

HEAVY ION THERAPY MASTERCLASS SCHOOL AND CAPACITY BUILDING FOR FUTURE ION RESEARCH AND THERAPY FACILITIES

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Heavy Ion Therapy MasterClass School

17 - 22 May 2021
Online Course

The program is intended for the students of the following disciplines Medical Physics, Physics, Radiotherapy, Radiology, Bioengineering and Imaging and Radiotherapy Techniques and early stage researchers.

In collaboration with



Topics

- Particle Therapy
- Treatment Planning
- Accelerator Physics
- Beam Delivery
- Radiation Protection
- Imaging
- Biophysics
- AI/ML for Particle Therapy

Programme Committee

- Y. Foka (GSI/EMMI, Chair)
- A. Gazibegović-Busuladžić (UNSA)
- N. Sammut (Uni. Malta)
- M. Sapinski (SEE/IST)
- J. Seco (DKFZ)
- M. Vretenar (CERN)
- N. Wahl (DKFZ)
- H.P. Wieser (LMU)

Scientific Assistants

- A. Mamas (AUTH/CERN)
- A. Kapić (EPFL/CERN)
- D. Škrijelj (UNSA/DKFZ)
- R. Taylor (IC/CERN)

Scope

Focus on Heavy Ion Therapy Treatment Planning Systems (TPS) including lectures, treatment planning tool demonstrations, hands-on exercises and student projects.

SIGN UP NOW TO THE FIRST HEAVY ION THERAPY COURSE!

Registration link:

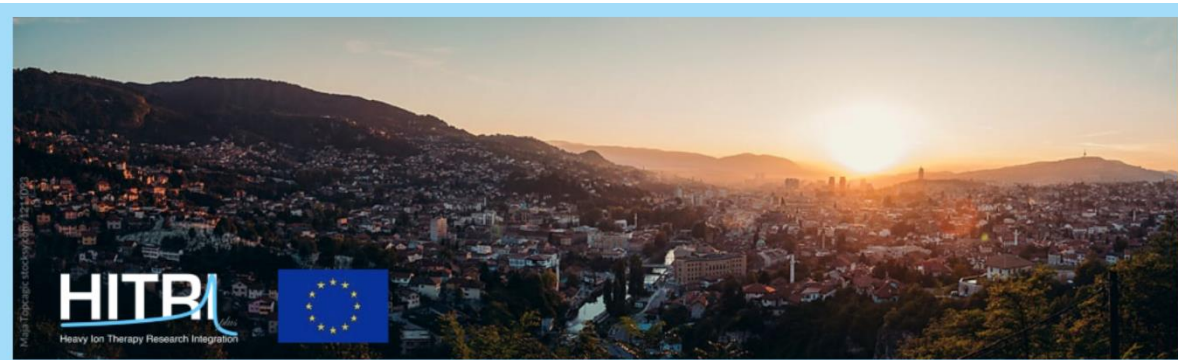
<https://indico.cern.ch/e/HeavyIonTherapyMasterClass>

Registration deadline:

15 May 2021



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



Heavy Ion Therapy Masterclass School

17-22 May 2021
Sarajevo-Online
Europe/Sarajevo timezone

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

Demonstrates potential of young generation

Total: 1050 participants

HITM School

- run smoothly
- provided interactivity
- was a success
- had a big impact

Breakdown of participants

- 36 lecturers
- 222 young researchers
- 234 PhD students
- 197 Master students
- 276 Undergraduate students





Executive Summary

Articles:

- CERN Courier
- ENLIGHT
- GSI News
- Accelerating News

- increasing interest in heavy-ion therapy research and related disciplines
- need for relevant training in specialised fields

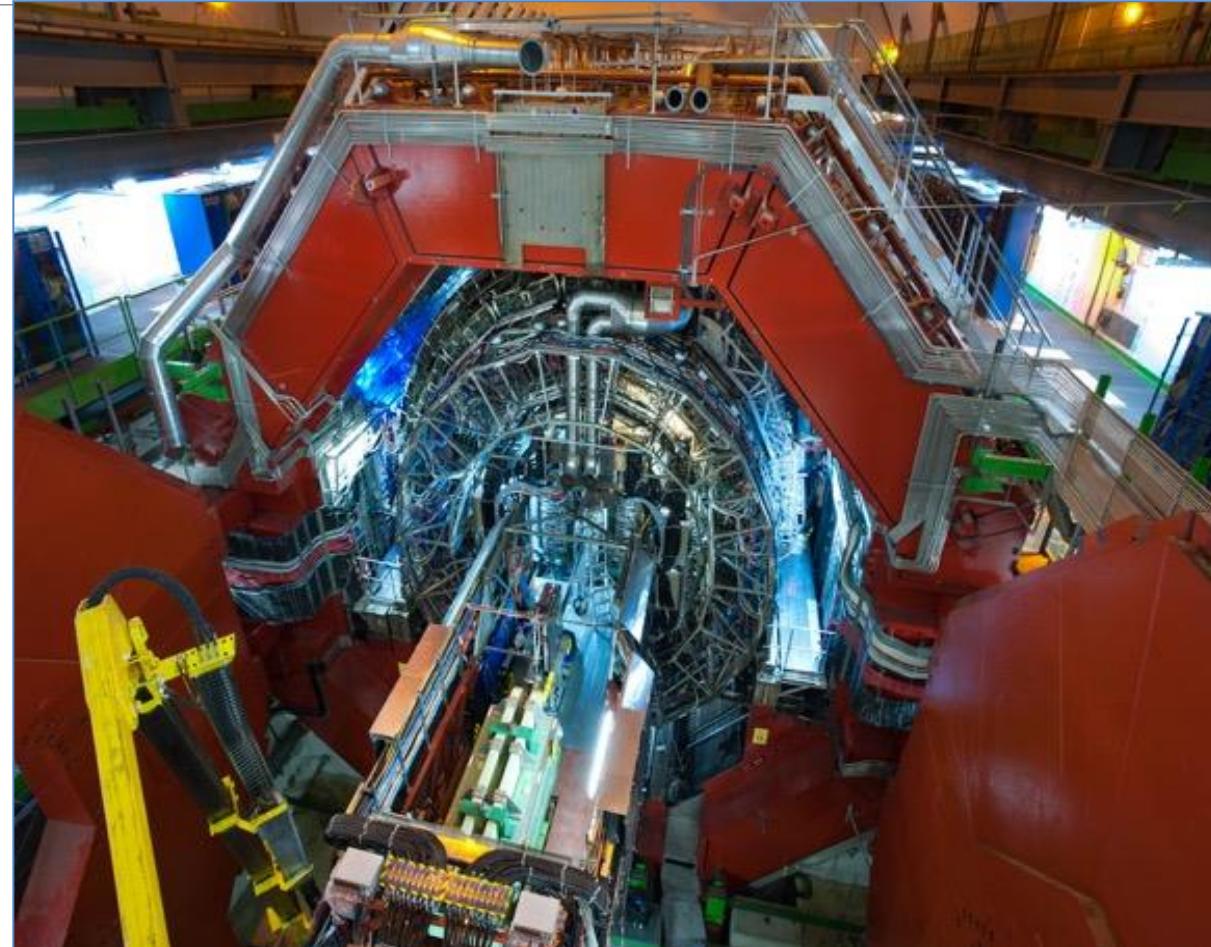
Some comments of participants:

- Its approach, regarding the content but also its format was “holistic, multi-disciplinary, original”
- Speakers, top experts in their fields, started from basic principles, and then progressed to deeper details, not taking shortcuts
- Beginners and participants from different fields could follow
- It gave the opportunity to have an overview of heavy-ion therapy but also included cutting-edge developments

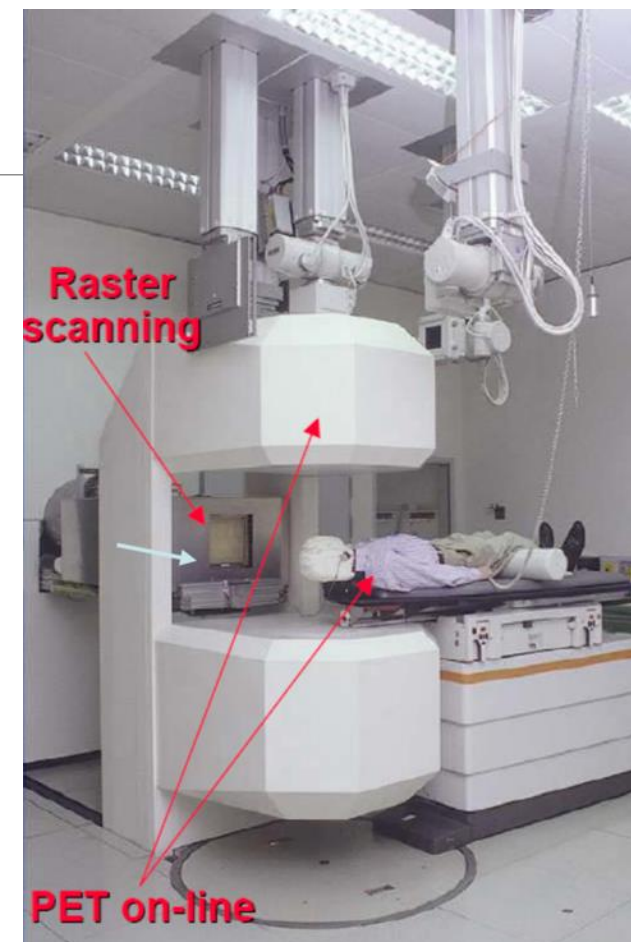


From heavy-ion research to heavy-ion therapy

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



Heavy-ion research and heavy-ion therapy at GSI



GSI pioneered heavy-ion (carbon) therapy for cancer tumours in Europe (90s)

Educational activities on applications of accelerators for cancer treatment: see Poster by Aristeidis Mamaras on PTMC





HITRIplus Project

Organised in the Framework of the HITRIplus EU-funded project

Large consortium of research infrastructures including CERN and GSI, plus universities, industry, all four existing European heavy-ion therapy centres, and the future research infrastructure SEEIST (South-East Europe International Institute for Sustainable Technologies)

Main aims:

- (a) transnational access,
- (b) new developments for the future SEEIST facility and upgrades of the existing ones
- (c) networking, training and education (capacity building)

Heavy Ion Therapy Masterclass School included in “Education and Training” Work Package addressing university students and up to early stage researchers and practitioners

First event of HITRIplus Project



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



SEEIIST initiative in South East Europe

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

Support capacity building in South East Europe

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



January 15, 2018



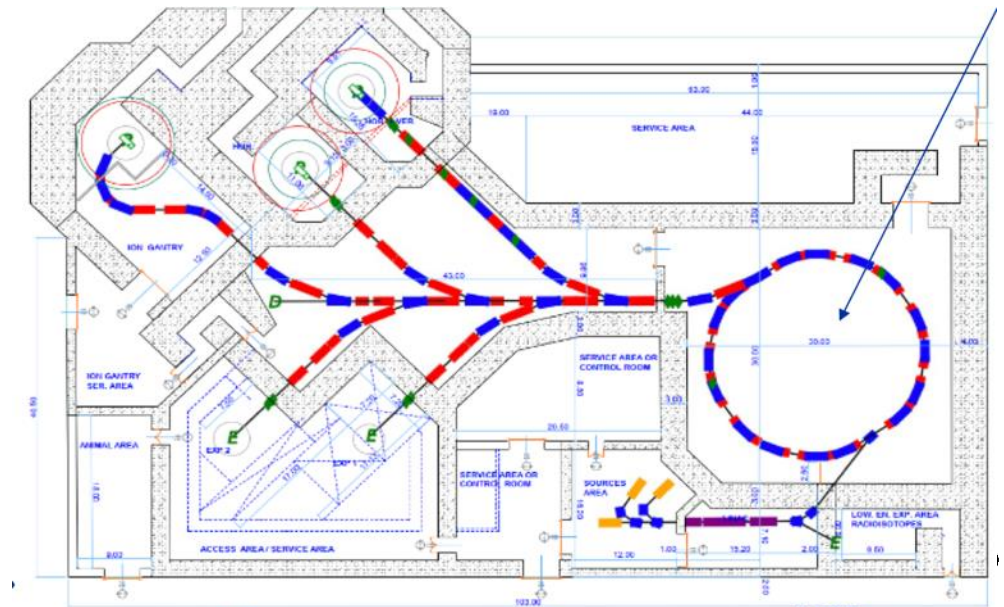


Capacity Building

Initially planned at Sarajevo

Ongoing collaboration with the University of Sarajevo,
supported by foundation “The Three Physicists”

- a new laboratory based on an ion source and low energy accelerator
- educational activities targeted to capacity building
- masters and summer students at CERN
working on different aspects of the accelerator complex



Carbon-ion cancer therapy centres in Europe

Technology and Knowledge Transfer

Scientific programme shaped to target topics in emerging fields

- importance of **fundamental research**
- **role of research centres** for developing new applications in medicine
- **use of accelerators** for cancer diagnostics and treatment

MedAustron, Austria

CNAO, Italy

HIT, Germany

MIT, Germany

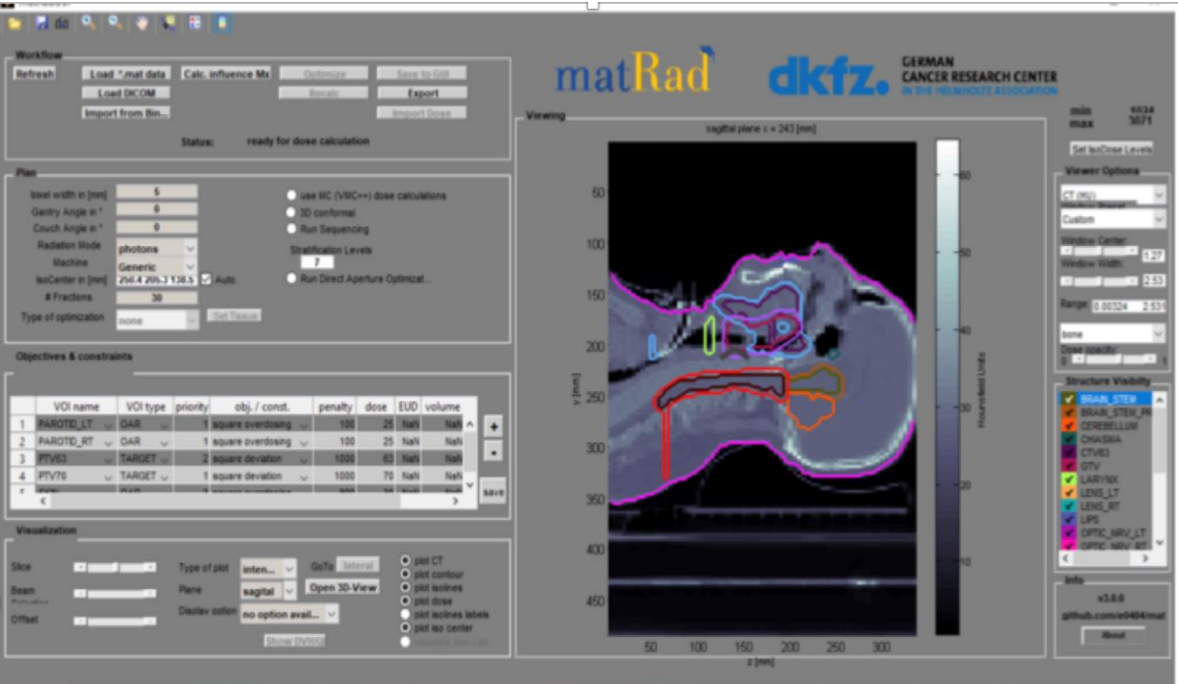


Treatment Planning



Virtual Therapy Centre

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



multidisciplinary facets of heavy- ion therapy
many different interesting career paths in many different fields

greatly appreciated: to have the full image
what happens from the beginning to the end

Particle Therapy MasterClass Format

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.

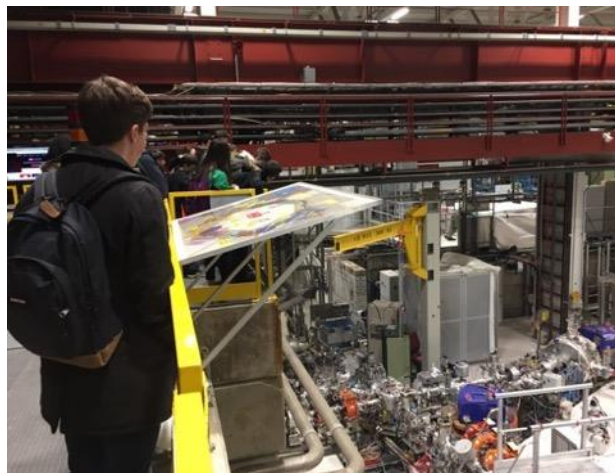
2-5 institutes per day performing the same programme

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: Morning Visits

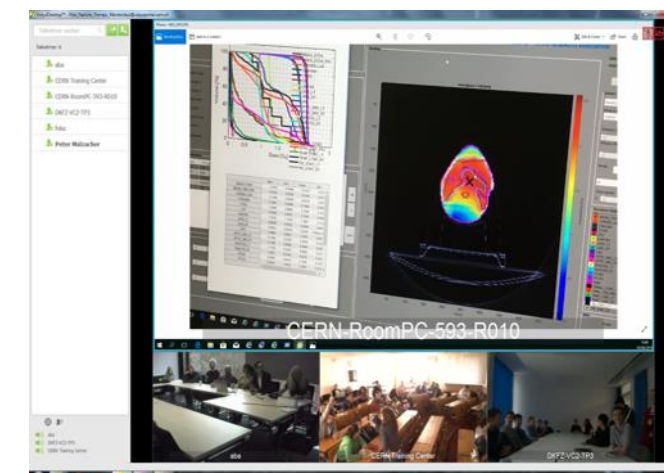


Poster: ARIS MAMARAS on PTMC

Local: Afternoon Hands-on



Common: Afternoon at 16:00 Video-Conference





School Format

“Original” format: appreciated by participants

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





Heavy Ion Therapy Masterclass School

School Lectures

Timetable: <https://indico.cern.ch/event/1024183/>

- Home
- Organizers and Sponsors
- Objectives and Scientific Programme
- Poster School
- Poster Social Events
- Agenda
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Contact

✉ hitm.adm@cern.ch

Timetable Heavy Ion Therapy MasterClass School 17 May 2021

17 May 2021, 08:23 → 22 May 2021, 19:00 Europe/Zurich

Webcast

There is a live webcast for this event

Watch

Main Topics:

- Heavy ion therapy
- Treatment planning
- Medical accelerators and accelerator physics including:
 - Ion sources
 - Beam optics
 - Beam delivery systems
 - Controls
- Linear accelerators for isotope production
- Radiation protection and safety
- Imaging for particle therapy and diagnostics
- Biophysics
- Machine learning applications for particle therapy
- European heavy ion therapy centres:
 - Current activities
 - Future upgrades

Spiral approach
Overview lectures: panorama
Focus lectures
Participation of experts from existing ion therapy centres

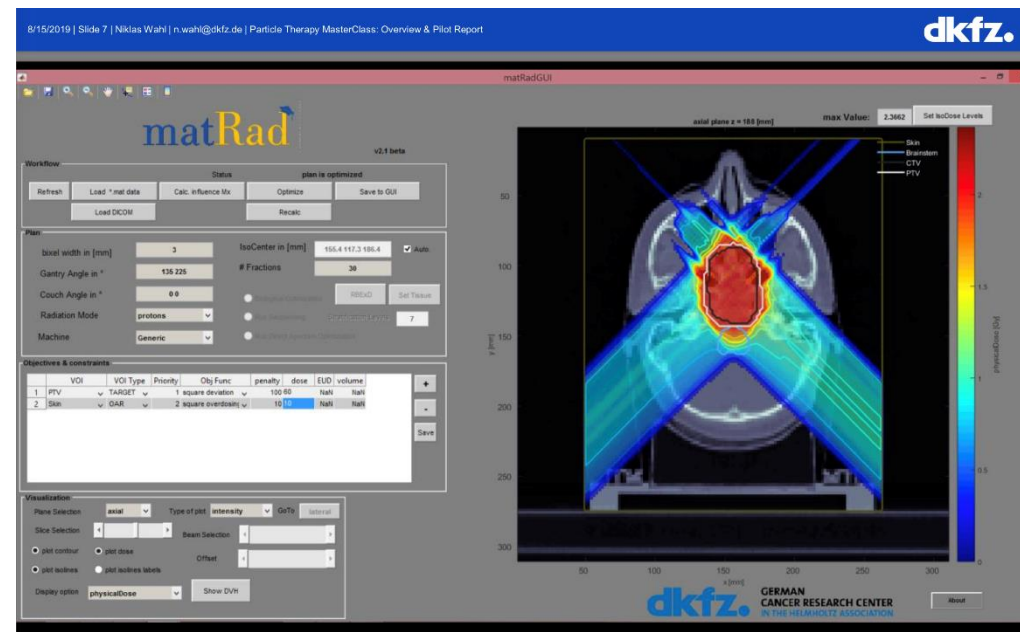




Hands-on Treatment Planning

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

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matRad - an open-source toolkit for dose calculation and optimization

14:00 → 15:30 Cancer Radiotherapy Introduction

Speaker: Joao Seco (DKFZ)

15:30 → 16:00 MatRad General Introduction

Speakers: Hans-Peter Wieser (LMU Munich), Niklas Wahl (DKFZ)

16:00 → 16:15 Complete the evaluation form

[Evaluation Form](#)

16:15 → 16:30

16:30 → 18:00 MatRad Installation & Data

Conveners: Hans-Peter Wieser (LMU Munich), Niklas Wahl (DKFZ)





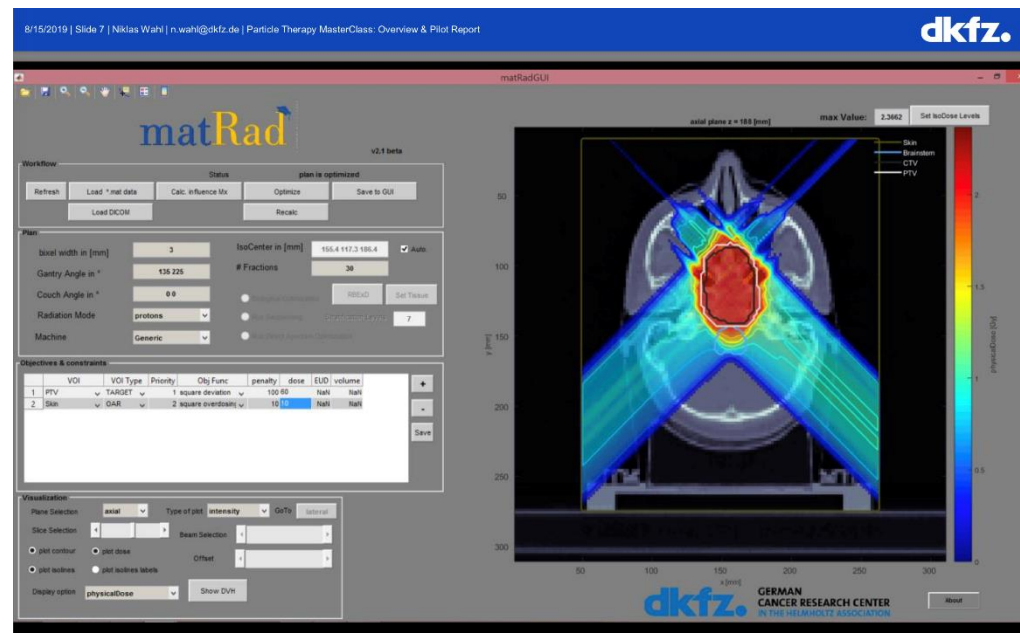
Hands-on Treatment Planning

Hands-on: managed by 2 expert tutors, one performing the steps, based on writeup and one handling questions

180 participants delivered matRad hands-on results

Out of 238 certificate requests, 158 eligible having delivered hands-on and sufficient attendance

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matRad - an open-source toolkit for dose calculation and optimization





Hands-on Treatment Planning

Thanks to: Niklas Wahl and Hans-Peter Wieser

Biological Treatment planning

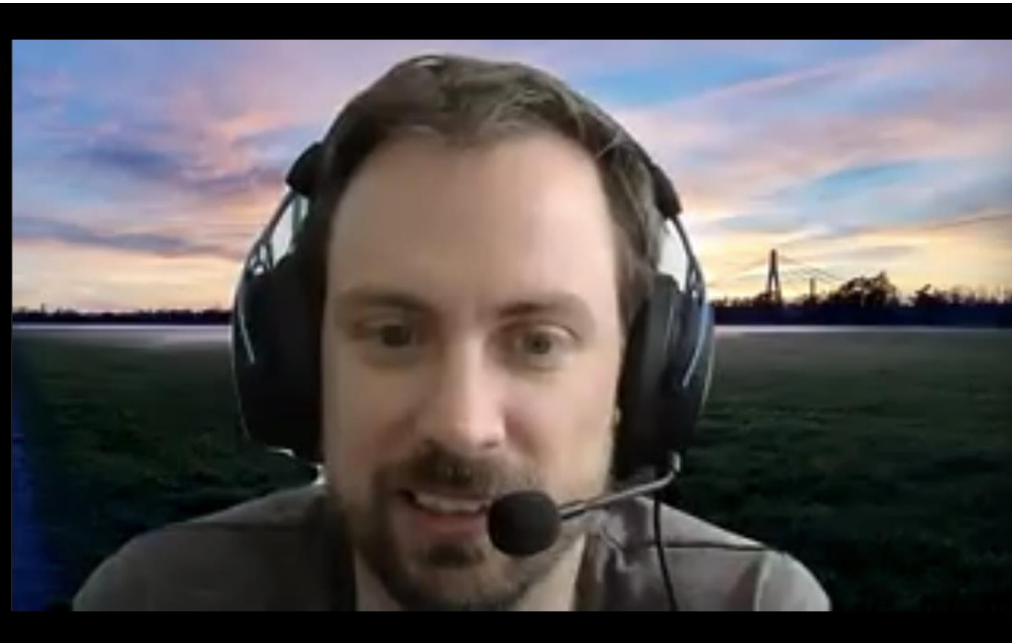
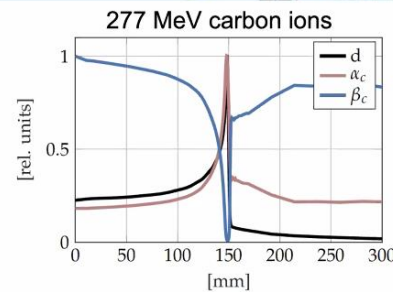
For **each** tabulated carbon ion energy E_0 and for **each** cell type: \rightarrow triplet of curves $d(E_0, z), \alpha_c(E_0, z, T), \beta_c(E_0, z, T)$

$$RBE = \frac{d_x}{d_I} \Big|_{iso-effective}$$

biological effect

$$RBE \times d = \sqrt{\frac{\epsilon}{\beta_x} + \gamma^2} - \gamma = \sqrt{\frac{\alpha_c d + \beta_c d^2}{\beta_x} + \left(\frac{\alpha_x}{2\beta_x}\right)^2} - \frac{\alpha_x}{2\beta_x}$$

adapt dose influence concept to radio-sensitivity parameters for fast evaluation of ϵ_i for different intensities w during optimization.



From Niklas Wahl to Everyone:
the blue area is bigger for carbon ions due to the fragmentation tail

Polls

Question: in Progress

Attendees are now viewing questions 147 of 229 (6)

1. Do you have MATLAB licenses?

Yes

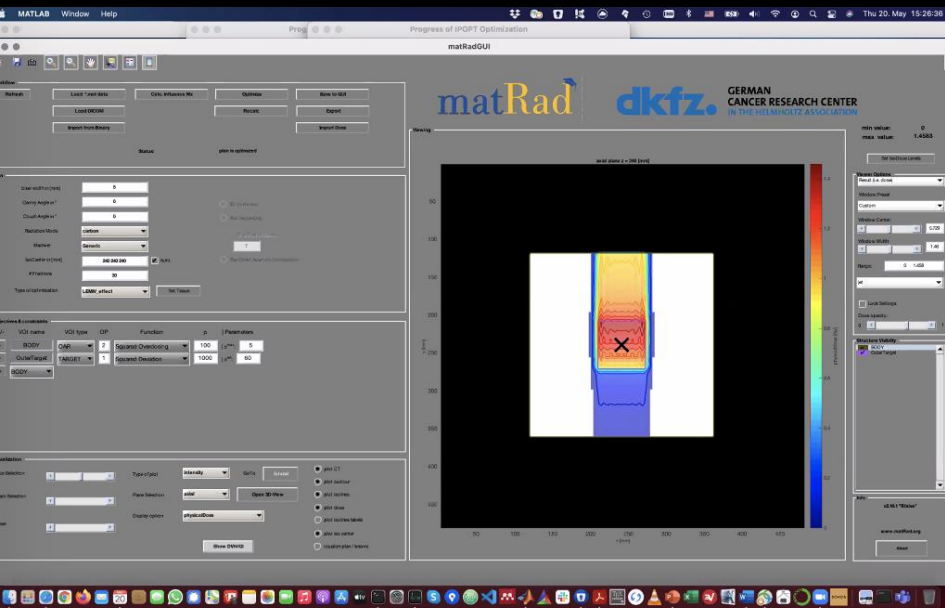
No





Hands-on Treatment Planning

Thanks to: Niklas Wahl and Hans-Peter Wieser



Computational load

From Dr Sonali Bhatnagar to Everyone:

the doc file is very helpful

From Besa Sadiku to Everyone:

Me to like Dr. Sonali, I miss any step, and my results are not the same that you're explaining us,

From Adin Alić to Everyone:

Computations are now really slow.

From Dr Sonali Bhatnagar to Everyone:

but hats off to you both for keeping patience with us. we are all working hard and trying to learn so the goal is achieved...
To work after your class, makes me miss on the social interactions sessions as earning matrad is important learning



Themes of Students Sessions

- **Tuesday:**
connected to GSI, the research institute where heavy-ion therapy was pioneered and CNAO, the running heavy-ion therapy centre
- **Wednesday:**
dedicated to treatment planning
expert from CNAO presented the real TP tools used in CNAO and explained real cases, discussed and contrasted to the matRad TP tool for training and research
- **Thursday:**
focus on International MasterClasses programme and preparation of PTMC tutors
presentations of the coordinators
complemented by presentation from Sarajevo MCs
on pedagogical value of MCs based on analysis of surveys and the PTMC experiences
- **Friday:** focusing on future facilities and career opportunities





Video-conference and virtual visits

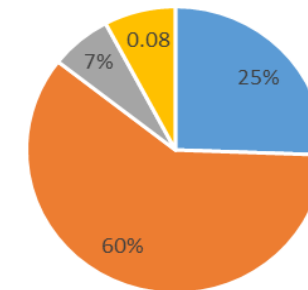


GSI moderator

CNAO moderator



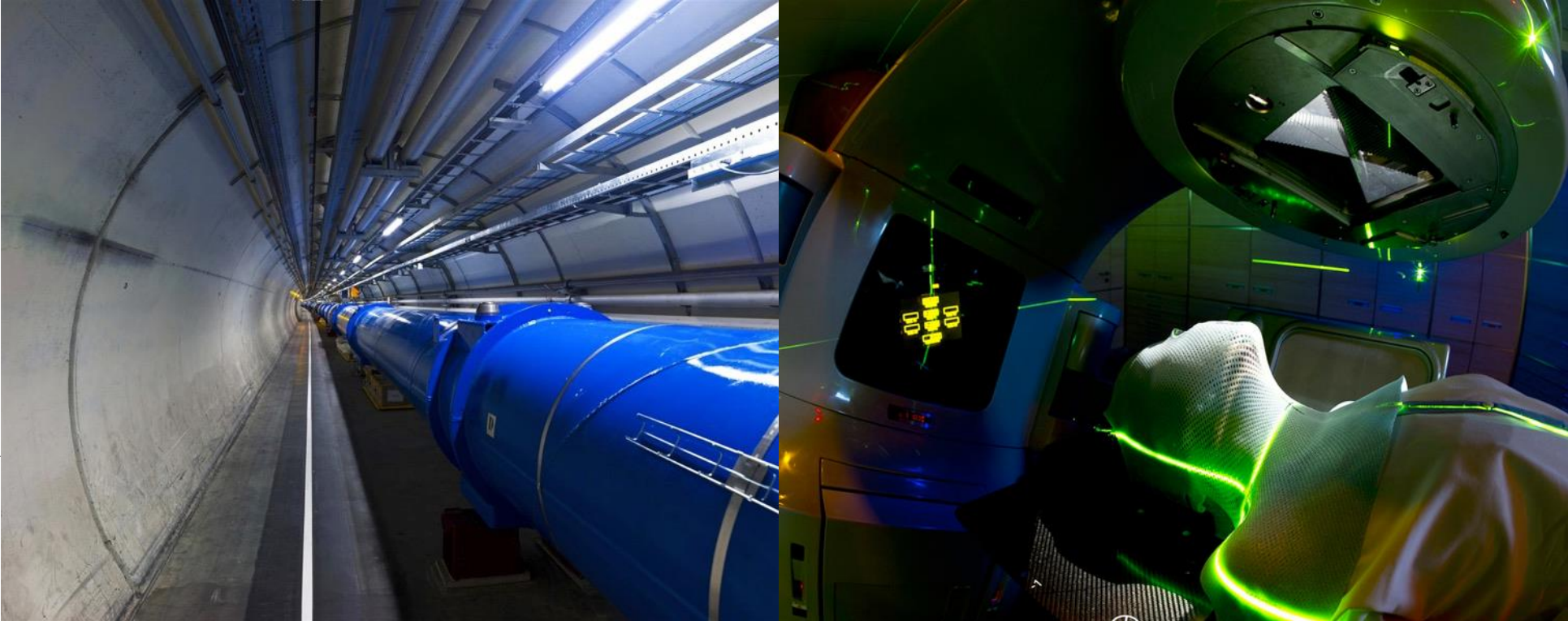
What do you like better in the students session?



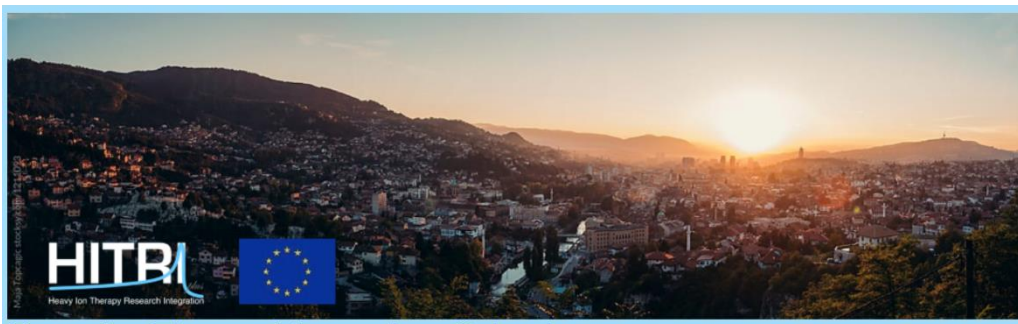
- All of the above
- Virtual visits to therapy center
- Students presentations
- Discussions of matRad results

From Physics to Clinics

From fundamental research...



.....to medical applications



Heavy Ion Therapy Masterclass School

Logistics and Challenges

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

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webcasting with support of CERN IT:

<https://webcast.web.cern.ch/event/i1024183>

Webcast link

Participants should join the webcast through the link: <https://webcast.web.cern.ch/event/i1024183>

Participant that will join hands-on and students afternoon sessions, they will be provided a zoom link also through webcast.

Shared document to submit questions

Participants can ask experts questions through this shared document:

<https://docs.google.com/document/d/1QXEi7wai8QtvNIWEcr1mcy7GgTuqGfUfY4nCADrc2v0/edit>

Evaluation form

Please use the evaluation form to give us your opinion, comments about the school:

https://docs.google.com/forms/d/1rF1A5U7rBTTSPjQ42Zb_Q9Fj7oG3cE6Q8ZdZYvlf_yg/edit

Social Events:

SIGNup Social Events Mon: ENLIGHT Networking

<https://forms.gle/4P2Db1LS5YG5fNEw9>

every day zoom links
and updates

For better interaction use of the

- shared doc to insert questions
- Zoom chat
- evaluation form
- polls

Recordings available in the timetable
for the ones at different time zones

Certificate of attendance





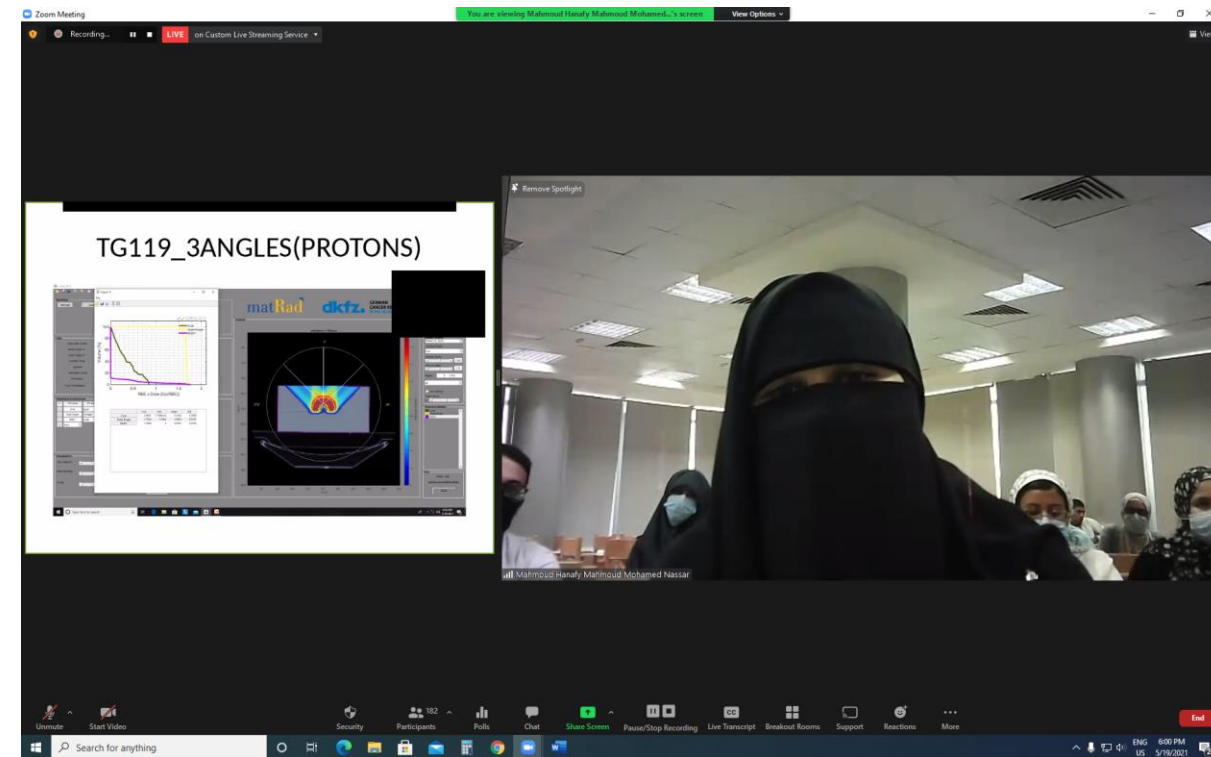
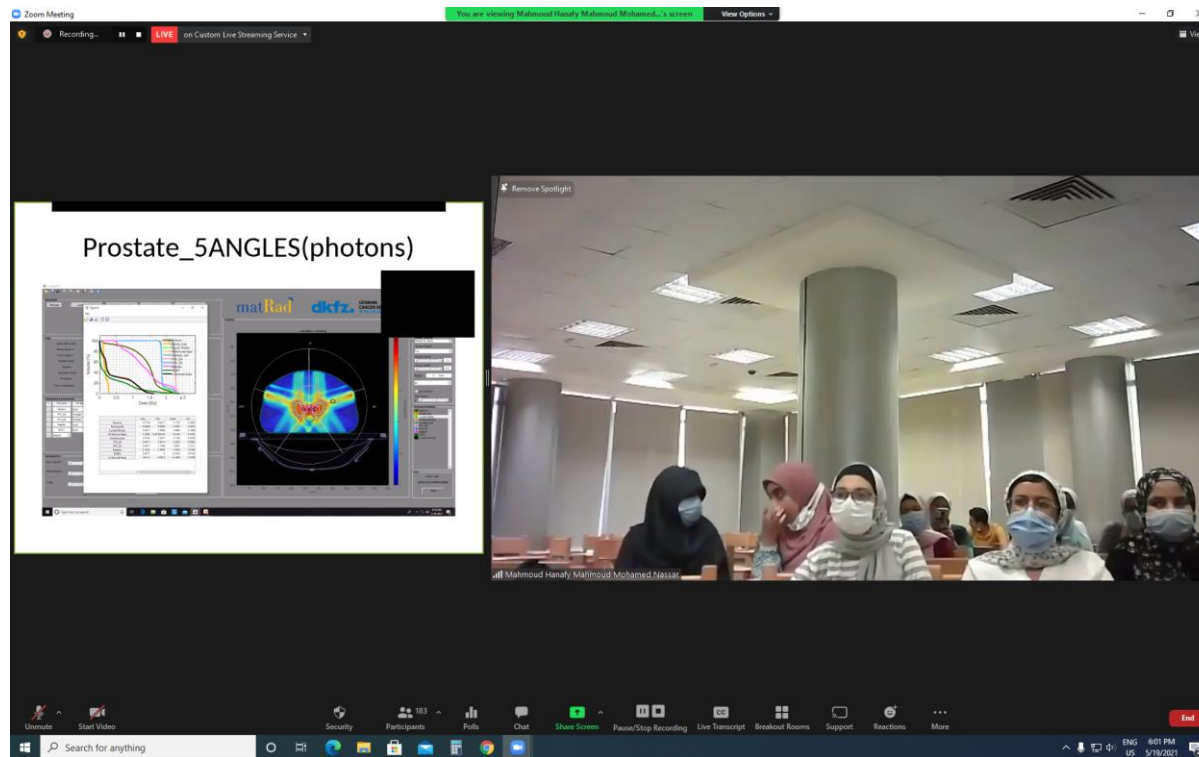
Opening Session

Uni of Benha, Egypt: Integrate the school into the Uni curriculum, presence of rector





Diversity and sharing know-how



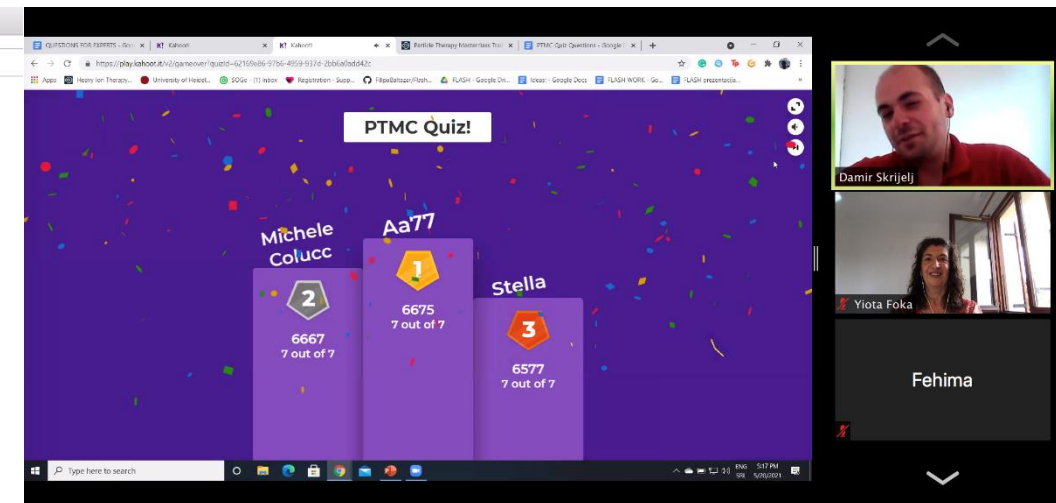
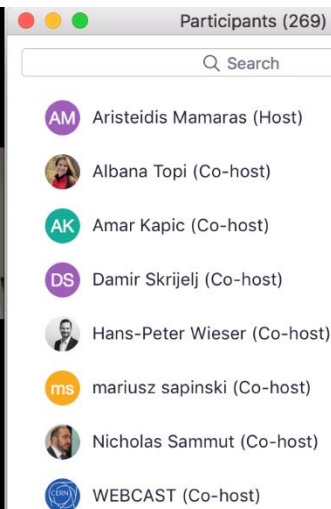
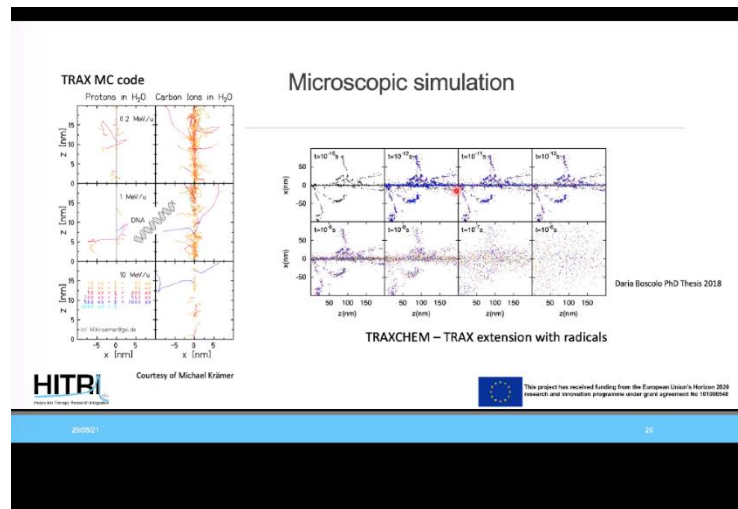


Gender equality and students presentations

Statistics

Out of a total of 36 speakers, 18 female
Plus 25 students' presentations

Timetable: <https://indico.cern.ch/event/1024183/>





Heavy Ion Therapy Masterclass School

School Lectures

Timetable: <https://indico.cern.ch/event/1024183/>

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Timetable Heavy Ion Therapy MasterClass School 17 May 2021

📅 17 May 2021, 08:23 → 22 May 2021, 19:00 Europe/Zurich

Webcast

📺 There is a live webcast for this event

Watch

Statistics

Total: 35.5 h

- **Lectures: 18 h**
- **Hands-on 7.5 h**
- **Students sessions: 5 h**
- **Social Events: 5 h**

Recordings and presentations
available in the timetable
for the ones at different time zones
Immediately at lunch break and evening

Overall: much-too-much...
but still participation to social events !!



Heavy Ion Therapy Masterclass

17th May - 21st May 2021
Evening Socials
From 18:00

HITRI
Heavy Ion Therapy Research Integration



MON

Introductory Drinks

Meeting the other attendees with drinks!

Speaker: Manjit discussing the ENLIGHT network
Dress Code: Smart Casual

TUE

Language Cafe

Learn other languages & cultures!

Speaker: Mimosa - ion treatment for beginners
Dress Code: Traditional

WED

Student Q&A

Ask advice & chat to current students

Speaker: CERN Knowledge Transfer
Dress Code: Pyjama Party

THU

Tours, Games & Disco

Share music tastes & play games & quizzes

Dress Code: Impress Us.

FRI

Career Fair

Discussion with experts on career paths

Speakers: CERN, GSI, CNAO, DKFZ & Cosylab
Dress Code: Formal Attire

Social Events Networking

The Platform

SpatialChat : 60 participants on Friday till 21:30

The Hosting team @ Social Events:



Amar Kapić

PhD student

EPFL/CERN



Aristeidis Mamaras

MSc student

AUTH/CERN



Damir Škrijelj

MSc student

UNSA/DKFZ



Rebecca Taylor

PhD student

ICL/CERN

Every evening 18:00-19:00 CET

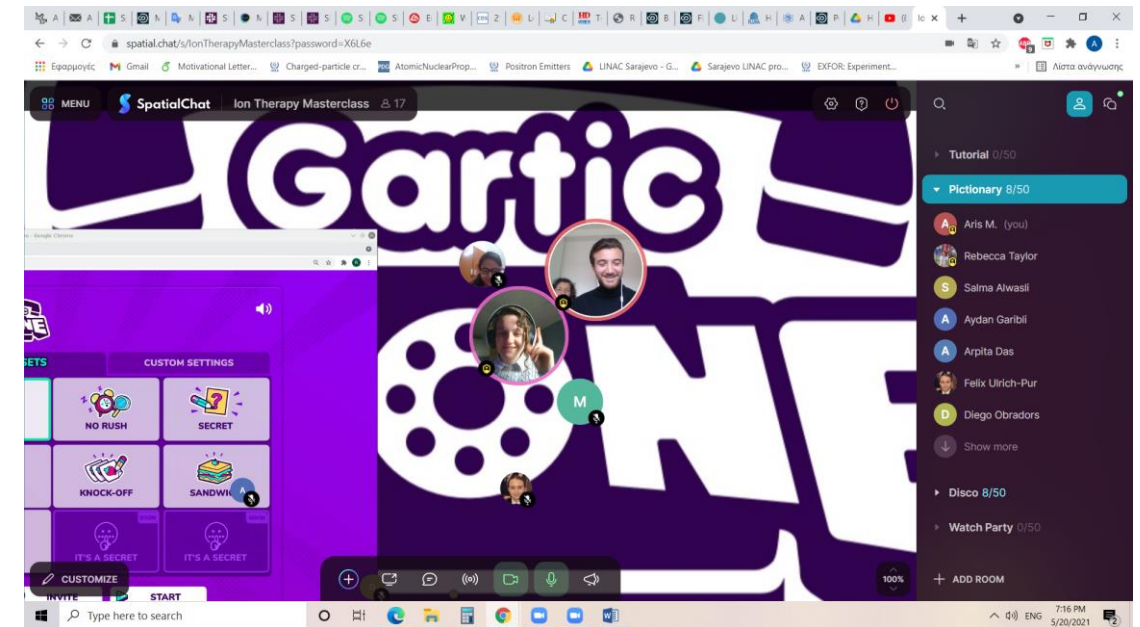
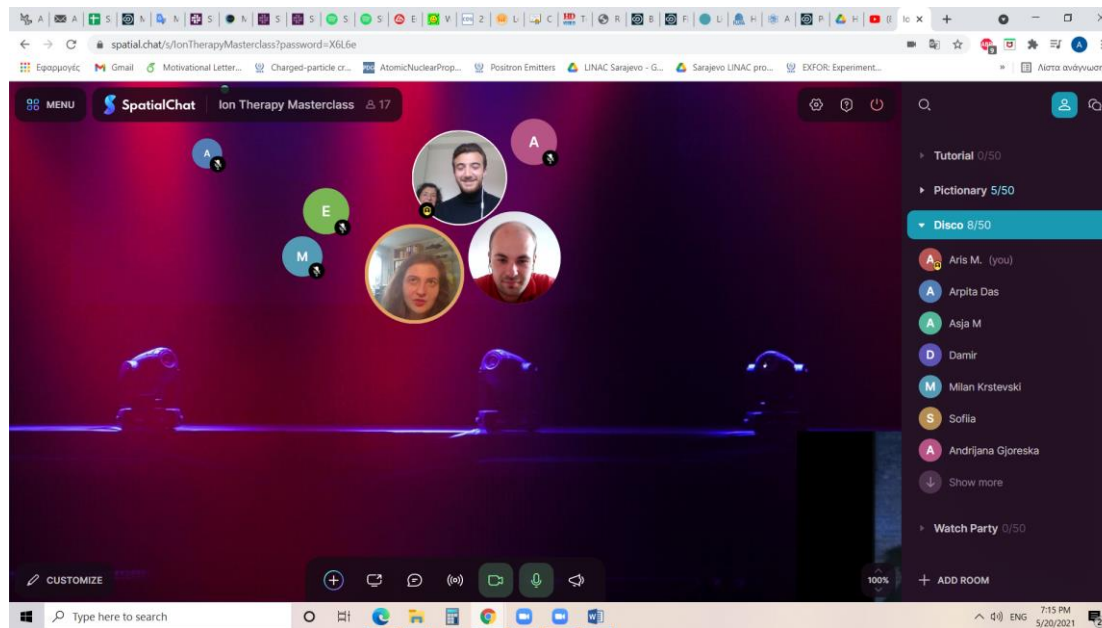
8 moderators on various topics
From Networking, to the Career Fair
Themes and Dress Code





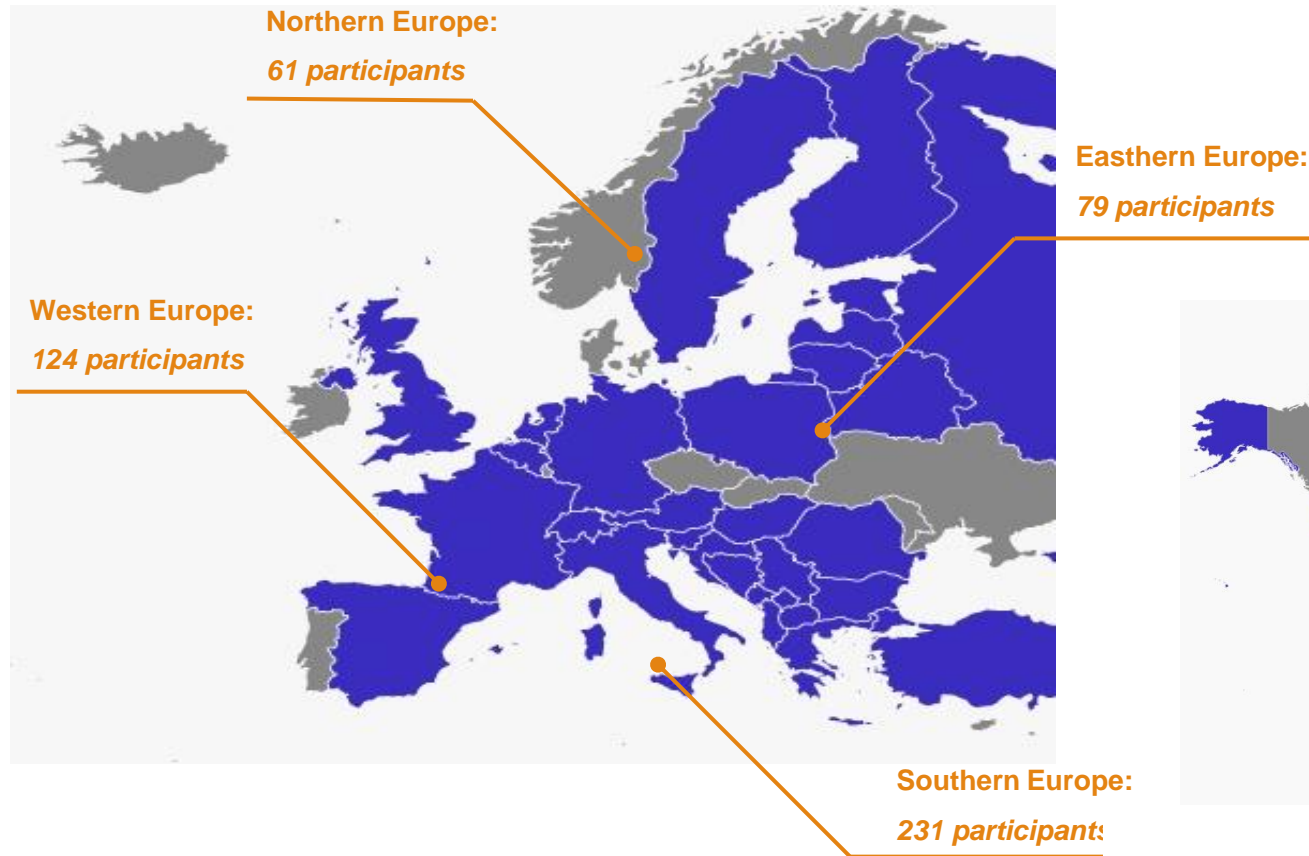
The disco and fun !

SpatialChat : 60 participants on Fri till 21:30





Expanding in Europe and beyond

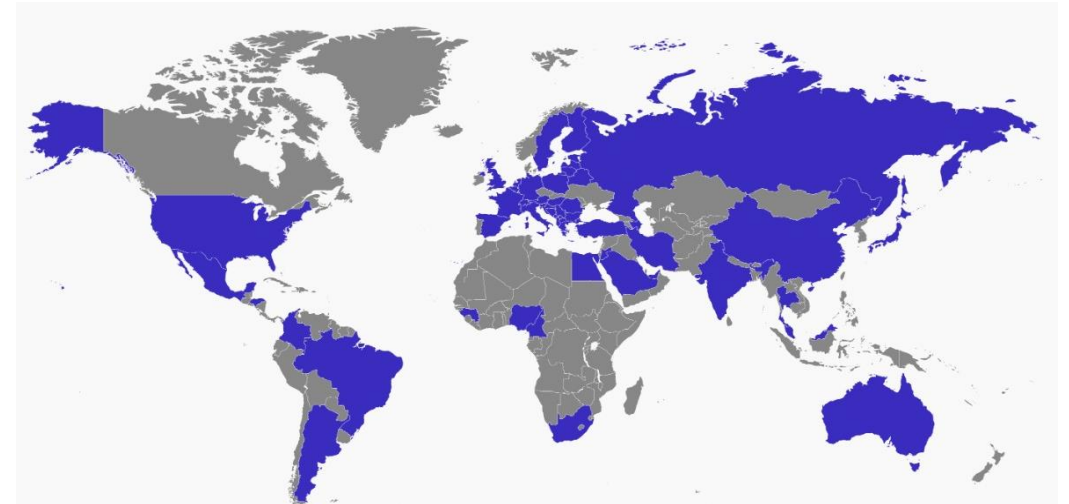


European countries:

➤ 495 participants

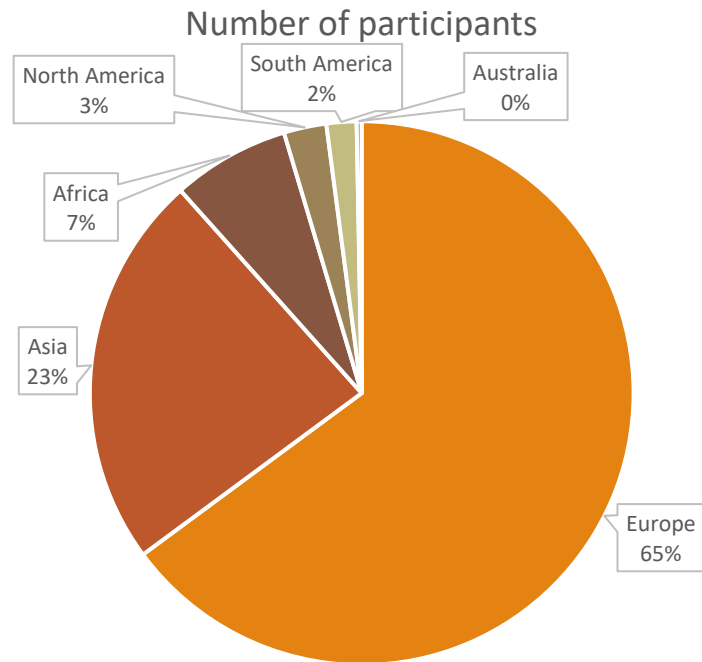
Non-European countries:

➤ 470 participants





Expanding in Europe and beyond



	Europe	Asia	Africa	North America	South America	Australia
Number of participants	436	158	47	17	12	2

India, Egypt, Australia
 Cameroon, Thailand, Iran, USA, Jordan, Nigeria, Ghana
 Azerbaijan, Singapore, South Africa, Malaysia,
 Colombia, Mexico



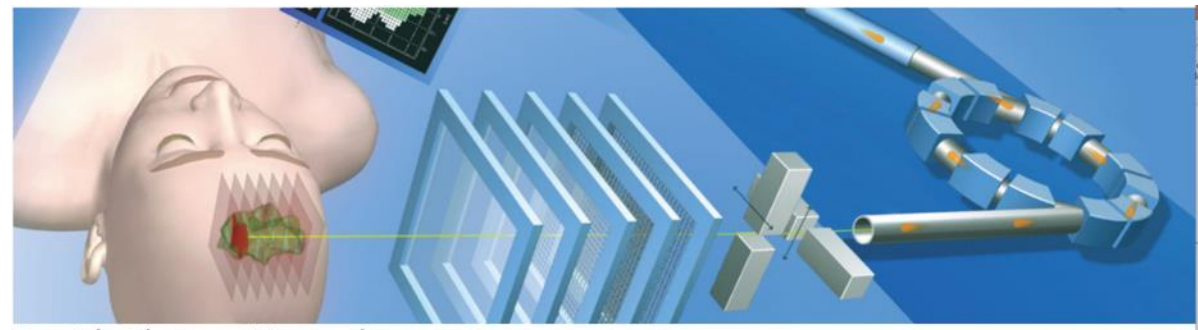


Heavy Ion Therapy Masterclass School

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

Full week course

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



Particle Therapy Masterclass

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

One day activity

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



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

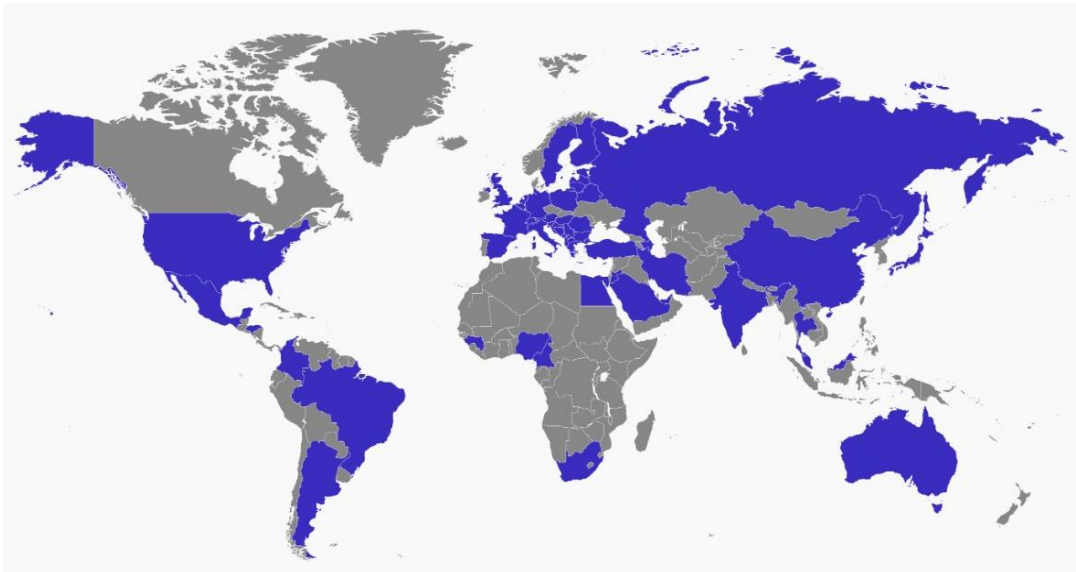
Information about upcoming modern techniques for cancer tumour therapy and new research avenues, where clearly the development of technology and the expertise of research laboratories is crucial.

World-wide reach motivating next generation of scientists

HITRIplus full week heavy-ion therapy masterclass school



Heavy Ion Therapy Masterclass School

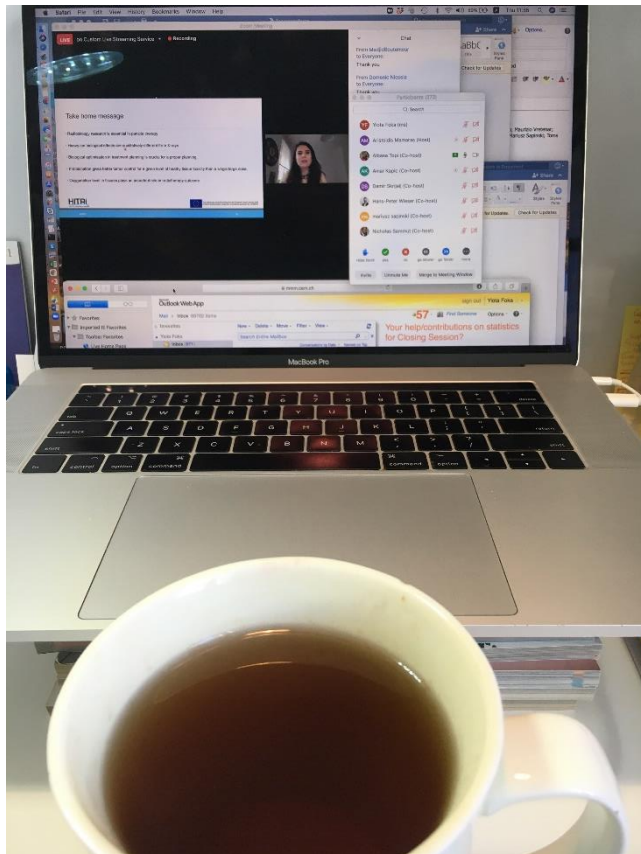


International MasterClasses one day activity



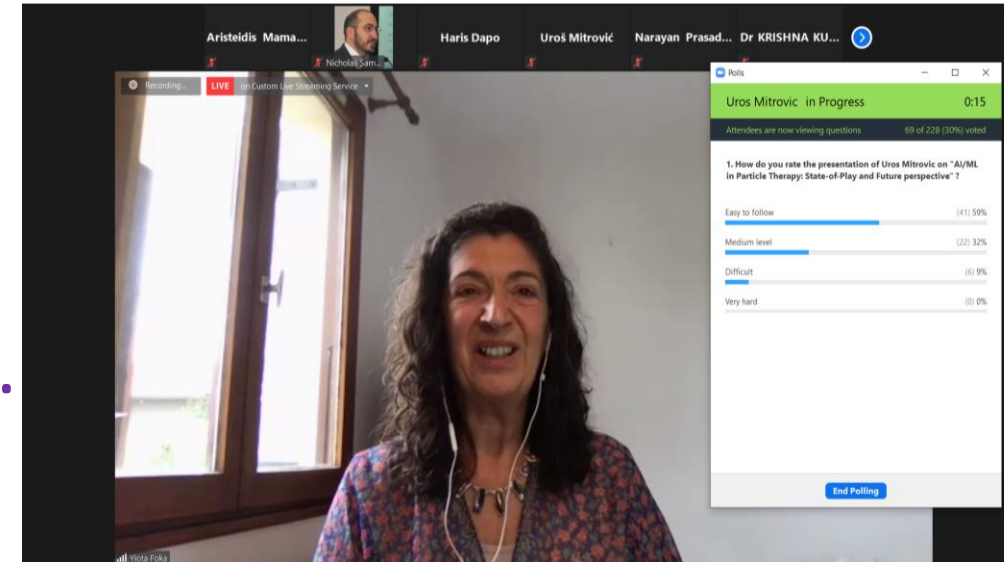


Thank you for your attention!



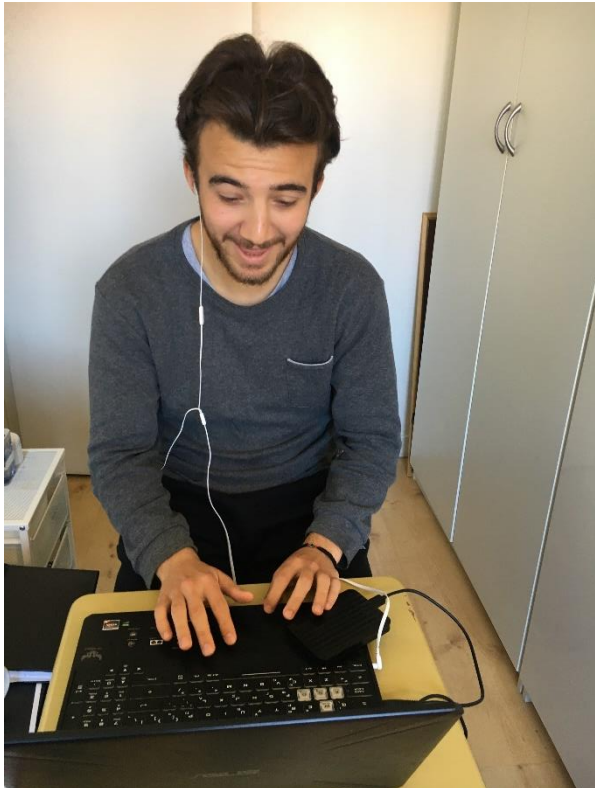
Statistics

- N. of litres of coffee
- N. of Kg of chocolate
- N. of emails answered
- N. of hours of sleep deficit...





Thank you for your attention!



Behind the scenes !



Big Thanks!



SOCIAL EVENTS



Career Fair

SpatialChat

Ion Therapy Masterclass

60

MENU

CUSTOMIZE

DKFZ is the largest biomedical research institute in Germany. They are developing novel approaches to make tumor diagnosis more precise and treatment of cancer patients more successful.

CNAO

Centro Nazionale di Adroterapia Oncologica

CNAO is an innovative and technologically advanced oncological center providing carbon ions and protons radiation therapy treatments for radio-resistant or inoperable tumors.

GSI in Darmstadt, Germany operates a worldwide leading accelerator facility for research purposes. Currently the international accelerator facility FAIR, one of the largest research projects worldwide, is being built there.

COSYLAB

Cosylab is a global technology company that develops and integrates state-of-the-art software and hardware for many of the most demanding and advanced radiotherapy and big-science systems in the world.

CERN, the European Organization for Nuclear Research, is one of the world's largest and most respected centres for scientific research. Its business is fundamental physics, finding out what the Universe is made of and how it works.

MedAustron, the center for cancer treatment and research, is unique in Austria. We can bring hope to patients and inspire new impulses in science.

Welcome to the Heavy Ion Therapy Masterclass Career's Fair

Please fill in the Evaluation Form for the social events:
<https://forms.gle/TG39tSFzNPamBA>

Rebecca Taylor (you)

Nicholas Sammut

Amer Ajanovic

Cosylab 3/50

GSI/FAIR 17/50

CERN 11/50

DKFZ 12/50

CNAO 14/50

MedAustron 0/50

Tutorial 0/50

Presentation Room 0/1000

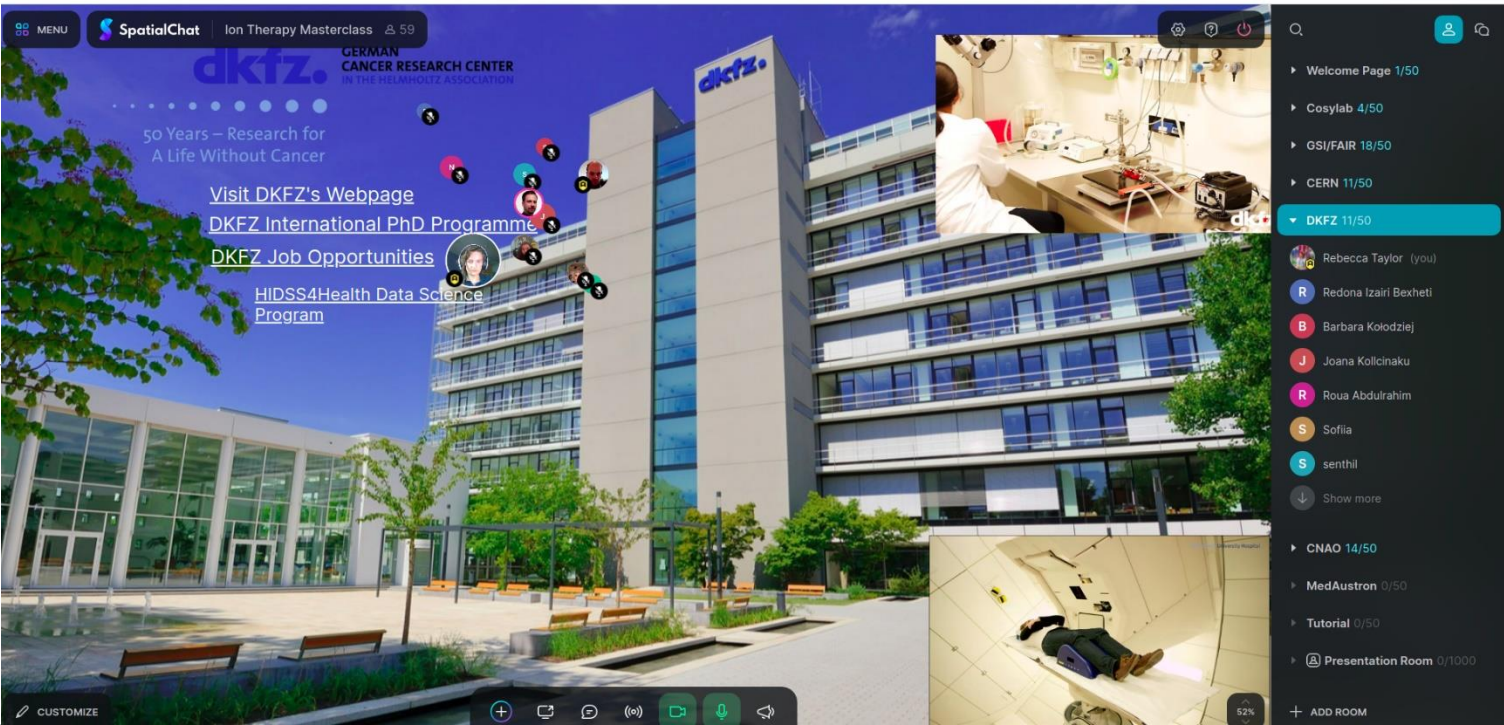
CERN Knowledge Transfer 0/50

ENLIGHT 0/50

+ ADD ROOM

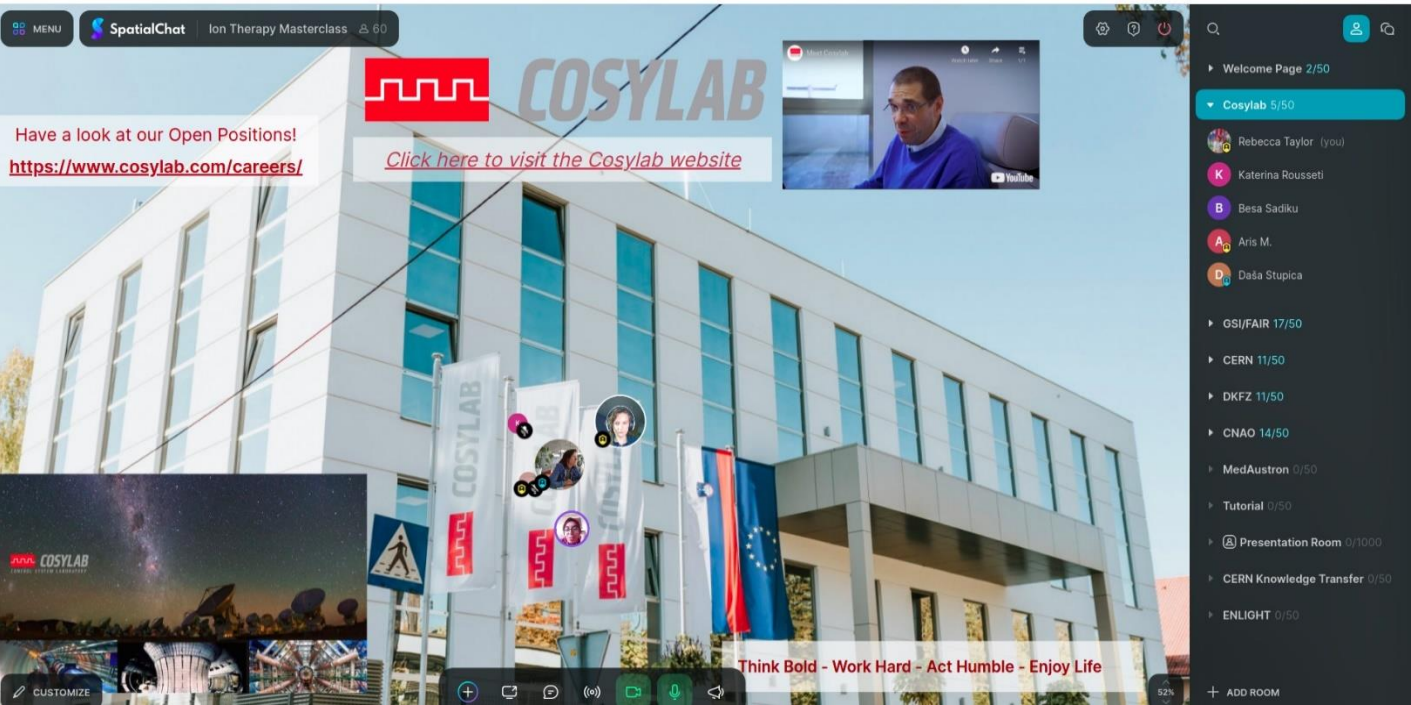
Social Events: Career's Fair

DKFZ



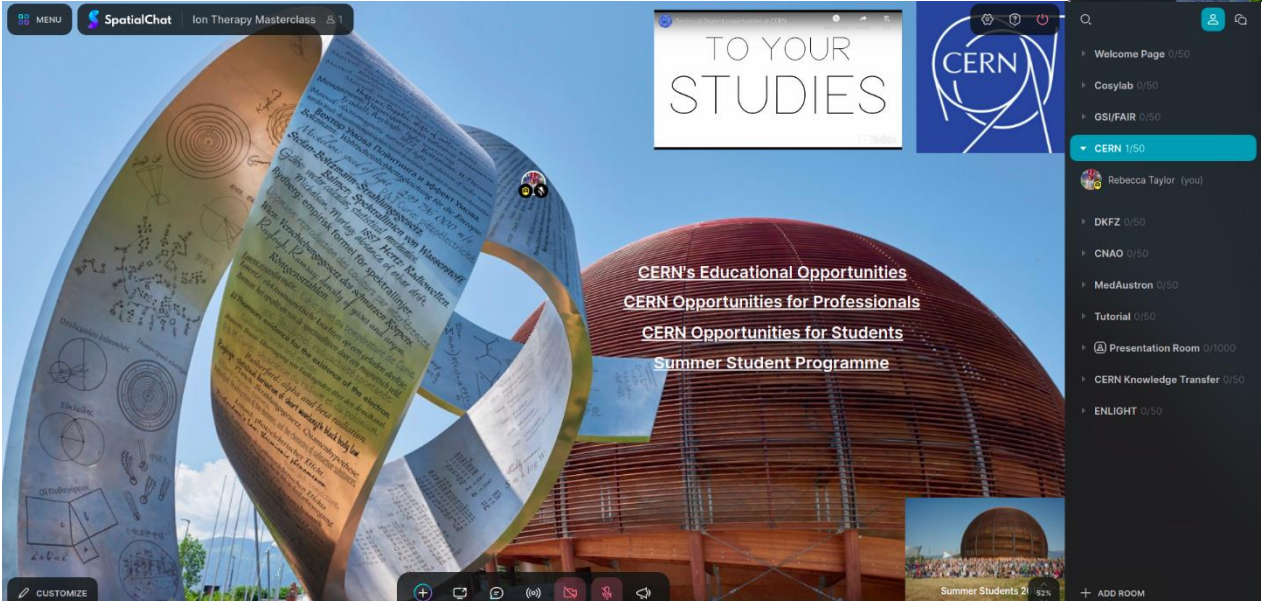
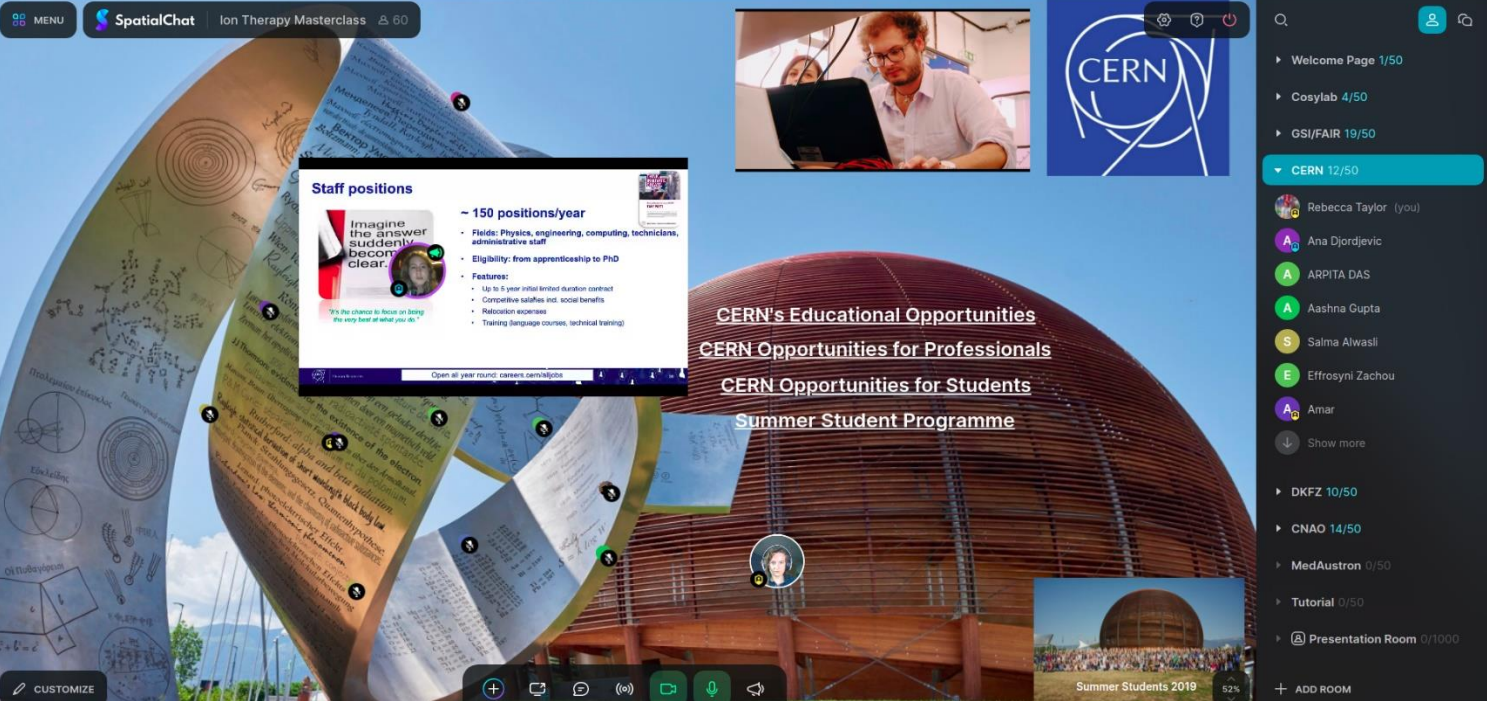
Social Events: Career's Fair

COSYLAB



Social Events: Career's Fair

CERN



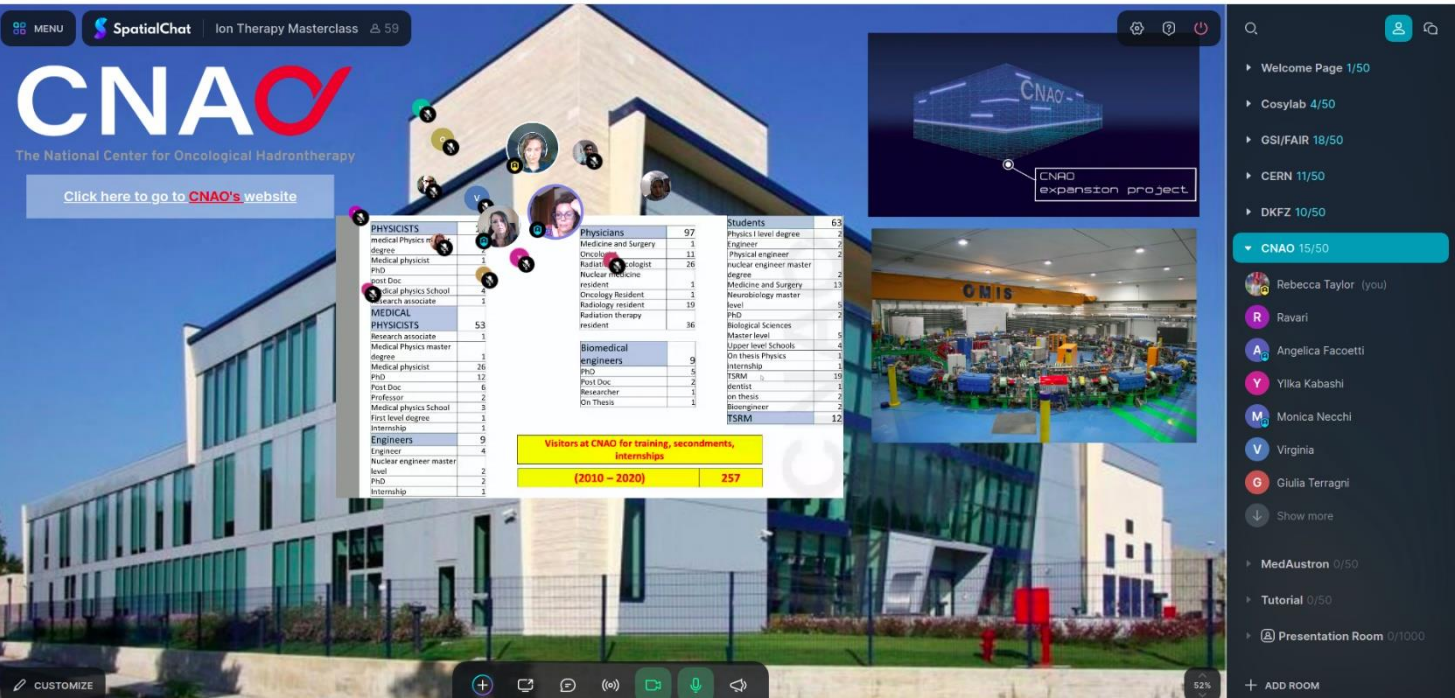
Social Events: Career's Fair

GSI



Social Events: Career's Fair

CNAO



MENU

SpatialChat

Ion Therapy Masterclass 59

The accelerator at MedAustron

Introduction to MedAustron

What makes working at MedAustron Special?

Accelerator Operators at MedAustron

MedAustron

We do not have a formal speaker from MedAustron, but please listen to what it is like to work there, and consider learning more about their company.

[Careers at MedAustron](#)

[Job Offers at MedAustron](#)

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8

WELCOME PAGE 1/50

COSYLAB 4/50

GSI/FAIR 18/50

CERN 11/50

DKFZ 10/50

CNAO 14/50

MedAustron 1/50

Rebecca Taylor (you)

Tutorial 0/50

Presentation Room 0/1000

CERN Knowledge Transfer 0/50

ENLIGHT 0/50

ADD ROOM