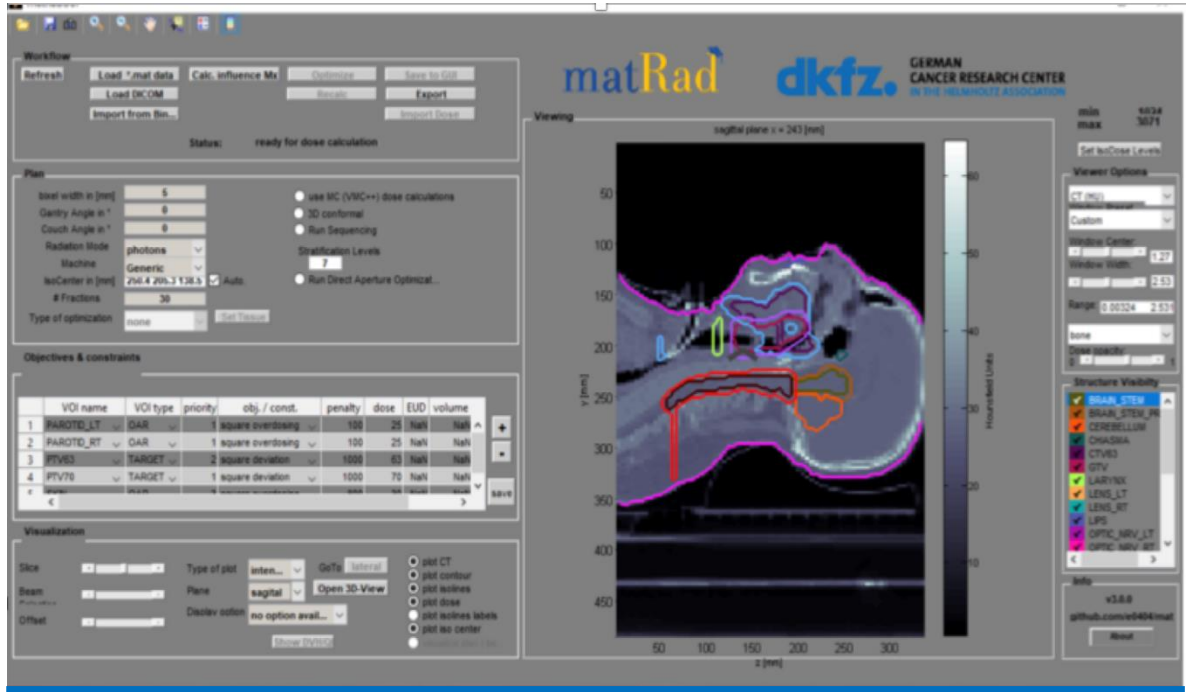
Particle Therapy MasterClasses
PTMC

Treatment Planning

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

Virtual Therapy Centre

Treatment Planning and all it entails to deliver the beam to the target



multidisciplinary facets of heavy- ion therapy

aim: give the full image what happens from the beginning to the end

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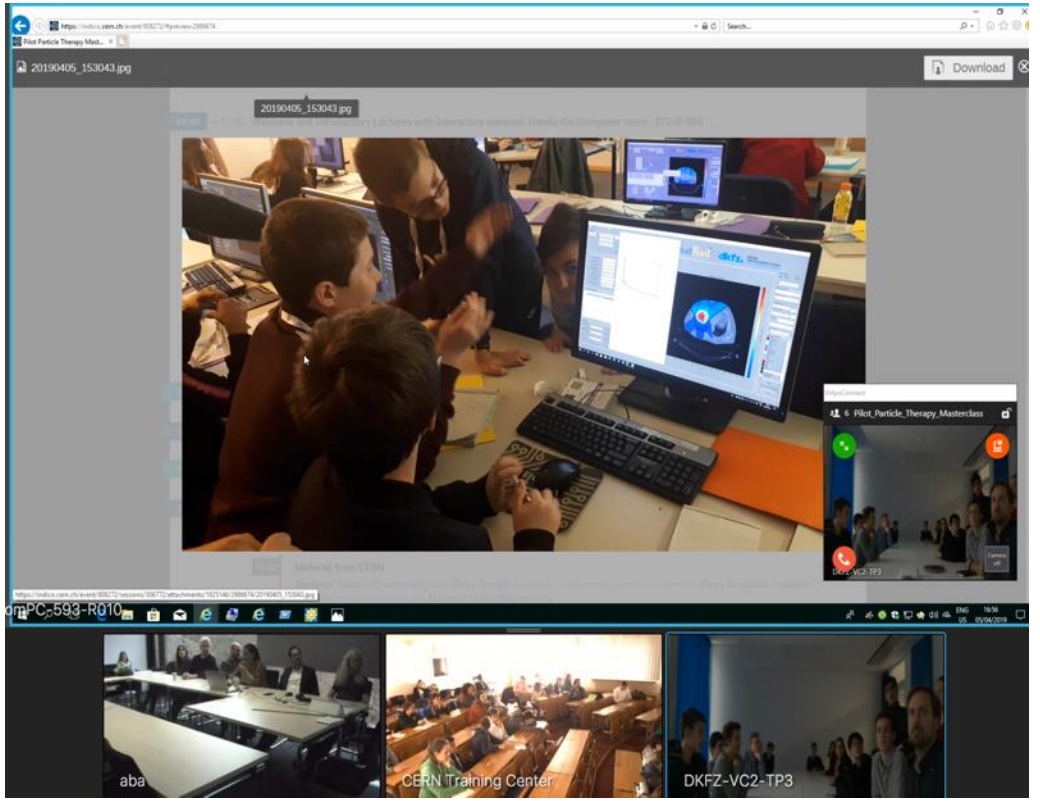
New PTMC and Treatment Planning

matRad open source Treatment Planning toolkit: DKFZ German Cancer Research Centre

First Local Test: GSI Feb 2019

CERN Open days

International Pilot: CERN, GSI, DKFZ April 2019



First tests positive feedback:

"motivation to contribute to the fight against cancer"

- **IMC Steering Group Approval: GSI May 2019**
- **web pages: Sarajevo Uni students Aug 2019 at CERN**

PTMC: Typical MasterClass Day Agenda

Scientists for a day !!

Adapted online/zoom due to covid

Every year, mid-February to mid-April
school-children (15-19 year old)
are invited at/by an institute of their area.

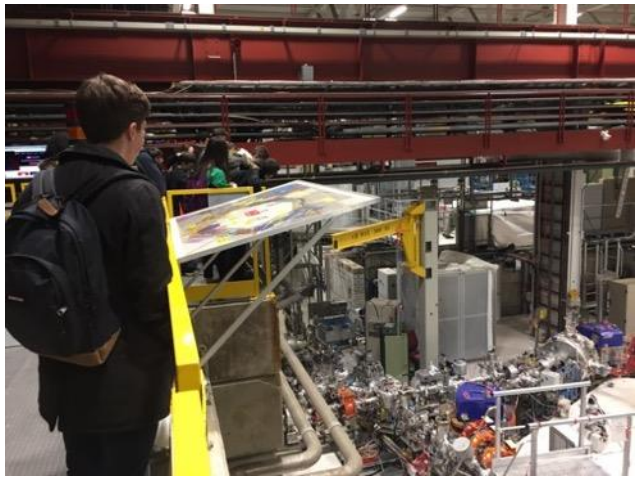
2-5 institutes per day performing
the same programme

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	**Common Video Conference**

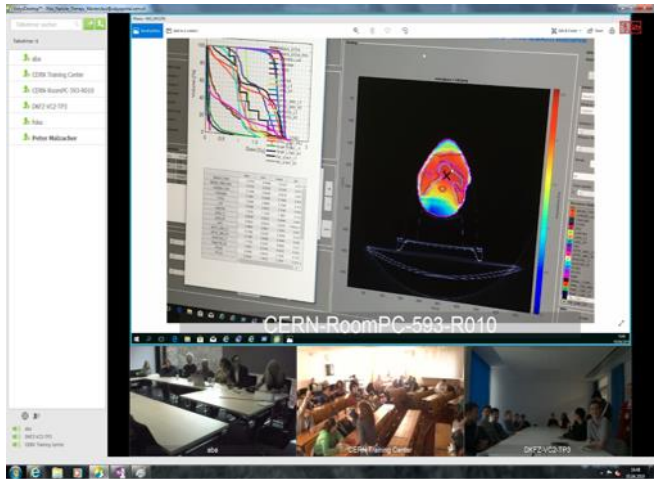
Local: Morning Presentations

Local: Afternoon Hands-on

Local: Morning Visits



Common: Afternoon at 16:00 Video-Conference



09:30 → 09:45 **Welcome**

Particle Physics Mas... | Particle Therapy Ma... | PTMC-8march2022_...

09:45 → 10:30 **Introduction to Particle Therapy**

Speaker: Aafke Kraan (INFN, Pisa)

INFN | INFN website | MasterClass_Particl... | Proton therapy 3 min...

10:30 → 11:00 **Video Visit to CNAO**

Virtual tour CNAO w... | Youtube Video Visit t...

11:00 → 11:30 **Coffee break**

11:30 → 12:00 **Particle Therapy at CNAO**

Speaker: Marco Pullia (CNAO)

12:00 → 12:30 **Particle Therapy treatment planning**

Speaker: Aafke Kraan (INFN, Pisa)

MasterClass_Treatm...

12:30 → 13:30 **Lunch Break**

13:30 → 14:59 **Hands-on session**

HandsOn_FirstExerci... | HandsOn_SecondEx... | Handson_ThirdExerc...

15:00 → 16:00 **Discussion of results locally**

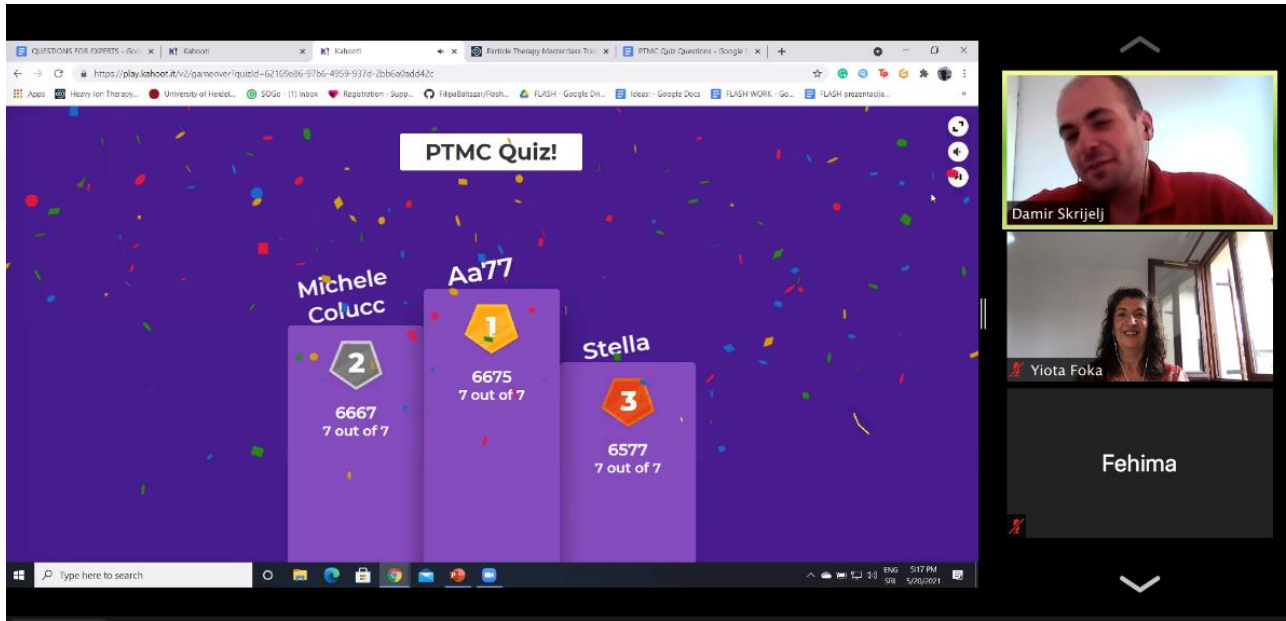
16:00 → 17:00 **Video Conference**

Indico page of Video Conference: https://indico.cern.ch/event/1122748/

Check List

- Contact school/teachers (during week days) or announce via proper channels and social media (on Saturday)
- Organise room (and lunch) at the institute or zoom

- Lectures in the morning
- Connect to virtual visits to existing therapy centres guided by their experts
- Hands-on in the afternoon
- Prepare students' presentations and discussions of their results locally
- Connect to common video-conference
- Finish with Quiz



Particle Therapy MasterClass

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

UTC timezone

Material

Here you can find useful presentations and animations on Particle therapy:

PTMC in a kit *(all the necessary material for the PTMC in a usb-kit)*

Demo

Presentations

Animations

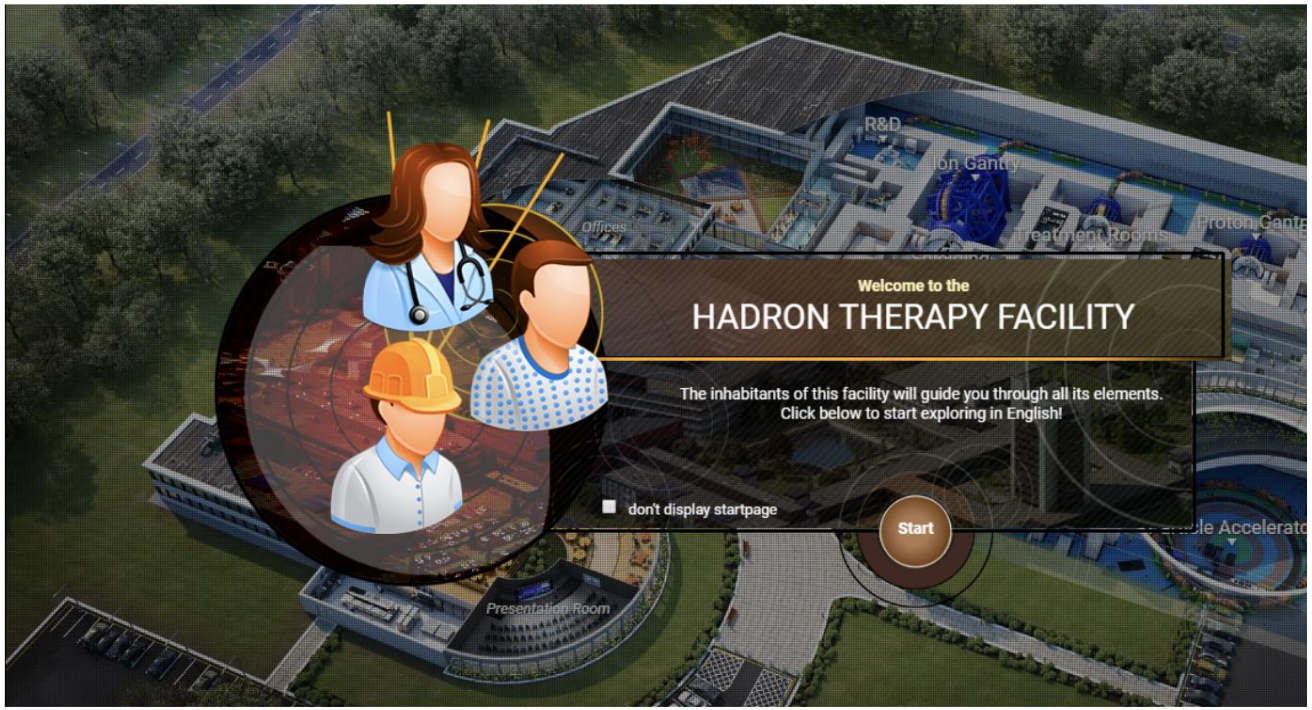
Posters

- Instructions in Lithuanian
- Instructions in N.Macedonian
- Instructions in Spanish
- 1_ParticleTherapy.pptx
- 2_WhatIsMatrad-AM.pptx
- 3_Installation-AM.pptx
- 4.1_Introduction to simulations-AM.pptx
- 4.2_Liver-AM.pptx
- 4.3_Head 'n' Neck-AM.pptx
- 4.4_Conclusions-AM.pptx
- Installation_MatRad.mp4
- Introduction to MatRad_PTMC - AM
- PTMC.mp4
- README_Installation_matRad.docx

Therapy Centres

ENLIGHT	ENLIGHT Animations, Courtesy of ENLIGHT
CNAO	CNAO Video, Courtesy of CNAO
HIT	HIT Video, Courtesy of HIT
MedAustron	MedAustron Video, Courtesy of MedAustron MedAustron Behind the Scenes, Courtesy of MedAustro

ENLIGHT Interactive Hadron Facility



Participation to Conferences

Presentations and Tutorials to Conferences:

1) **CERN/Fermilab school 2021, home page**

- International Masterclasses (IMC) session, timetable
- recording of the presentation/slides by Yiota Foka
- recording of the tutorial/material by Aristeidis Mamaras
- presentation

2) **APS home page**

- International Masterclasses (IMC) session
- Presentation

3) **EPS home page**

- International Masterclasses (IMC) session
- Presentation
- Proceedings

4) **vConf 2021 home page**

- International Masterclasses (IMC) session
- Presentation
- Proceedings

Heavy Ion Therapy Masterclass School

https://indico.cern.ch/e/HeavyIonTherapyMasterClass

Heavy Ion Therapy Masterclass school format

HITM school format: inspired by PTMC

Highlight:
Hands-on sessions, "do it yourself" guided by experts, with real data and professional tools and methods

Pedagogical elements facilitating learning

- Lectures in the morning
- Hands-on in the afternoon
- Students' presentations and discussions of their results with experts
- Virtual visits to existing therapy centres guided by their experts, supported by web-cam or videos
- Every day started with videos while participants were connecting to give them a visual impression and help them relate what they would listen
- Every day ended with social events, to provide opportunities for networking and entertainment
- Last day dedicated to "future developments" just before the "Careers Fair" in the evening

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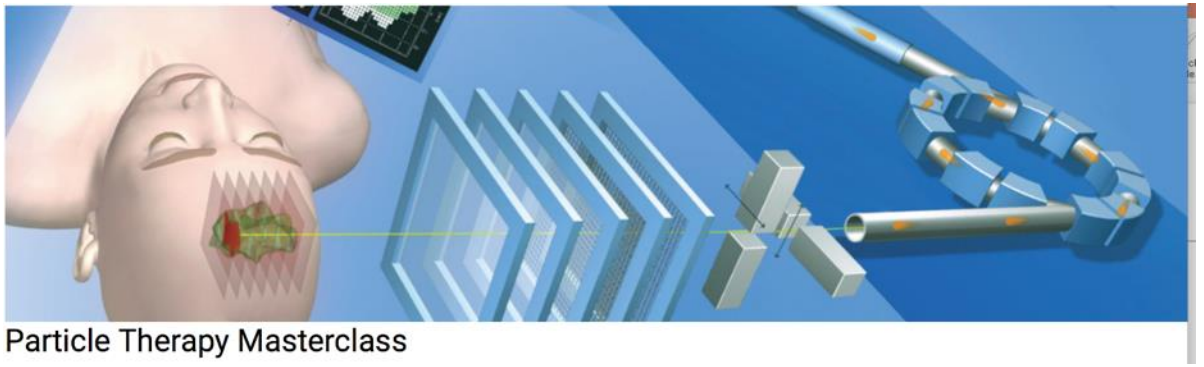
Heavy Ion Therapy Masterclass School

https://indico.cern.ch/e/HeavyIonTherapyMasterClass



Particle Therapy Masterclass

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

Full week course

The HITM school is aimed at university students, and up to early stage researchers.

One day activity

The Particle Therapy MasterClass, is aimed at high-school students (16-18)

Future tutors

Interesting career paths in emerging fields where often there is lack of specialised personnel

Information about upcoming modern techniques for cancer tumour therapy and new research avenues, where clearly the development of technology and the expertise of research laboratories is crucial.

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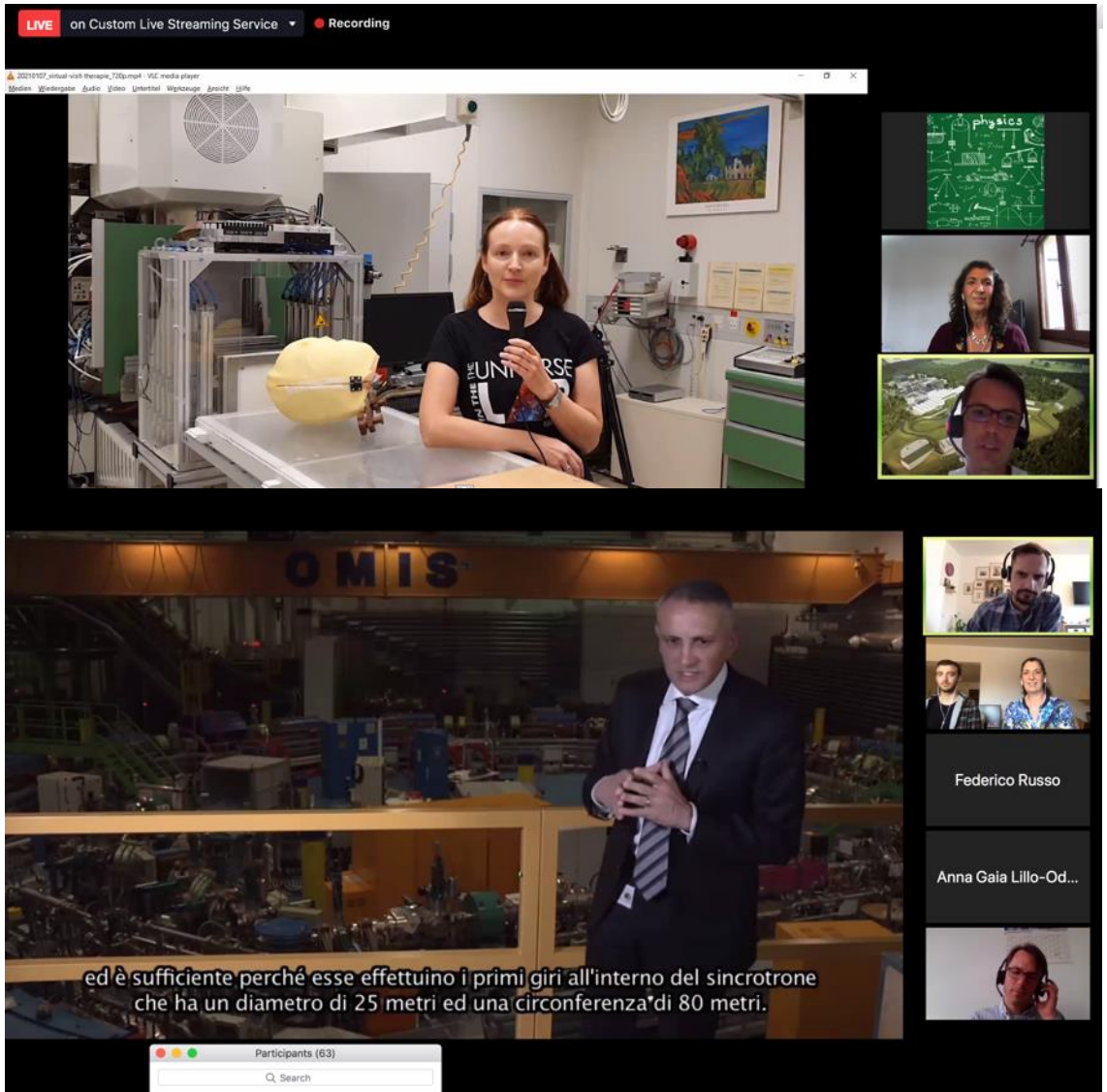
Virtual visits and video-conferences

Virtual visits during video-conference: GSI research institute, CNAO, MedAustron therapy centers

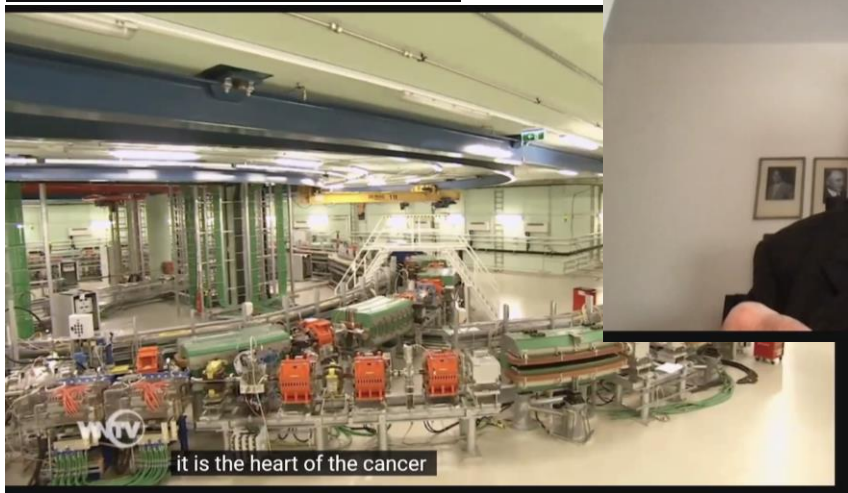


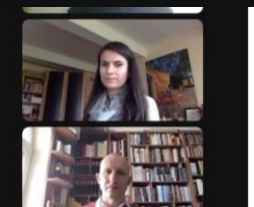
GSI moderators

CNAO moderator

medAustron moder.

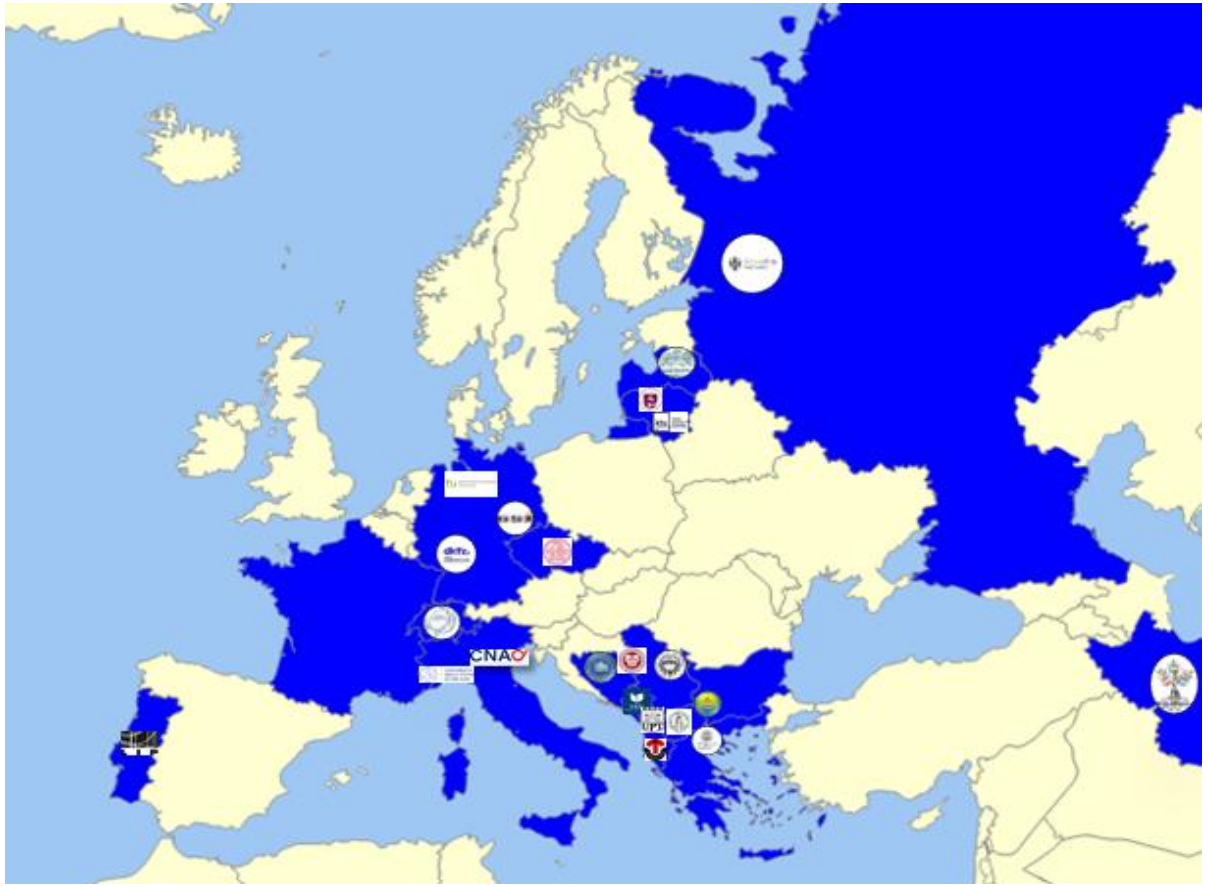
U. Amaldi: HI therapy pioneer





Participants of online PTMC in IMC2021

PTMC: https://indico.cern.ch/event/840212/



PTMC2021 online:
more than 1500 students participated
from 20 countries and 37 institutes during 6 sessions

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Participants of online PTMC in IMC2022

PTMC: https://indico.cern.ch/event/840212/

PTMC2022 online:
more than 1500 students participated
from 22 countries and 37 institutes during 6 sessions

online and in-person participation

web pages with agendas of every institute with material
in different languages, publicly available for future events

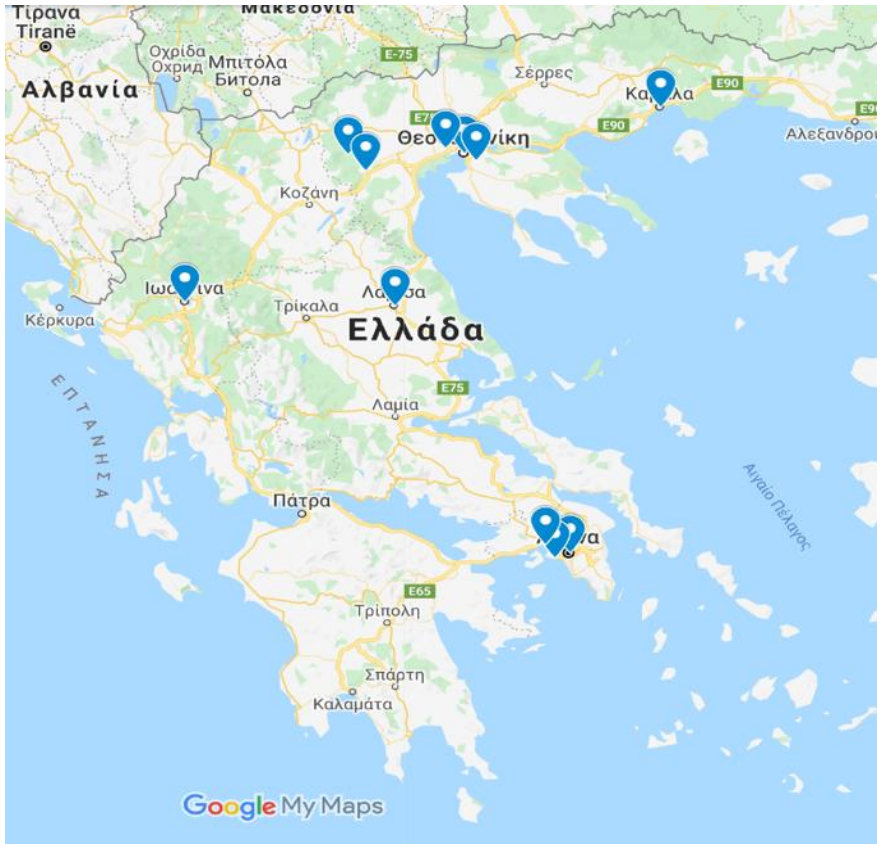
Training sessions planned and upon request

Interest of students, motivation of tutors (voluntary work), potential impact

PTMC in Greece

PTMC2021 online: through Library of Veroia

Total of 366 live views
from at least 20 major regions of Greece

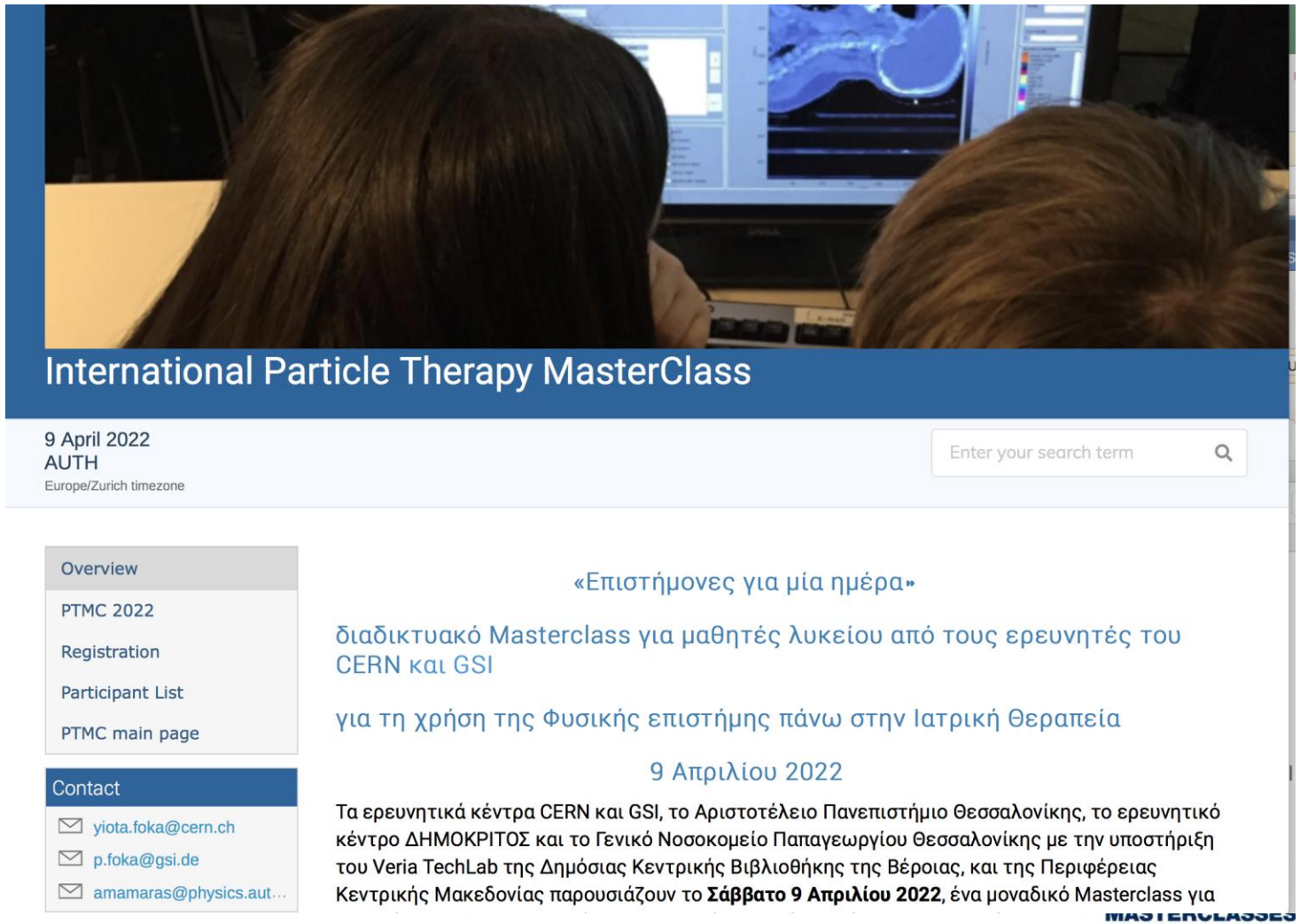


- Press Release published in **nation-wide media**
- Post on Facebook resonated with **3,600** people
- Announcement viewed **941 times** on website

PTMC2022 online: more than 150 participants

AUTH uni, Dimokritos research centre, Papageorgiou Hospital, Technopolis.

Publicity: Library of Veroia extended networks and national press



Aims and expectations

- **Attract school-children to STEM at early stages: decide future studies/career**
- **Cultivate confidence through the hands-on (I can do it!)**
  and "demystify the difficulty" of physics, math….
  NOTE: a Master thesis survey/study has shown that students do learn!
- **Support female students** (i.e. 11 Feb, 8 March sessions) **handle prejudices** (i.e. MSc/PhD in Mexico)
- **Create groups of Uni assistants/tutors that learn better in order to teach**
- **Demonstrate a return to society from investment in fundamental research**
- **Enhance awareness of broader public**
  extended reach to family, friends, personal environment
- **Prepare future generations aware of importance of fundamental research and its applications:**
  - favourable politicians,
  - evidence-based decision-making society

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World-wide reach motivating next generation of scientists

International MasterClasses one day activity; material can be used in different ways, for different occasions

Flagship project of IPPOG,
the International Particle Physics Outreach Group

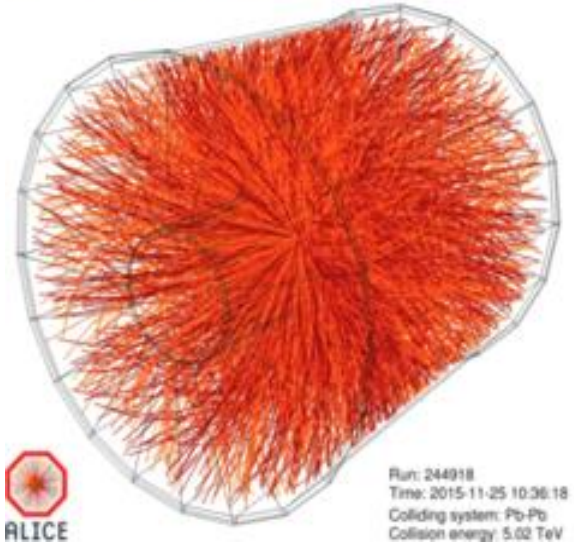
Feedback: example from Serbia, almost 50% of IMC participants enrolled at UNI

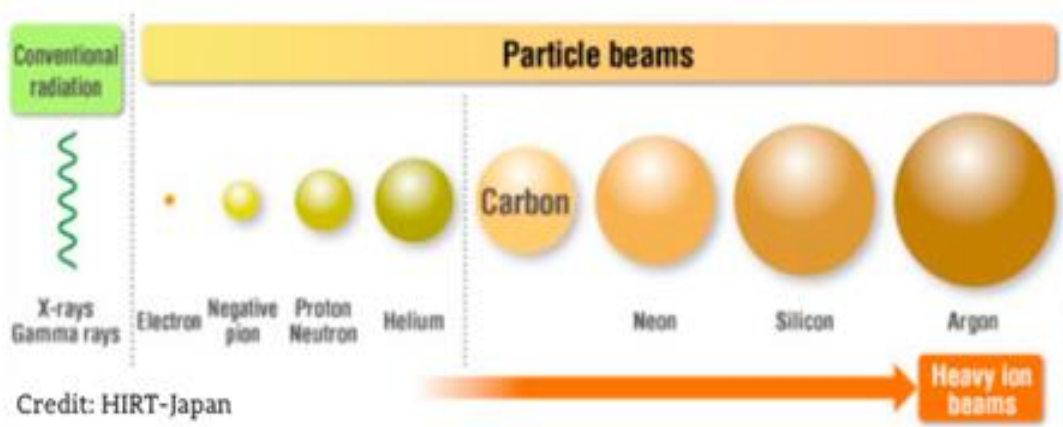
Heavy-ion research and heavy-ion therapy

Pb-Pb at 5.5 TeV
pp at 14 TeV

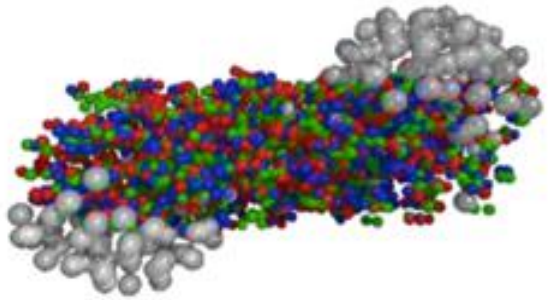
fundamental science
QGP studies

Credit: CERN





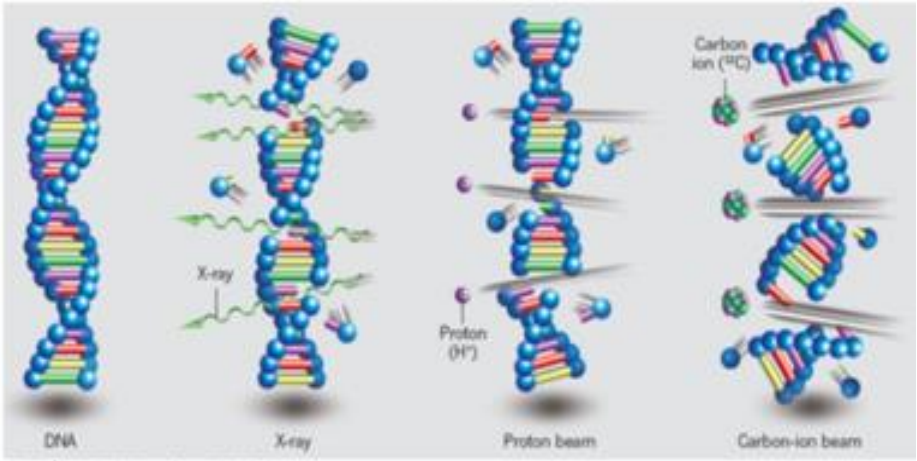
Credit: HIRT-Japan



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

applied science
medicine

Credit: HIT Heidelberg



Credit: T. Nomiya, NIRS Japan

Acknowledgements PTMC

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Hans-Peter Wieser

DKFZ Heidelberg

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Katrin Platzer, Malte Ellerbrock
Noa Homolka Amit Ben Antony Bennan

GSI

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GSI Biophysics:
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GSI ALICE, EMMI :
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GSI IT :
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CERN (staff and users)

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CERN/KT: Manuela Cirilli Anais Rassat Rita Ferreira Giovanni Porcellana
CERN: Visits Service Erwan Harrouch Francois Butin
CERN: Training Centre: Eric Bonnefoy M-L LECOQ

Uni Sarajevo: web pages

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Acknowledgements PTMC

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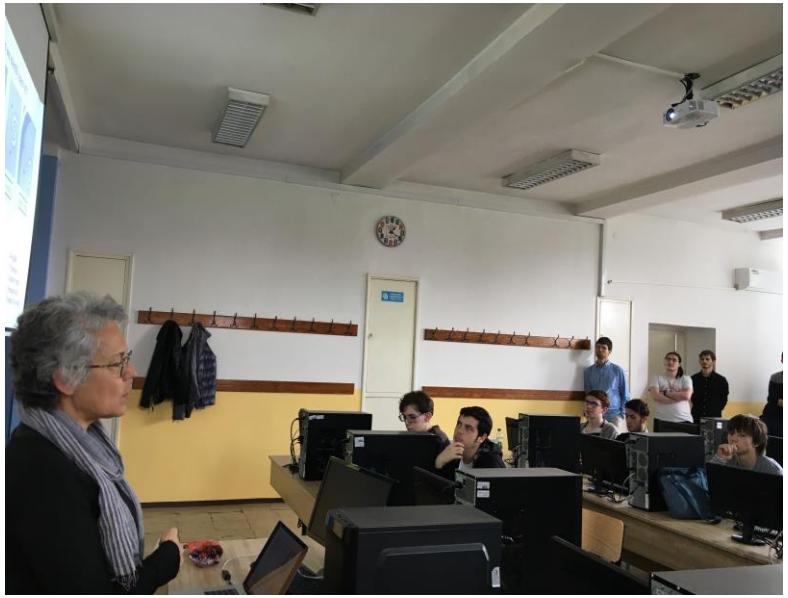
From first MasterClasses at UNSA/Sarajevo in 2019 to hundreds of students

Sponsored by “Three Physicists Foundation”: Origin of New Projects




Support preparation of
next generation experts
for next generation facilities
for research and therapy
of cancer tumours with ions
Architectural design, Kaprinis Architects

Thank you for your attention !

"This material was prepared and presented within the HITRIplus **Specialised Course on Heavy Ion Therapy Research,** and it is intended for personal educational purposes to help students; people interested in using any of the material for any other purposes (such as other lectures, courses etc.) are requested to please contact the authors (Yiota Foka yiota.foka@cern.ch).