

Από την Φυσική στην Ιατρική



Architectural design, Kaprinis Architects

Γιωτα Φωκα (GSI/CERN)

Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης, 10 Μαΐου 2022

Outline

Particle Therapy

- Introductory concepts in Particle Therapy
- Current Status and Future Plans

Next generation facility SEIIST

- **SEIIST:** South East European Institute for Sustainable Technologies
- **HITRIplus** EU-funded project

Capacity Building and Information Activities

- **Particle Therapy MasterClasses (PTMC);** addressing high-school students
- **Heavy Ion MasterClass (HITMC) school;** addressing early stage researchers
- **Information events;** for scientific/medical communities
- **SEEIIST meets Industry;** academia-research-industry workshop

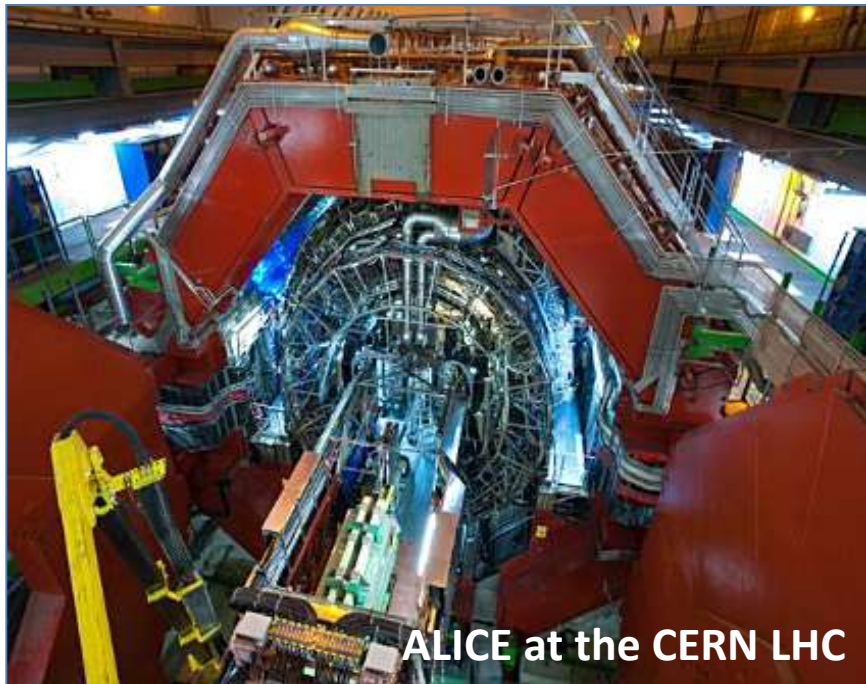
Benefits for society from fundamental research

- Applications
- Opportunities for young people

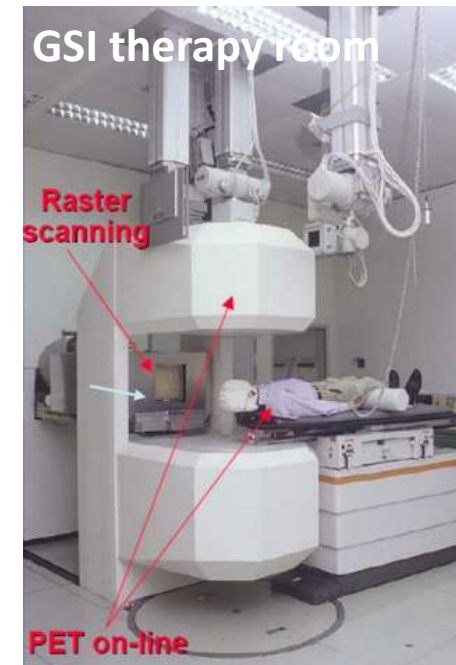
Βαρέα Ιόντα για Έρευνα και Θεραπεία Καρκίνου

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



Mission and mandate of research institutes: fundamental research
Developed technologies and acquired knowledge find applications for society
Next Steps: Next Ion Medical Machine Study, NIMMS, CERN group

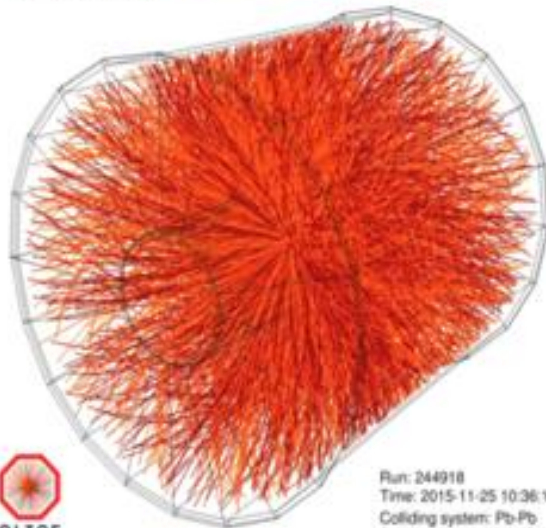
Βαρέα Ιόντα για Έρευνα και Θεραπεία Καρκίνου

Pb-Pb at 5.5 TeV
pp at 14 TeV

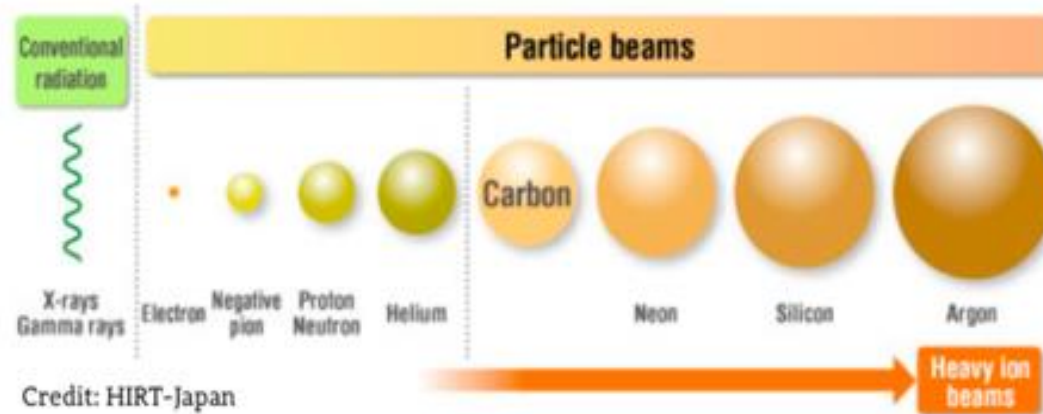
fundamental science
QGP studies



Credit: CERN



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



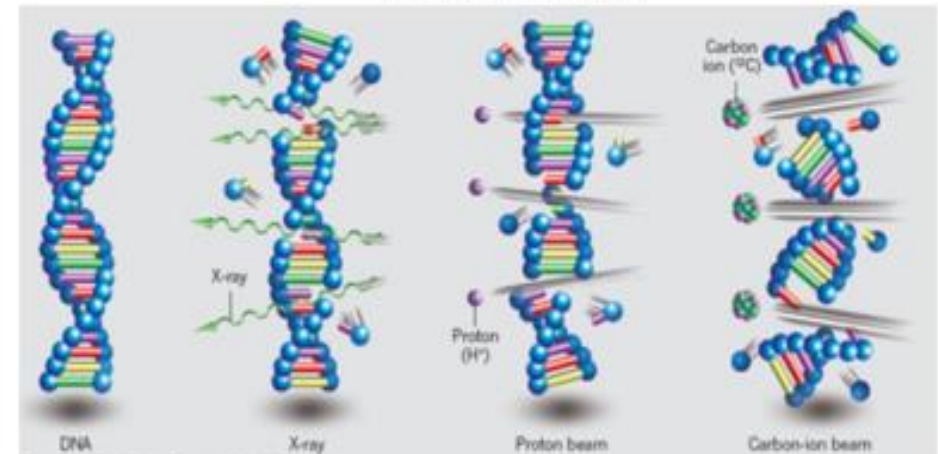
Credit: HIRT-Japan

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

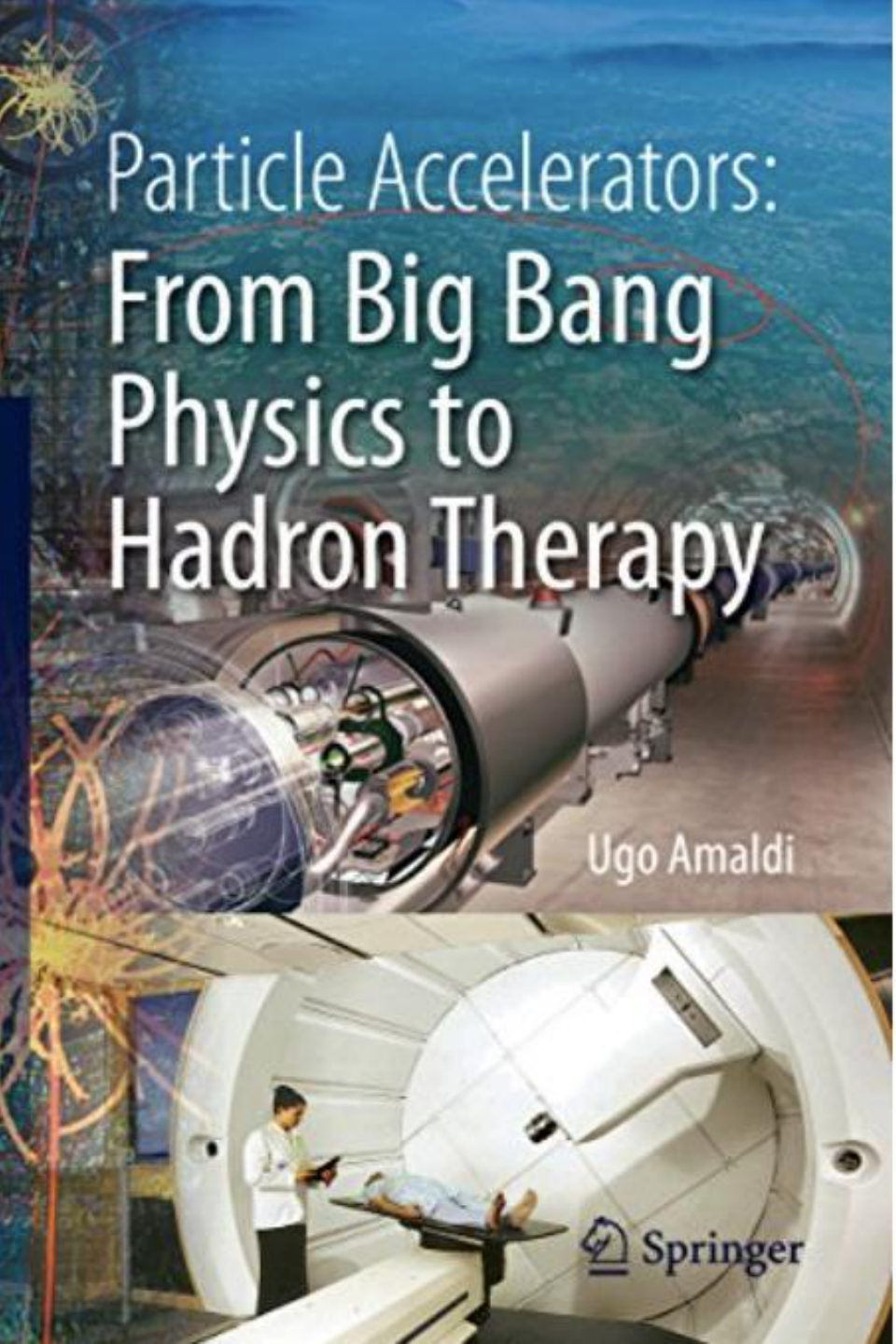
applied science
medicine



Credit: HIT Heidelberg



Credit: T. Nomiva, NIRS Japan



Particle Accelerators: From Big Bang Physics to Hadron Therapy

Ugo Amaldi

 Springer

Πως σχετίζεται η Φυσική με την Ιατρική;

Τι είναι η θεραπεία καρκινικών όγκων με ιόντα;
γνωστή και ως “αδρονική” θεραπεία καρκίνου
με πρωτόνια ή ιόντα άνθρακα

Πώς μπορούν να χρησιμοποιηθούν
σωματίδια για θεραπεία καρκίνου;

Πρώτη θεραπεία καρκινικού όγκου σε κέντρο ερευνών φυσικής



1932 - E. Lawrence
First cyclotron

1954 – Berkeley treats
the first patient



PERCENTAGE DEPTH DOSE

Το 1946, ο Robert Wilson πρότεινε την χρήση πρωτονίων για θεραπεία καρκίνου.

Το 1954, η πρώτη θεραπεία καρκινικού όγκου στο Berkeley.

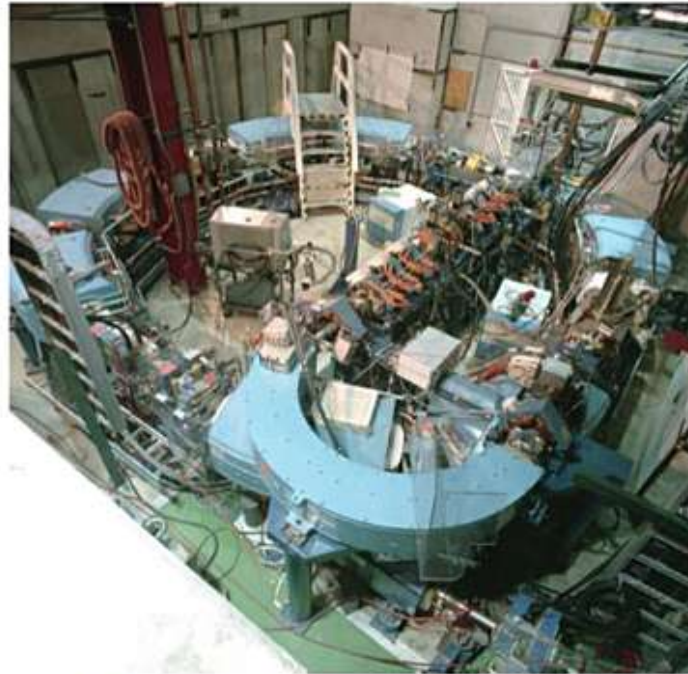
Berkeley cyclotron

Nobel Prize 1939

Από την Φυσική στην Ιατρική

Από τα κέντρα ερευνών φυσικής στις κλινικές

1993- Loma Linda
USA (proton)



First dedicated clinical
facility

1994 – HIMAC
Japan (carbon)



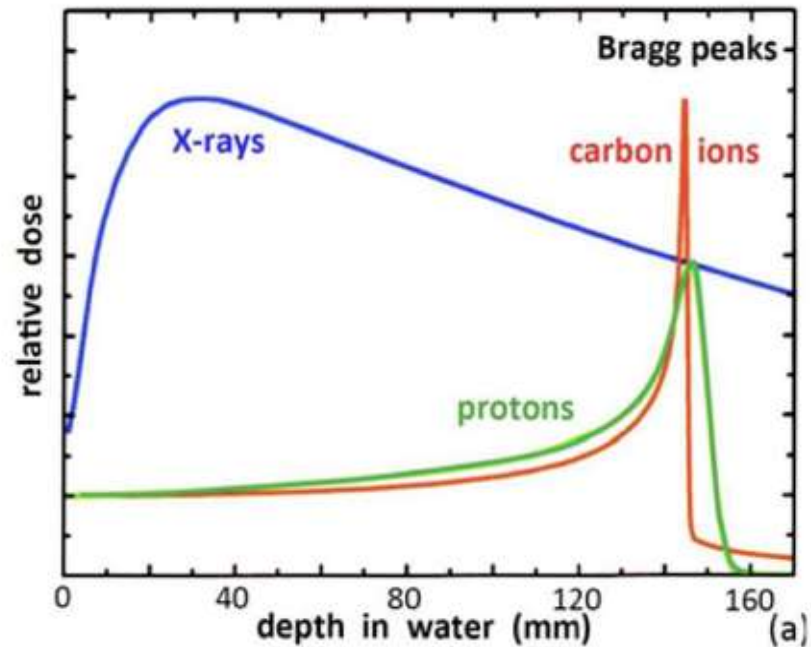
1997 – GSI
Germany (carbon)



Αδρονική θεραπεία καρκινικών όγκων

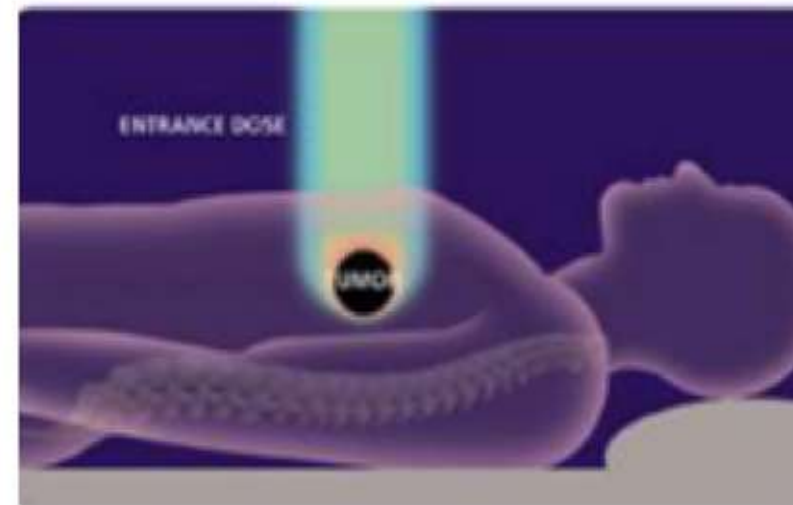
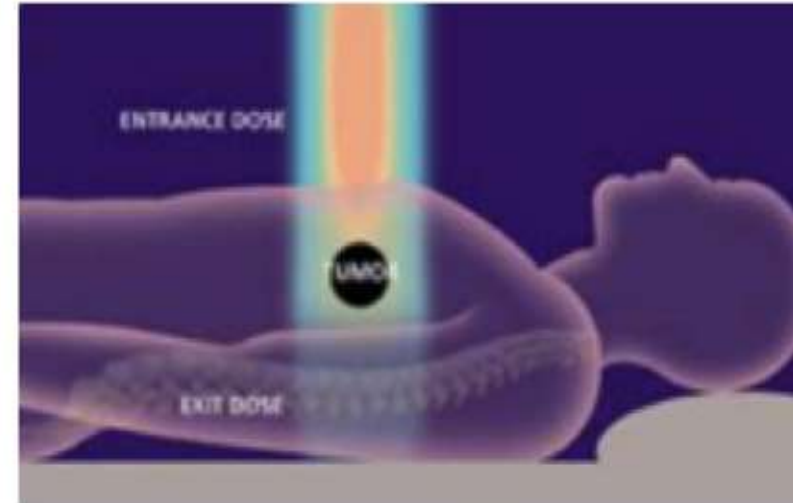
Bragg Peak: φορτισμένα σωματίδια αποθέτουν ενέργεια σε συγκεκριμένο βάθος, ανάλογα με την ενέργεια της δέσμης

The Bragg peak



Different from X-rays or electrons, protons (and ions) deposit their energy at a given depth inside the tissues, **minimising dose to the organs close to the tumour**, sparing nearby organs.

Required energy for full-body penetration: 230 MeV protons, 450 MeV/u C-ions.



Χρήση επιταχυντών στην Αδρονική θεραπεία

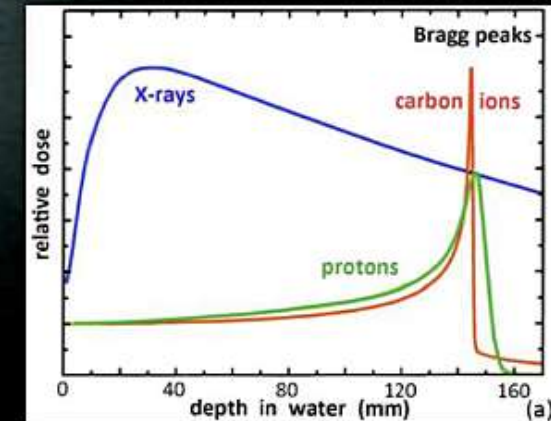
A «beam» of accelerated particles is like a small “knife” penetrating into the matter



Particles can penetrate in depth (different from lasers!).

Particle beams are used in medical and industrial applications, e.g. to cure cancer, delivering their energy at a well-defined depth inside the body (Bragg peak)

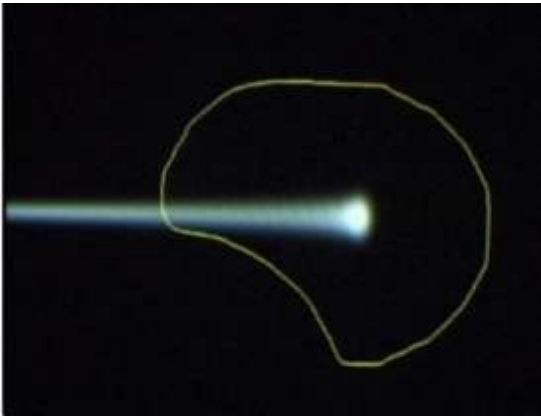
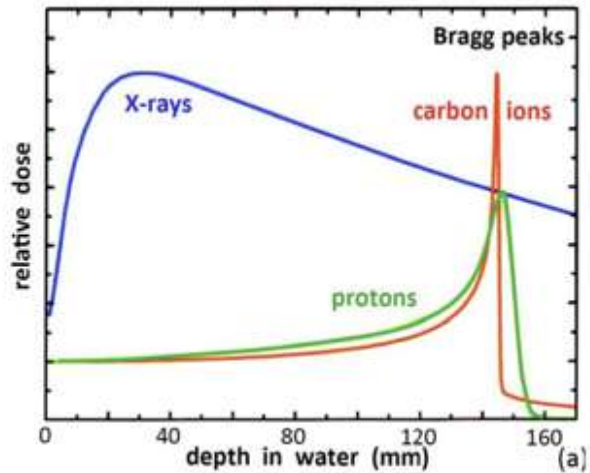
A particle beam can deliver energy to a very precisely defined area, interacting with the electrons and with the nucleus.



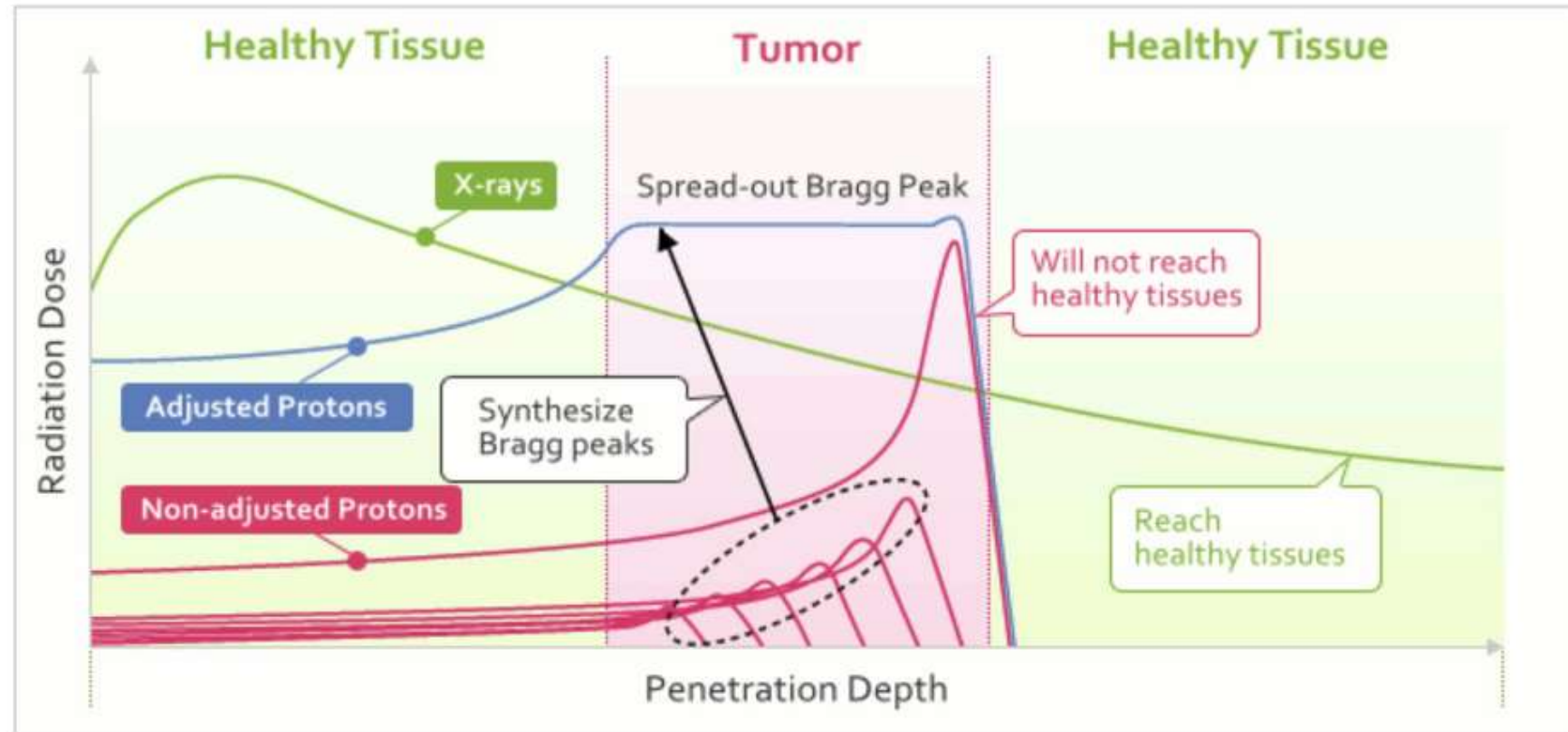
Accelerators: can precisely deliver energy

Αδρονική θεραπεία καρκινικών όγκων

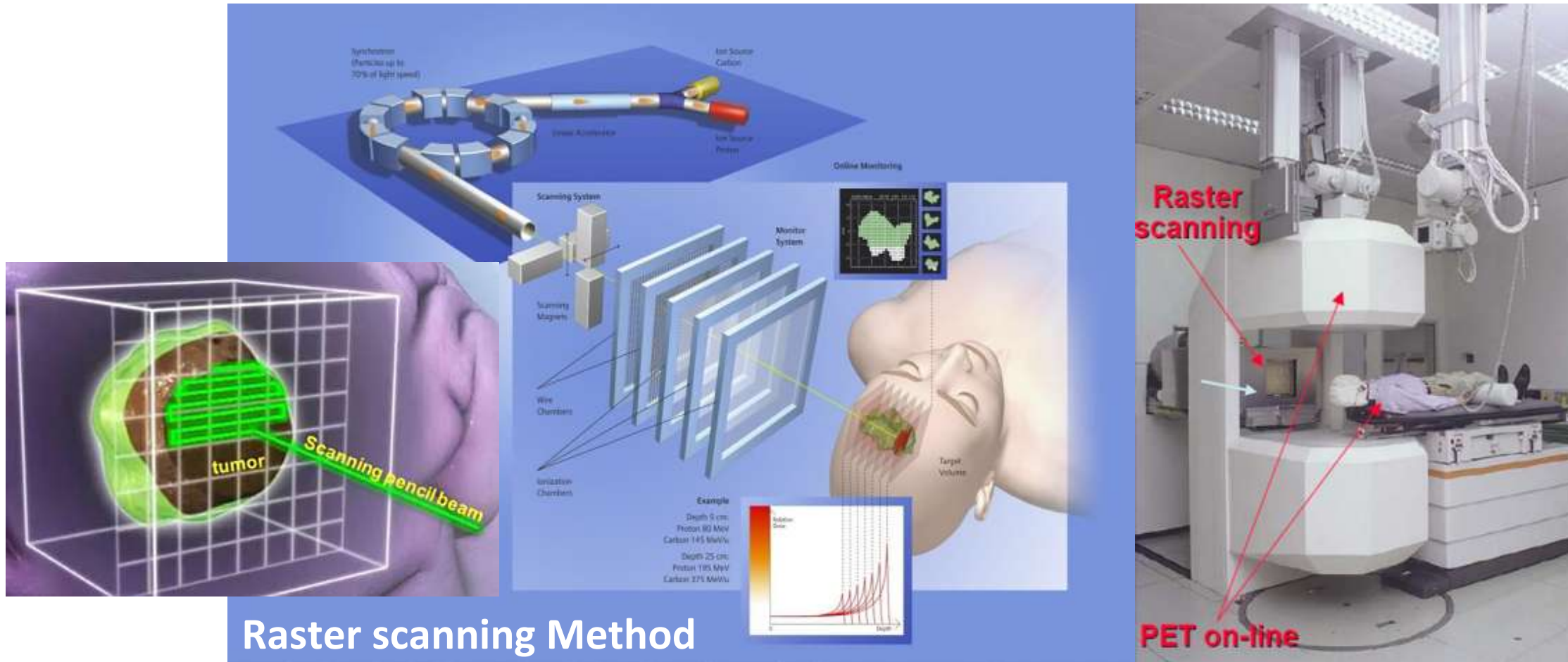
Bragg peak



Spread out Bragg peak



Βαρέα Ιόντα για Θεραπεία Καρκίνου στο GSI



Raster scanning Method

Haberer et al., NIM A , 1993

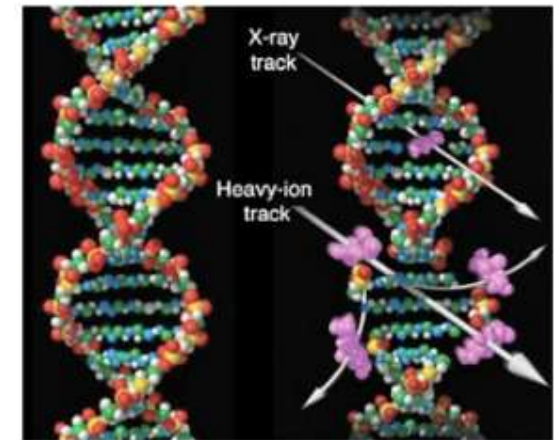
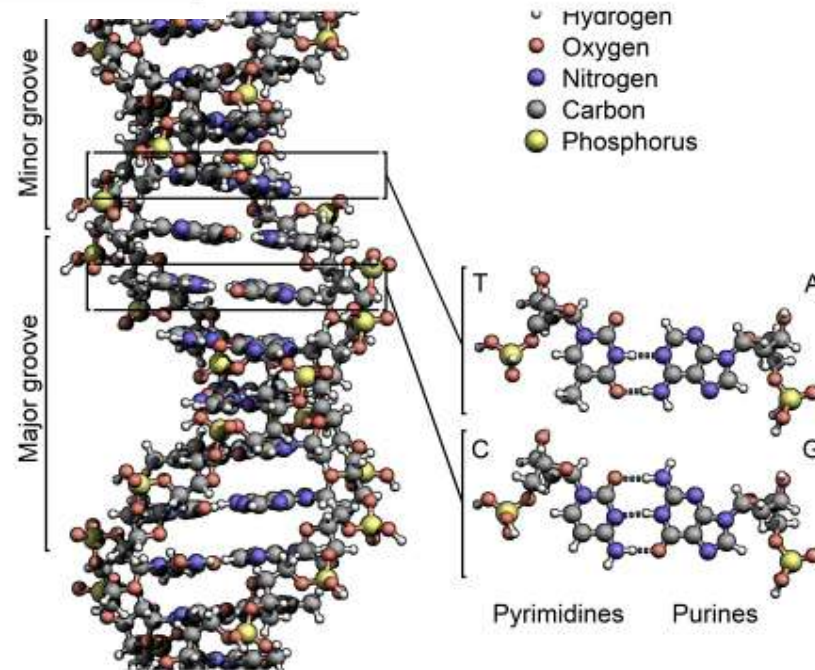
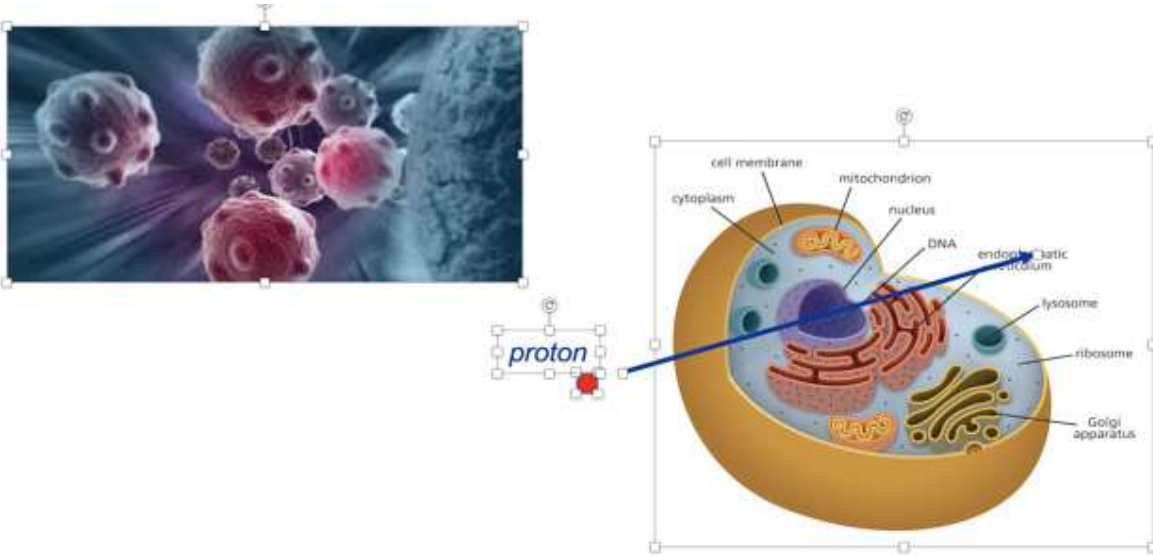
scanning of focussed ion beams in fast dipole magnets

active variation of the energy, focus and intensity in the accelerator and beam lines

Εφαρμόσθηκε στα κέντρα θεραπείας του HIT και MIT της Γερμανίας

Δέσμες σωματιδίων για καταστροφή κυττάρων

Κατανοώντας τις ιδιότητες των σωματιδίων και μαθαίνοντας πώς να τα επιταχύνουμε και να τα κατευθύνουμε σε συγκεκριμένο στόχο, γεννήθηκε η ιδέα να τα χρησιμοποιήσουμε για να καταστρέψουμε καρκινικά κυτταρα

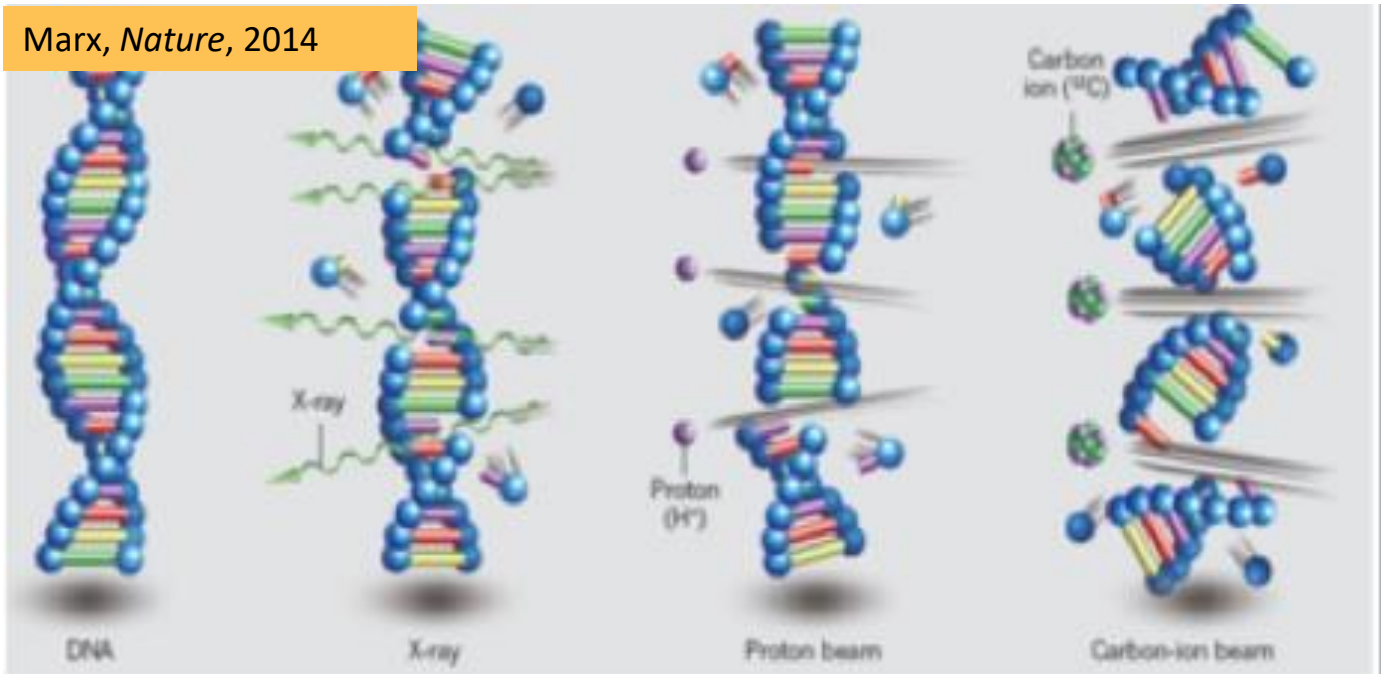


Δέσμες σωματιδίων για καταστροφή κυττάρων

Οπλοστάσιο για θεραπεία καρκινικών όγκων

Πρωτεΐνες για επιδιόρθωση
σε μικροσκόπιο

Marx, *Nature*, 2014

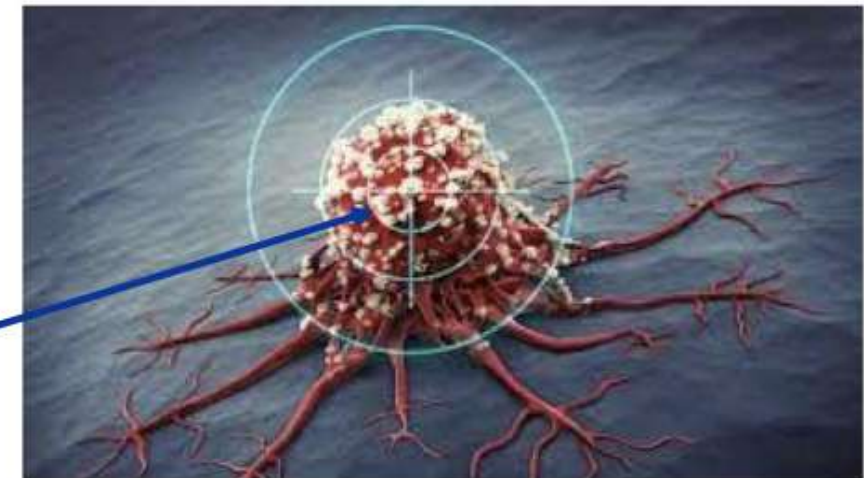
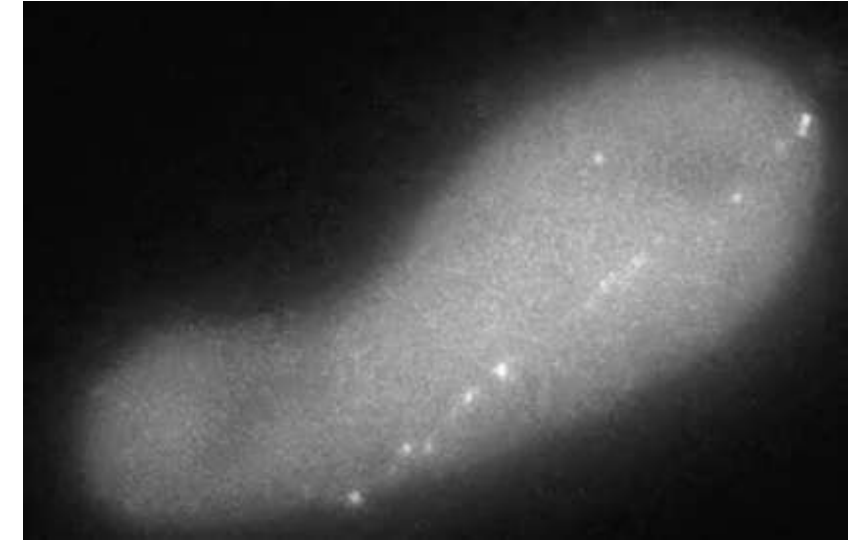


DNA φωτονία πρωτονία ιοντα ανθρακα

Στοχεύοντας τον Στόχο και μόνο το Στόχο !

Στόχος:
καταστροφή καρκινικών κυττάρων
MONO !!

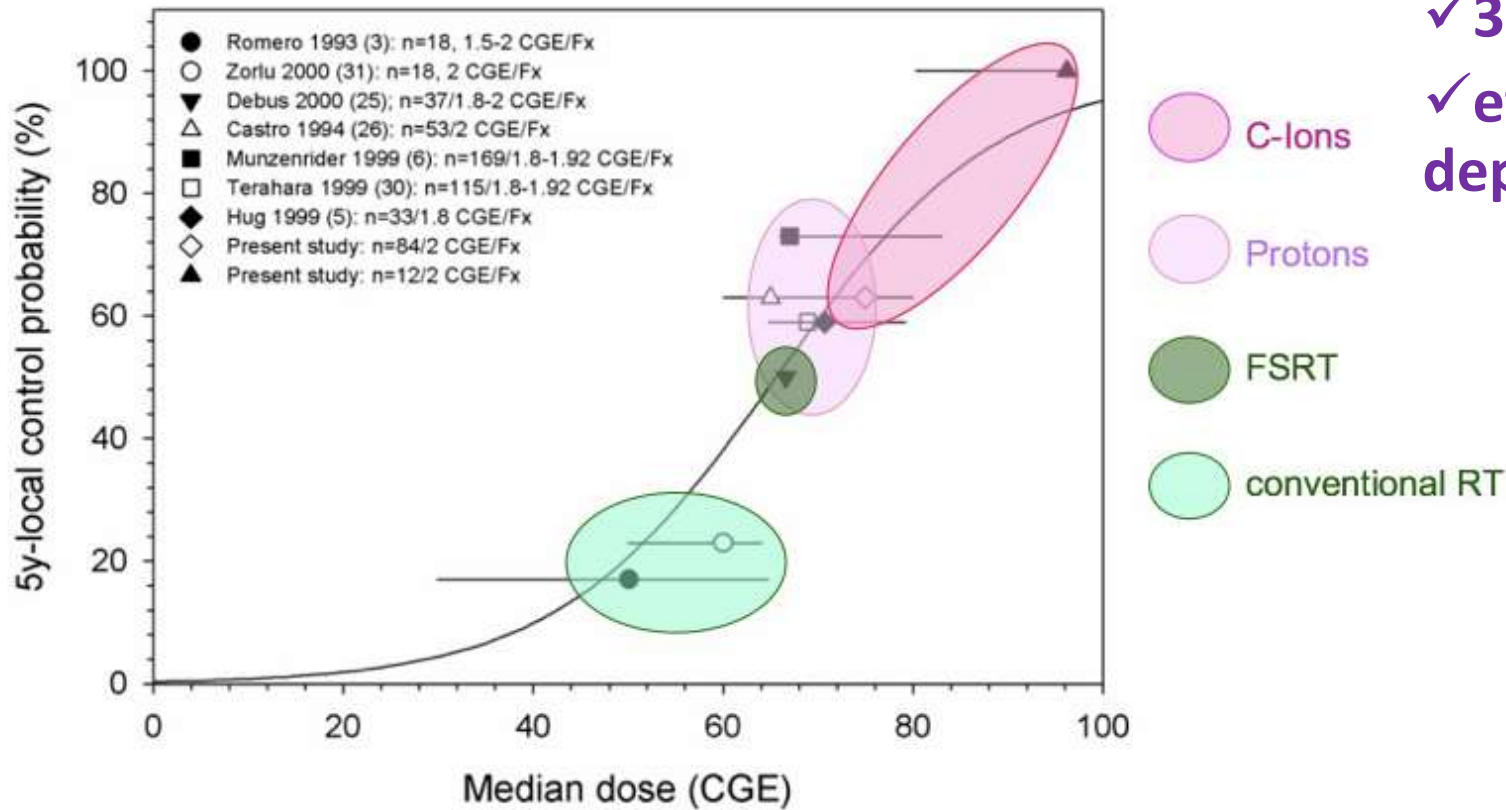
proton



Αποτελεσματικότητα ιόντων άνθρακα

Carbon ions

Radiotherapy of Skull Base Chordomas Motivation: Dose Response Relationship



Double-strand breaks (not reparable)

✓ 3x more damage (RBE)

✓ effective in hypoxic (oxygen-depleted) “radioresistant” tumours

Δωμάτιο θεραπείας στο GSI (Cave M)



D. Schulz-Ertner, IJROBP 2007

Ραδιο-ανθεκτικοί ογκοί

Αποτελεσματικότητα iónτων άνθρακα με ραδιο-ανθεκτικούς ογκούς

Klein et al. *Radiation Oncology* (2017) 12:208
DOI 10.1186/s13014-017-0939-0

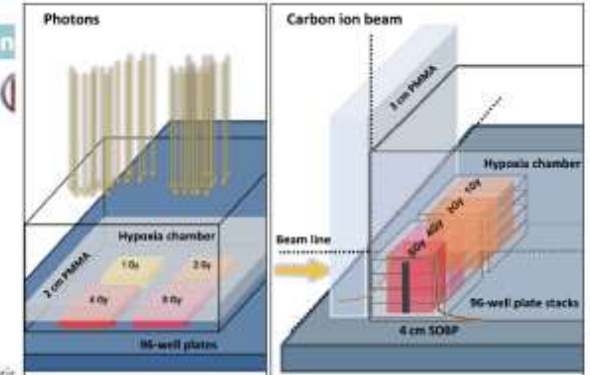
Radiation Oncology

RESEARCH

Open

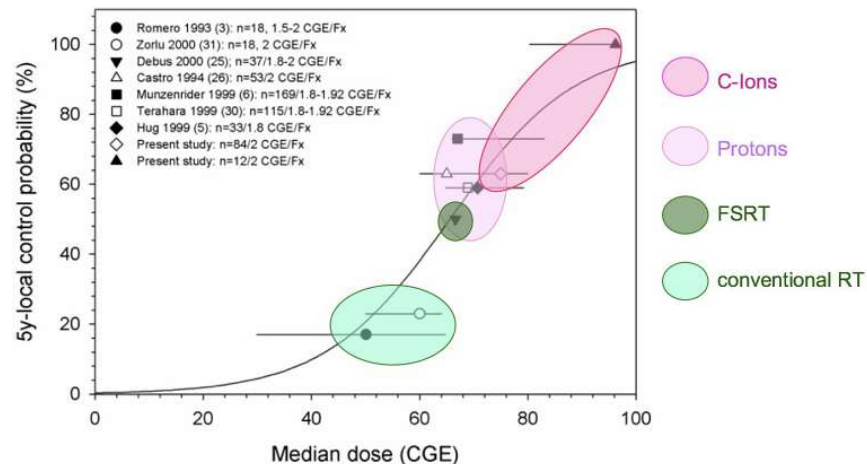
Overcoming hypoxia-induced tumor radioresistance in non-small cell lung cancer by targeting DNA-dependent protein kinase in combination with carbon ion irradiation

Carmen Klein^{1,2,3,4}, Ivana Dokić^{1,2,3,4}, Andrea Mairani^{1,2,3,4,5}, Stewart Mein^{1,2,3,4}, Stephan Bruns⁴, Peter Häfner⁴, Thomas Haberer⁴, Oliver Jäkel³, Astrid Zimmermann⁷, Frank Zenke², Andree Blaukat⁷, Jürgen Debus^{1,2,3,4,5*} and Amir Abdollahi^{1,2,3,4,5*}



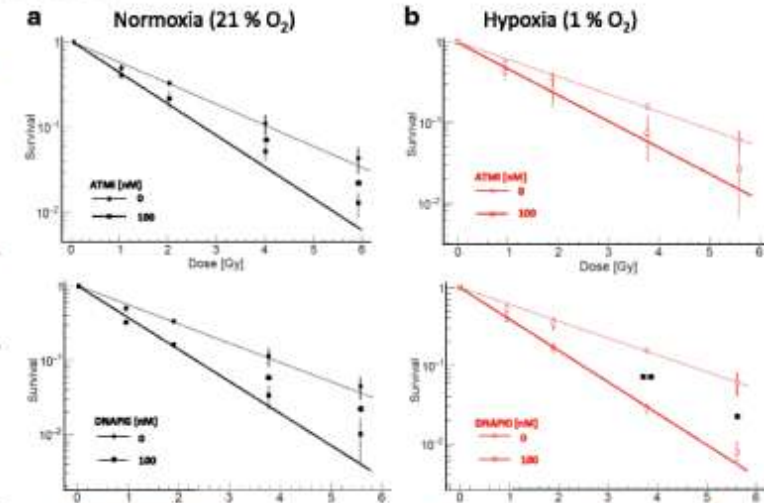
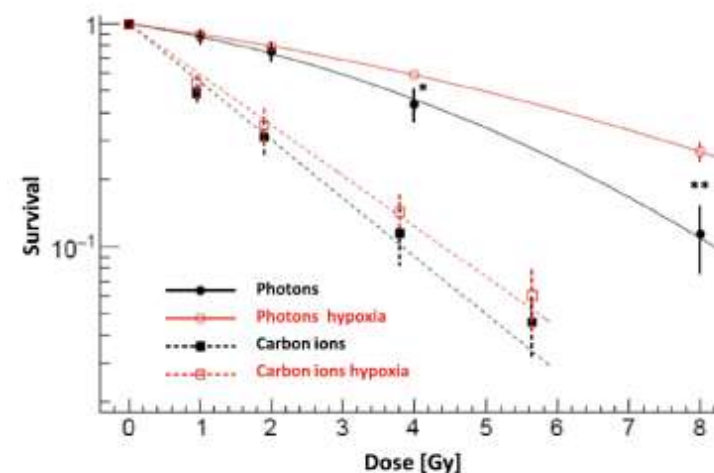
Radiotherapy of Skull Base Chordomas Motivation: Dose Response Relationship

Carbon ions



D. Schulz-Ertner, IJROBP 2007

Oxygen effect after photon and carbon ion irradiation

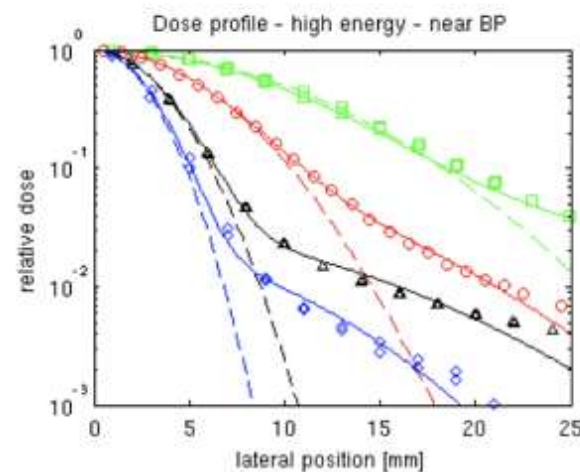
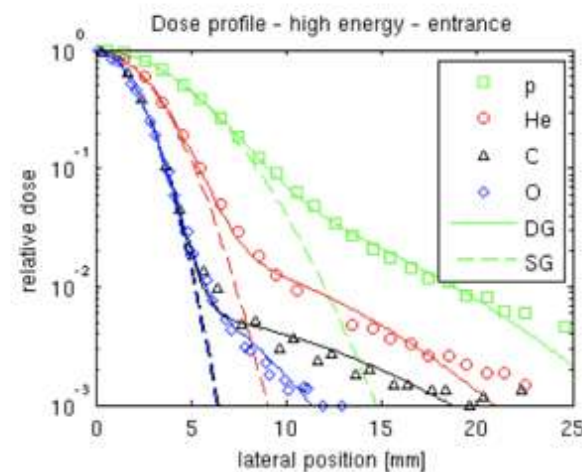
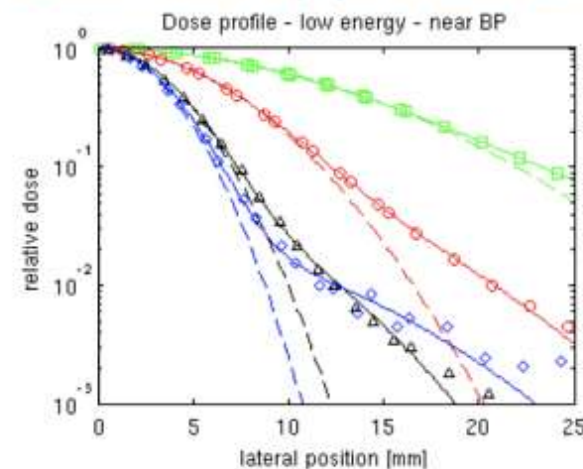
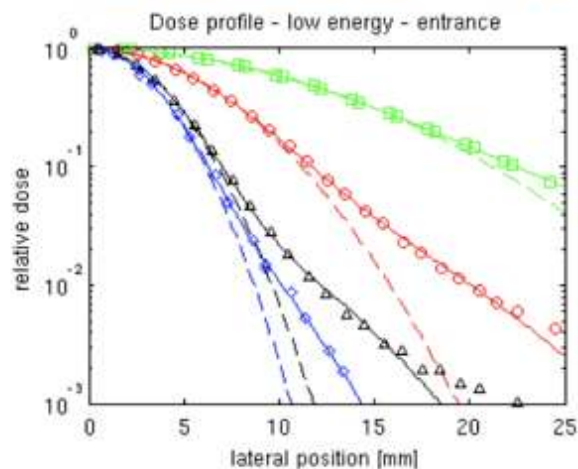
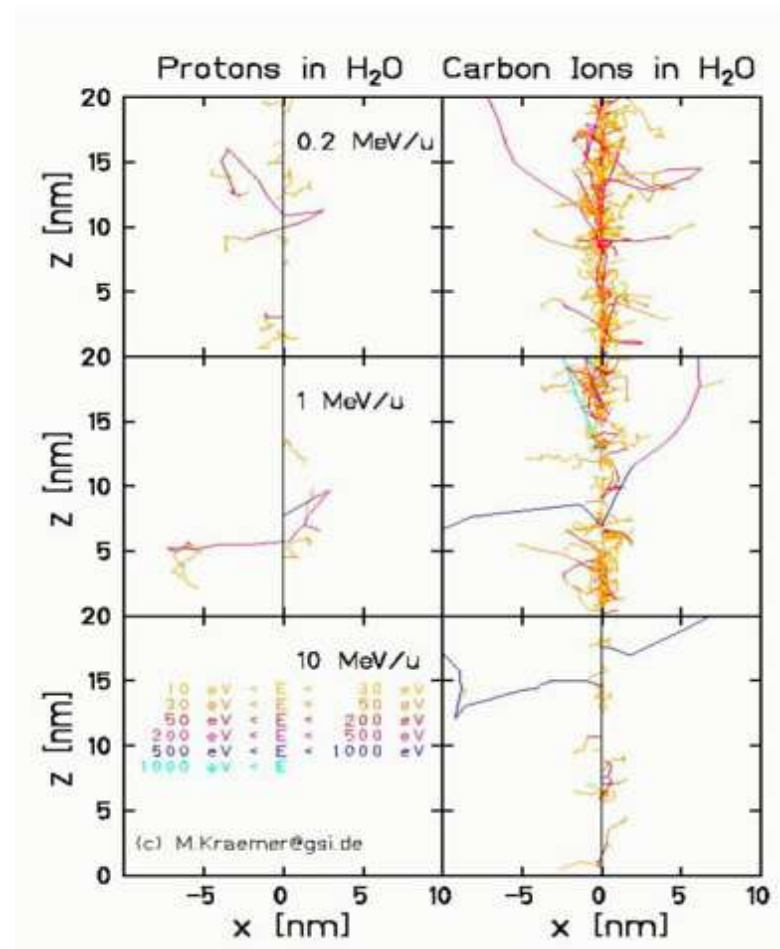


DNAPK further augments efficient eradication of hypoxic tumor cells by carbon ion

Έρευνα με διάφορα είδη ιόντων

Από έρευνα με προσομοιώσεις
μέχρι και την εφαρμογή θεραπείας με He
στο κεντρο HIT της Χαϊδελβέργης

Rationale for 4He -beam therapy: scattering



P
He
C
O

— solid
double
Gaussian (DG)
fits

- - -dashed
simple
Gaussian (SG)
fits.

Αποτελέσματα θεραπείας στο GSI

- Chondrosarcoma discovered and surgically removed in 2003
 - Recurring tumor in 2007 at age 8
 - Treated in GSI Cave M with carbon ions
 - Local control of tumor for 10 years and counting
 - Under regular supervision in Heidelberg
 - 2017 - preparing to enroll in informatics
-
- **No longterm side effects**

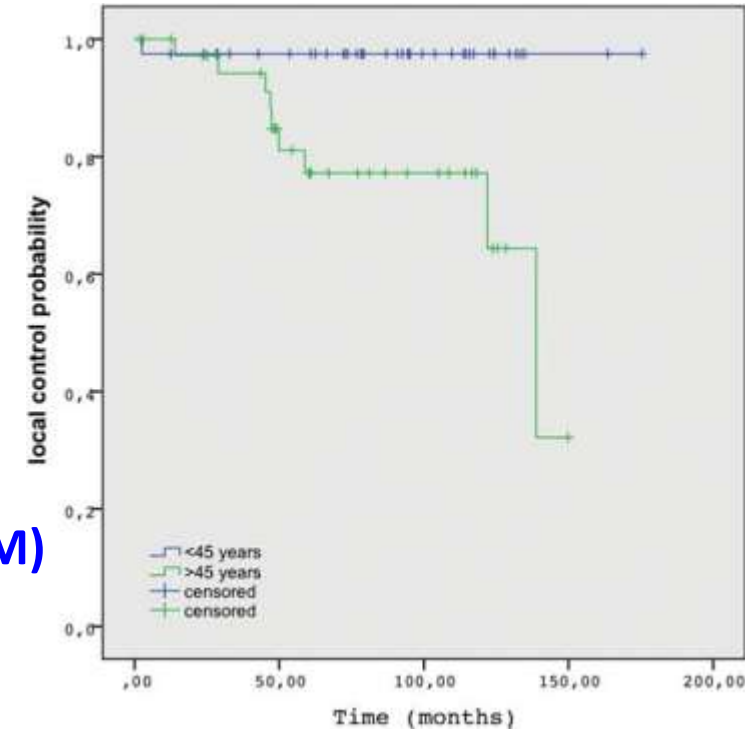
<http://www.deutsche-uniklinika.de/themen-die-bewegen/hinter-den-kulissen-patienten-erzaehlen/chondrosarkom/>



Δωμάτιο θεραπείας στο GSI (Cave M)



Ποσοστό επιτυχίας



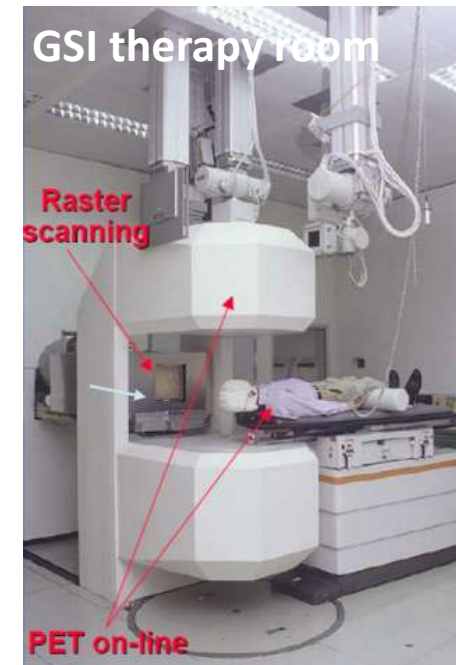
Συνεχια Έρευνας για Θεραπεία Καρκίνου στο GSI

GSI δωμάτιο θεραπείας σήμερα

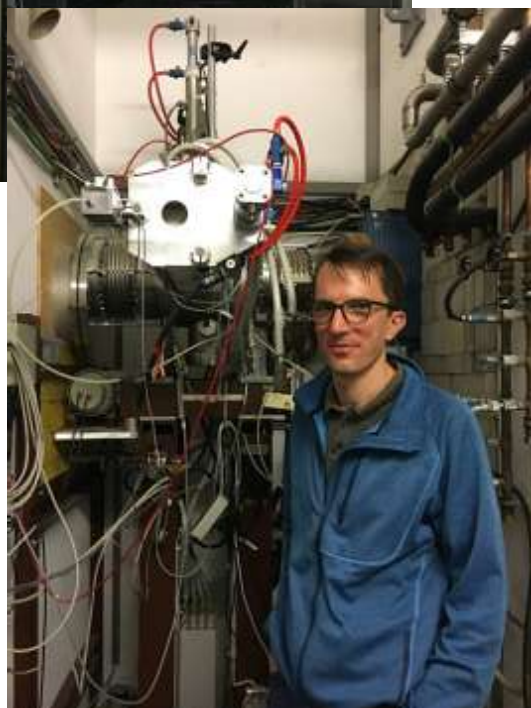


Έρευνα για την θεραπεία κινούμενων
οργάνων, πνευμόνων κλπ

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

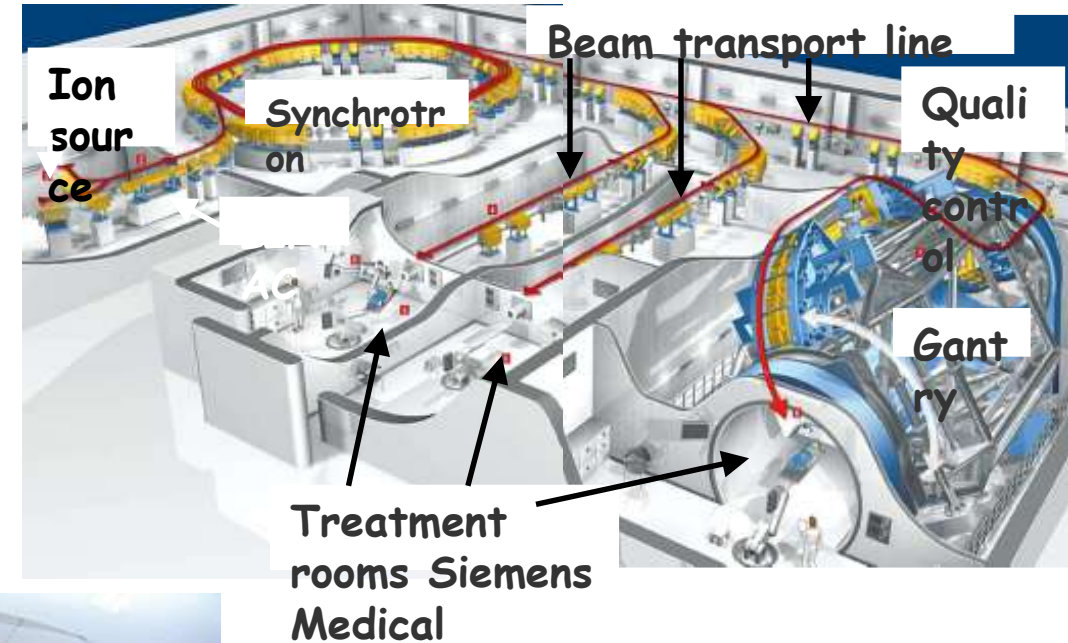


Τι υπάρχει πίσω από τους τοίχους?



**GSI δωμάτιο θεραπείας:
πίσω από τους τοίχους**

Βαρέα Ιόντα για Θεραπεία Καρκίνου στο HIT πανεπιστημιακό νοσοκομείο της Χαιδελβεργης



Το πρώτο κέντρου θεραπείας ιόντων
στην Ευρώπη: Το HIT στην Heidelberg

Ξεκίνησε την θεραπεία ασθενών το 2009.

Ακολούθησε το MIT στο Marburg

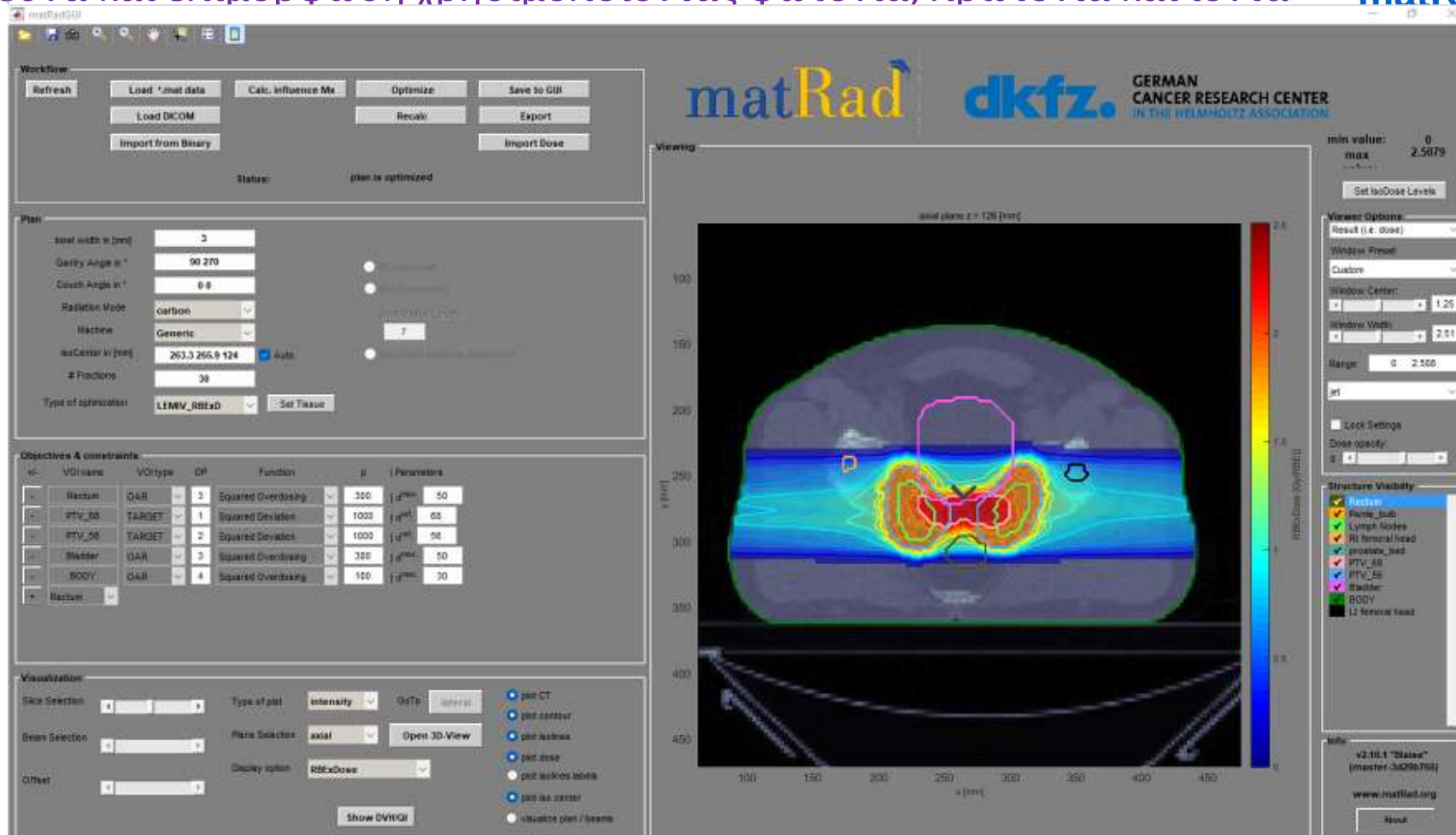


Σχεδιασμός Θεραπείας

**matRad Treatment Planning: επαγγελματικό open source λογισμικό,
για τον υπολογισμό κατανομής της δόσης (σχεδιασμού πλάνων θεραπείας)**

Αναπτύχθηκε στην Χαϊδελβέργη από το DKFZ, Γερμανικό κέντρο έρευνας για τον καρκίνο για έρευνα και επιμόρφωση χρησιμοποιώντας φωτόνια, πρωτόνια και ιόντα **matRad:**

matRad: www.matrad.org



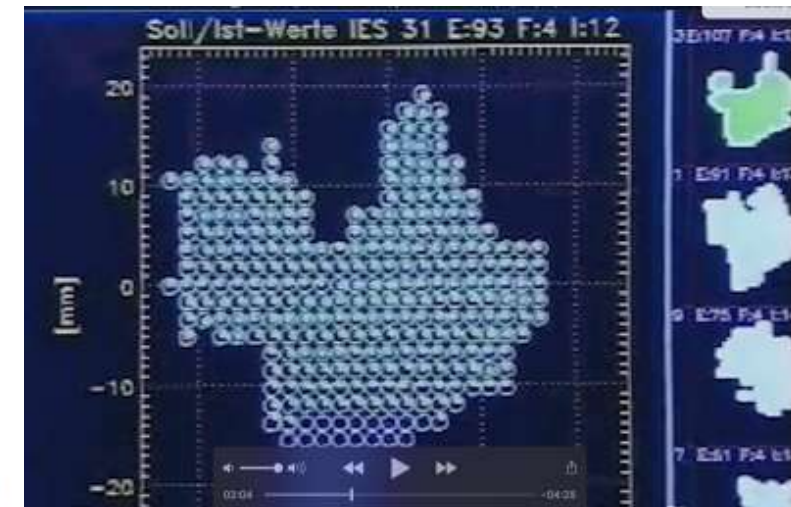
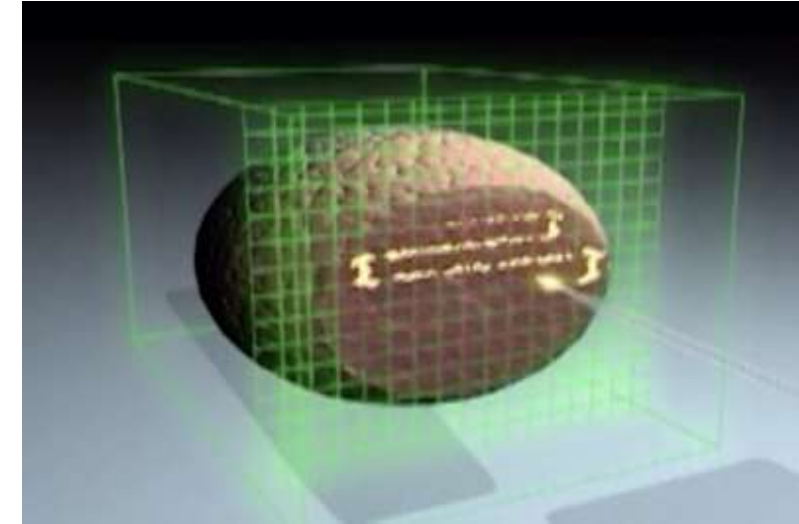
Απαιτήσεις και παράμετροι των ιατρικών επιταχυντών

Accelerator Requirements for Scanning

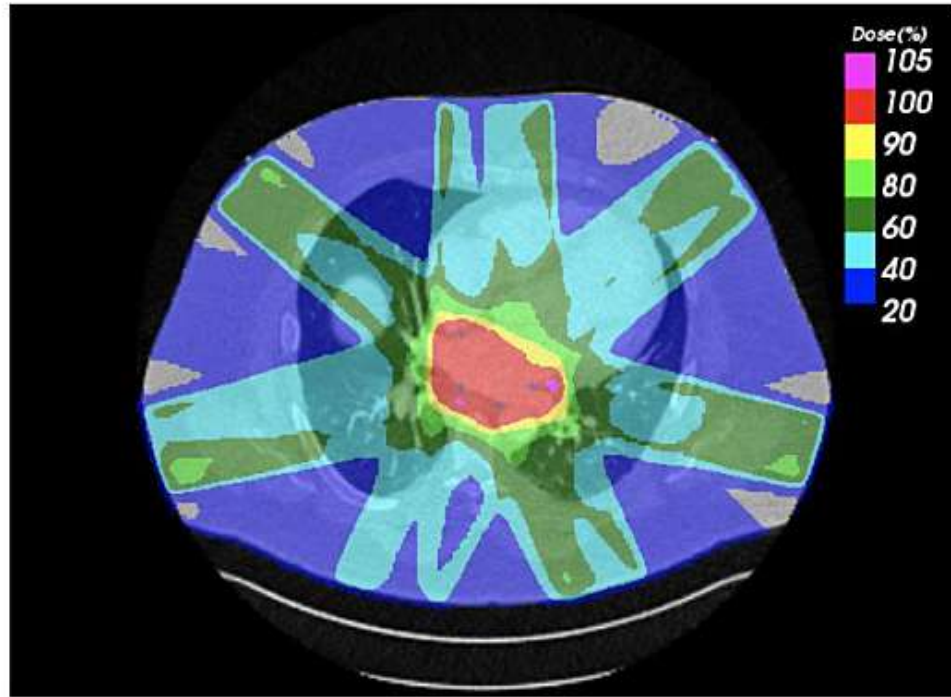
Example: beam parameters Heidelberg Ion Therapy (HIT)

Parameter	
ions	protons and carbon (3 ion sources); pre-clinical: helium, research: oxygen (from carbon source)
intensity	$2 \times 10^6/\text{s}$ to $8 \times 10^7/\text{s}$ for carbon $8 \times 10^7/\text{s}$ to $4 \times 10^8/\text{s}$ for protons 10 steps ; maximum extraction time 5 s Increase needed ~ 5x (FLASH not understood today)
energy	88-430 MeV/u for carbon 50-221 MeV/u for protons 255 steps , 1-1.5 mm spacing, 2-30 cm range in water
focus	3.5-13 mm FWHM 11-33 mm FWHM 4 steps

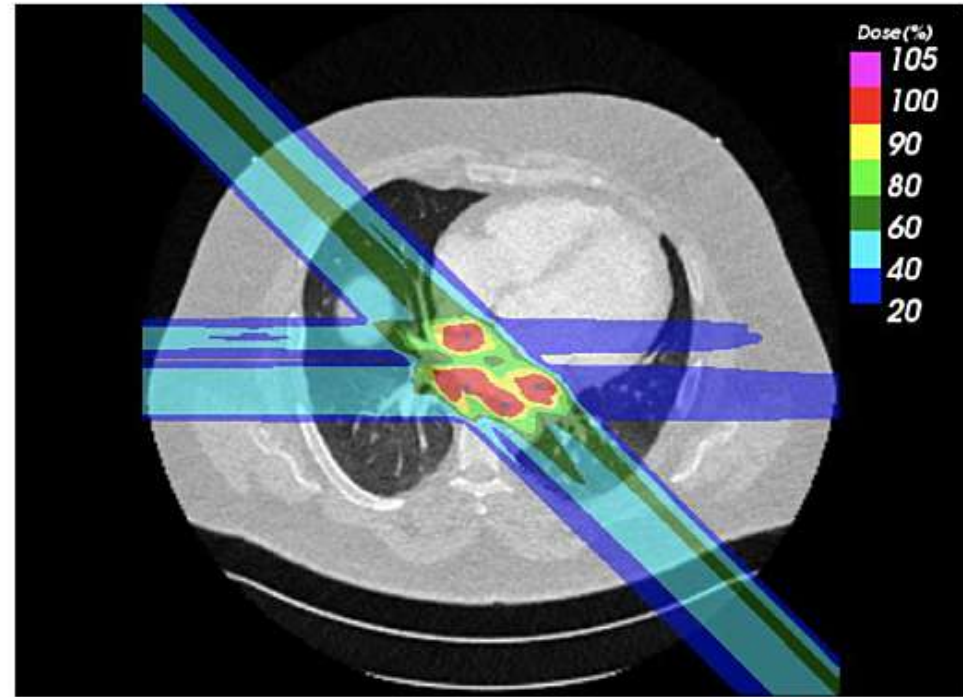
→ a total of $3 \times 10 \times 255 \times 40 = 30600$ settings per treatment room!



Σύγκριση φωτονίων με ιόντα άνθρακα



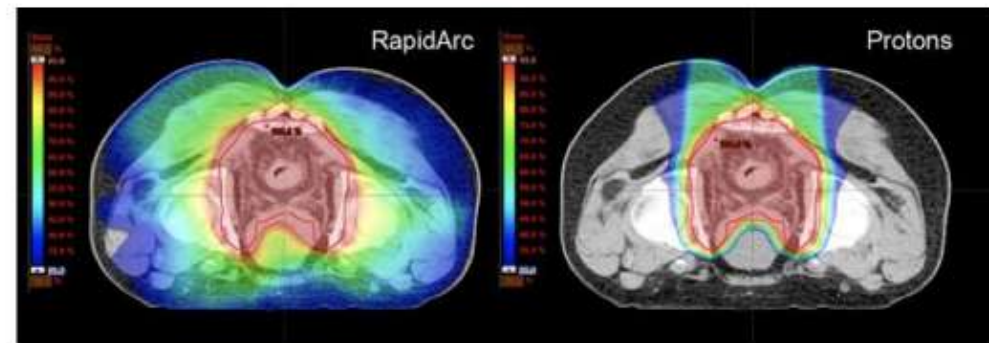
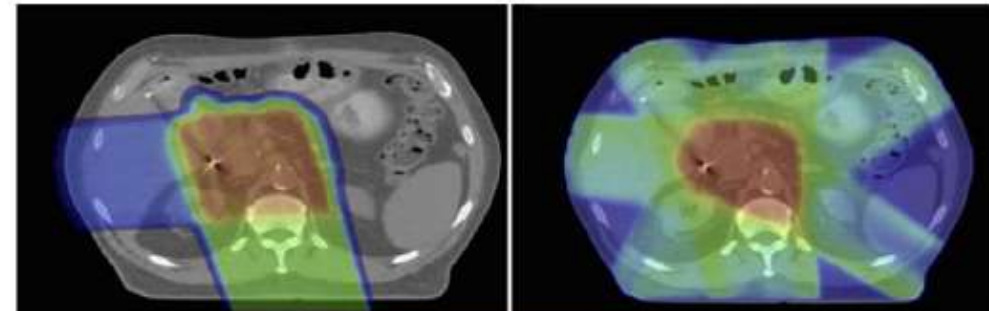
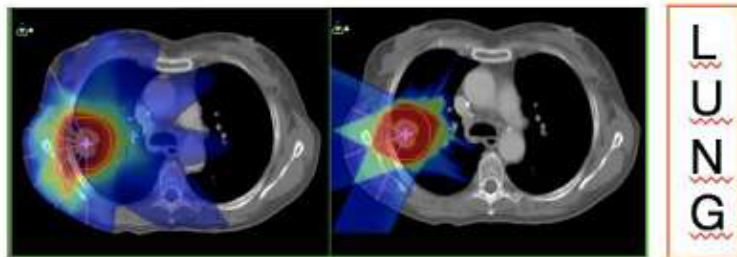
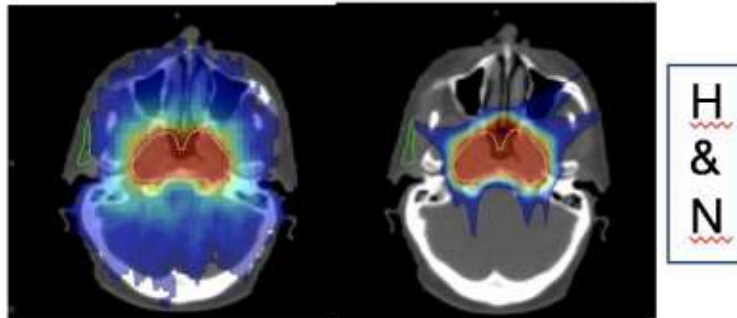
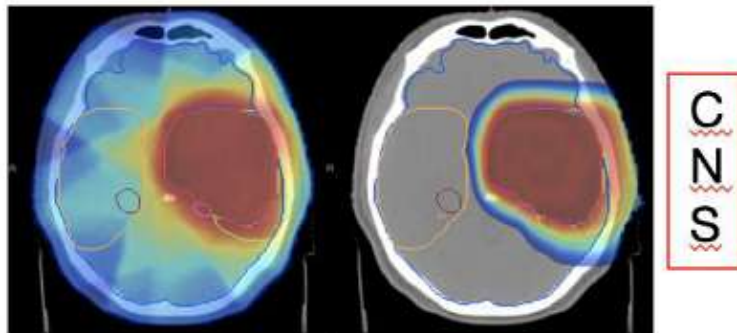
Photons



Carbon

Σύγκριση φωτονίων με ιόντα άνθρακα

Particle therapy: dose advantage in more patients



Διαφορετικοί επιταχυντές για διαφορετικά σωματίδια

Ions deliver more energy to the tissues but **need more energy to enter the body** → higher energy accelerator, **factor 2.8** in diameter with respect to protons

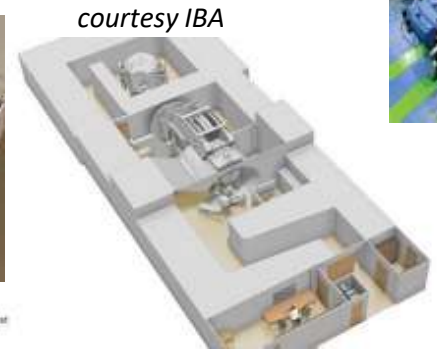
Conventional x-ray
Radiotherapy



Linac, X-rays
~50 m²
~5 M€



Cyclotron, protons
~500 m²
~40 M€



CNAO, Ιταλία

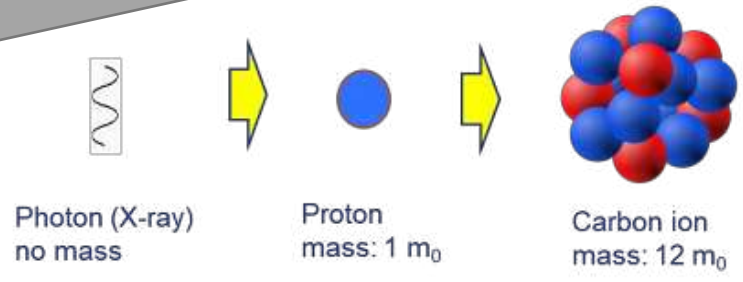


HIT, Γερμανία

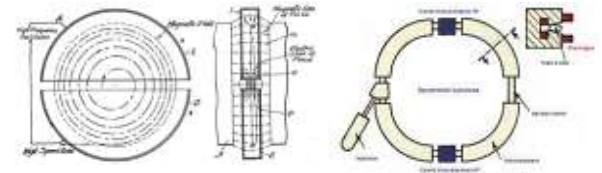


Synchrotron, heavy ions
~5,000 m²
~200 M€

A synchrotron is a “hollow cyclotron”:
Because higher energies need larger particle orbits, in the synchrotron a time-varying magnetic field covers only the external part.

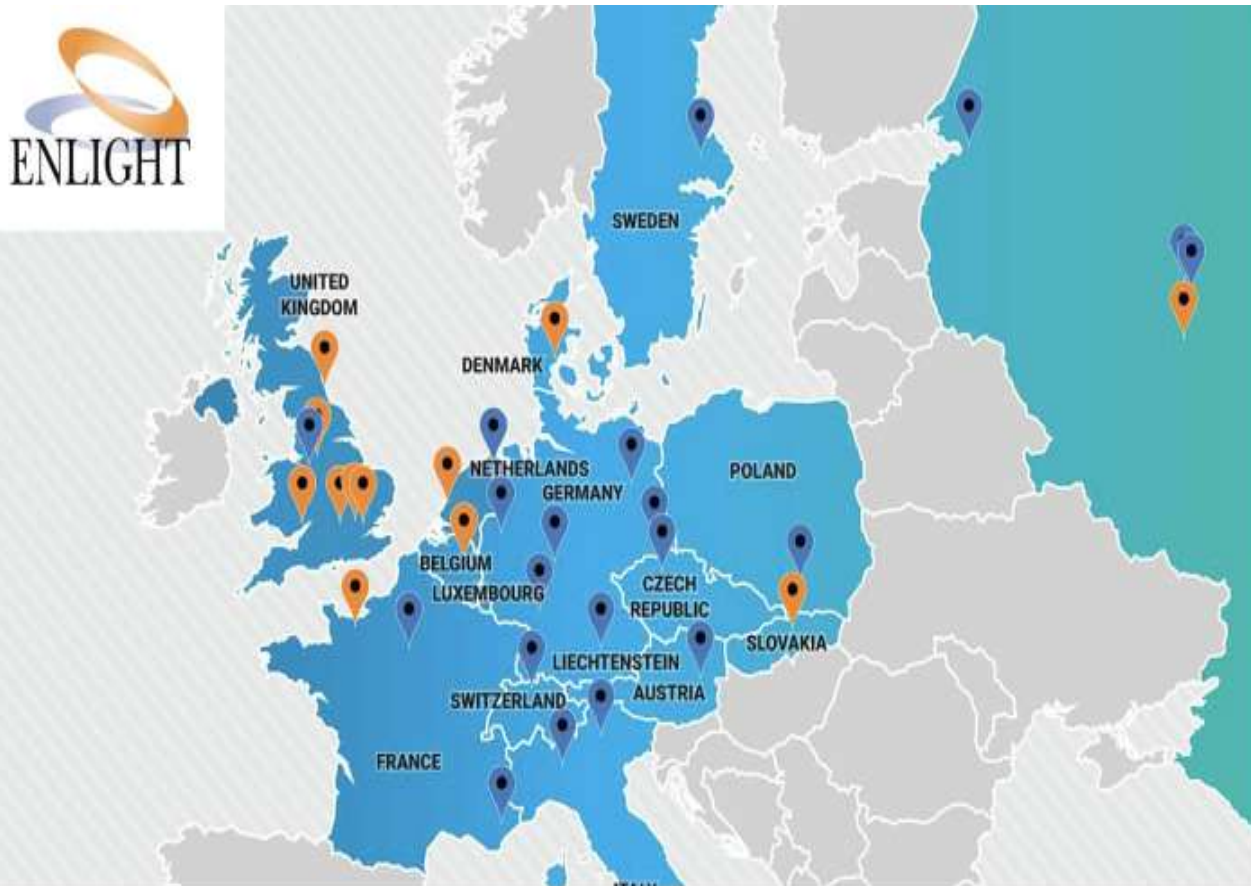


Wikimedia commons

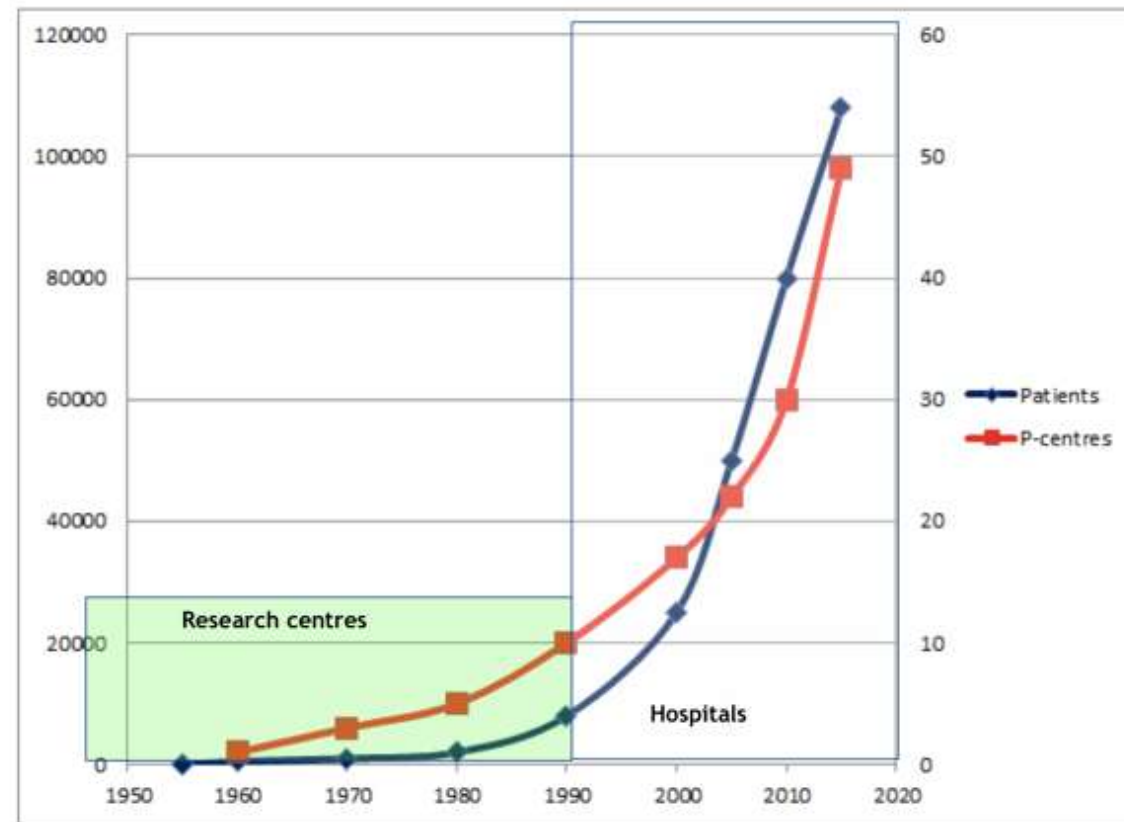


Κέντρα Αδρονικής Θεραπείας

Ευρωπαϊκά κέντρα αδρονικής θεραπείας (2018)



[Data from www.ptcog.ch]



Hadron therapy is an advanced niche in cancer therapy:

22,000 patients/year (2018) treated with particle beams against 25,000,000 patients/year with conventional RT.

Τέσσερα κέντρα σωματιδιακής θεραπείας βαρέων ιόντων για θεραπεία καρκίνου στην Ευρώπη

MedAustron, Αυστρία



CNAO, Ιταλία



HIT, Γερμανία



MIT, Γερμανία



Παγκόσμια κέντρα βαρέων ιόντων για θεραπεία καρκίνου



- > 90 proton centers not shown, ~35 in the US
- 1 carbon center in the US in planning stage

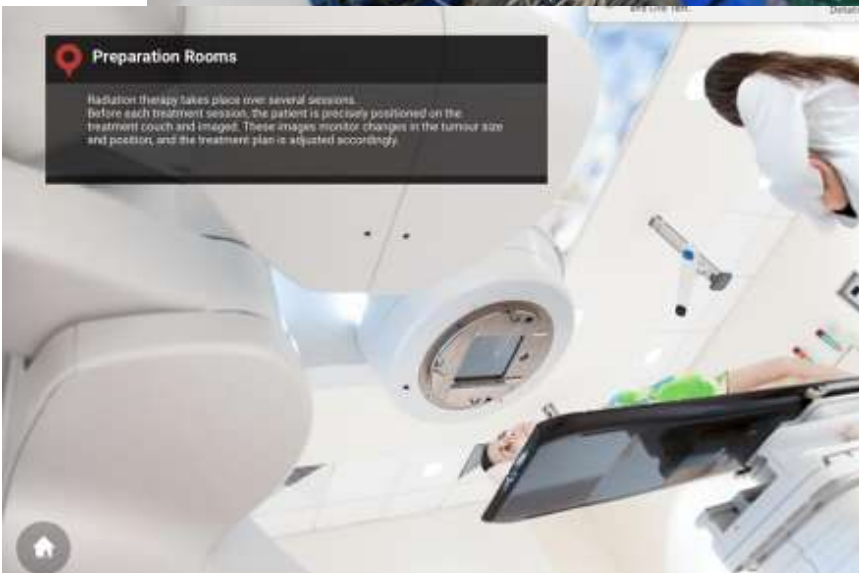
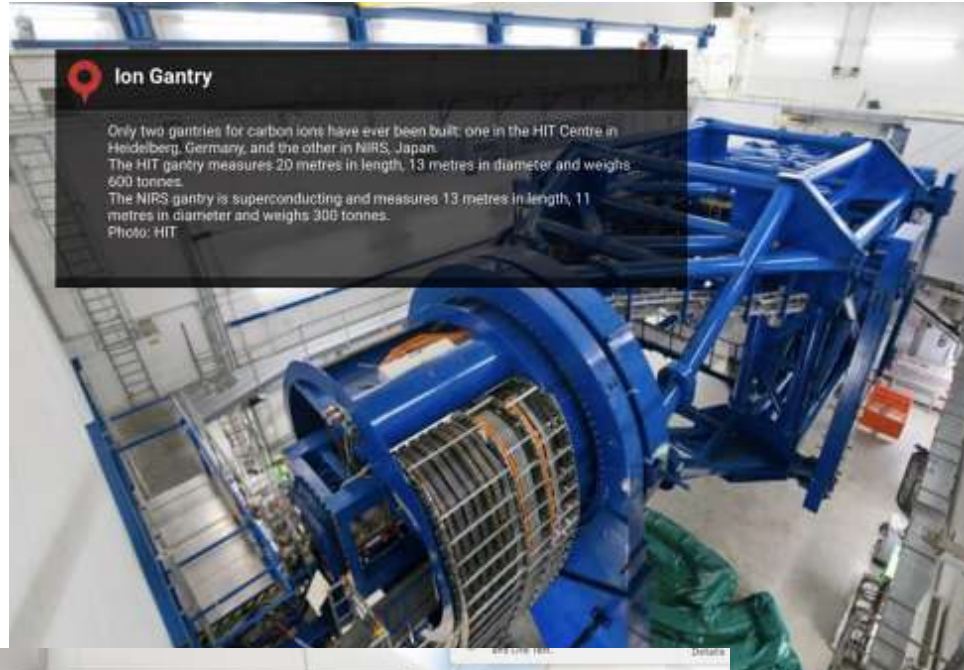
Εικονικό κέντρο σωματιδιακής θεραπείας



The accelerator system (ion source, injector, particle accelerator, beam lines, gantry) represents more than 75% of the construction and operation costs of the facility.

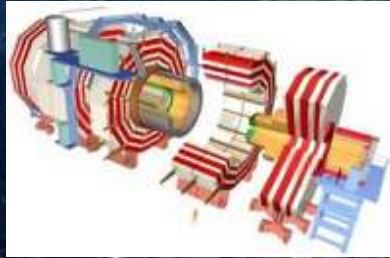


Εικονικό κέντρο σωματιδιακής θεραπείας

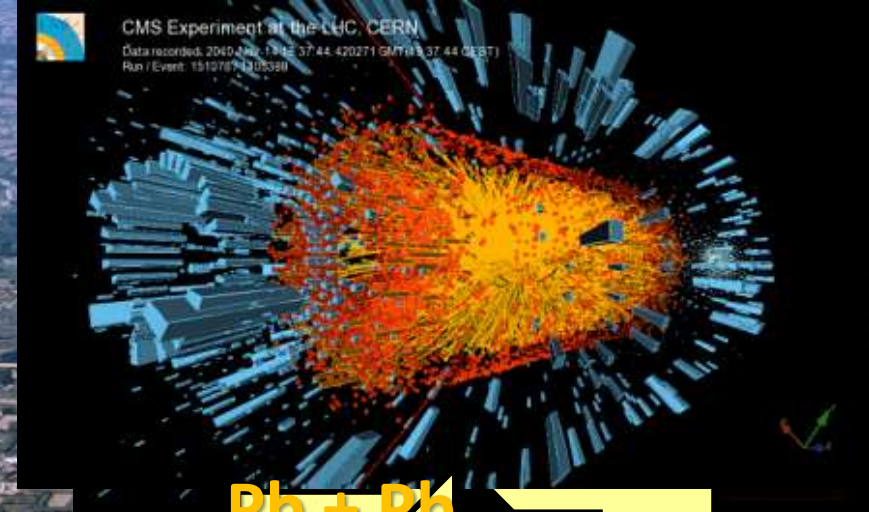


Large Hadron Collider of 'Large Hadrons'

Design Energy:
14 TeV (pp)
1150 TeV (PbPb)



CMS



Pb + Pb

LHCb

Βραβείο Nobel Φυσικής 2013



ALICE

ATLAS



Από την βασική έρευνα

στις εφαρμογές για ιατρική

Ποια είναι τα οφέλη;

Η τεχνολογία επιταχυντών
χρησιμοποιείται για έρευνα
και για θεραπεία καρκίνου

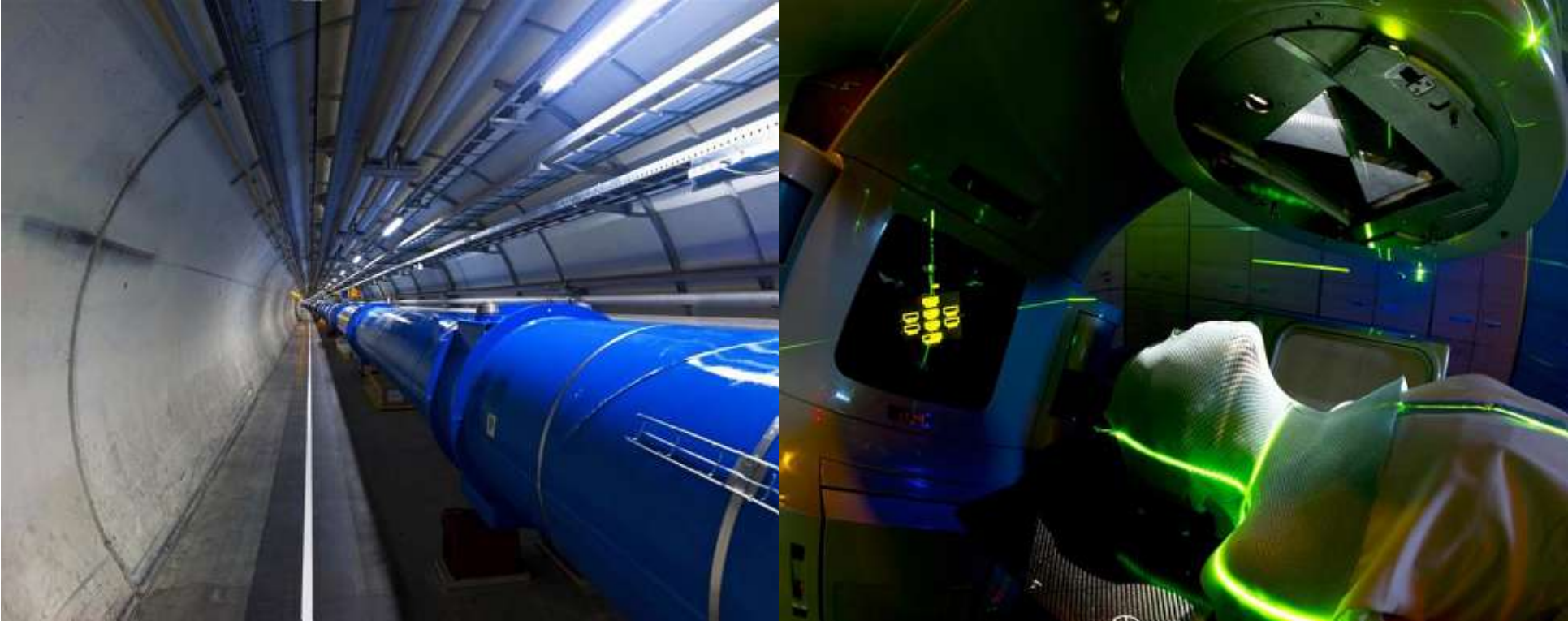
Καινοτόμες τεχνολογίες
που αναπτύσσονται
για τα μελλοντικά σχέδια
του CERN
ήδη βρίσκουν εφαρμογές



Επιταχυντές για την υγεία

Επιταχυντές για την υγεία

Από την βασική έρευνα...



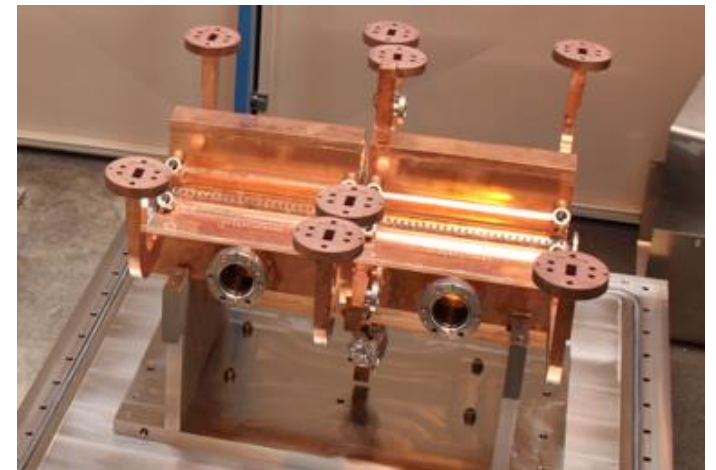
.....στις ιατρικές εφαρμογές

Οφέλη από R&D επιταχυντών για την Κοινωνία



FLASH radiotherapy: very fast delivery
(high dose-rate $<0.5s$) **of very large dose**

The Hospital of Lausanne, CHUV, has secured funding for the construction of a **prototype FLASH radiotherapy facility** based on technology developed for the future proposed **CLIC project of CERN**.



CLIC RF X-band cavity prototype (12 GHz, 100 MV/m)

Particle accelerator technology made huge progress in the last 20 years, towards **more compact and performant** accelerator designs.

We can today explore new accelerator designs profiting of the **latest advances in accelerator technologies**.

Next Ion Medical Machine Study, NIMMS, at CERN

Establishment of NIMMS, the

Next Ion Medical Machine Study at CERN (2018):

- Building on the experience of the PIMMS (proton-ion medical machine study) of 1996/2000;
- Federating a large number of partners to develop designs and technologies for next-generation ion therapy;
- **Partners** can use the NIMMS technologies to assemble their own optimized facility.



Basic requirements of the next generation cancer therapy accelerator:

- ☐ Operation with **multiple ions**: protons, helium, carbon, oxygen, etc. for therapy and research.
- ☐ **Lower cost and dimensions**, compared to present;
- ☐ **Faster dose delivery** with **higher beam intensity** and **new delivery schemes (FLASH)**
- ☐ A **gantry** device to precisely deliver the dose to the tumour.

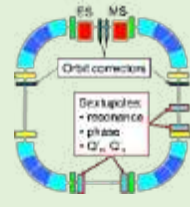
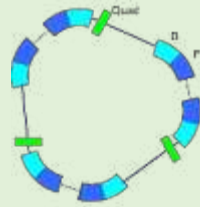
International partners collaborating with NIMMS:

- ☐ **SEEIIST (South East European International Institute for Sustainable Technologies)**
- ☐ TERA Foundation (Italy)
- ☐ GSI (Germany)
- ☐ INFN (Italy)
- ☐ CIEMAT (Spain)
- ☐ Cockcroft Institute (UK)
- ☐ University of Manchester (UK)
- ☐ CNAO (Italy)
- ☐ Imperial College (UK)
- ☐ MedAustron (Austria)
- ☐ U. Melbourne (Australia)
- ☐ ESS-Bilbao (Spain)
- ☐ Riga Technical University (Latvia)
- ☐ Sarajevo University (Bosnia &H.)



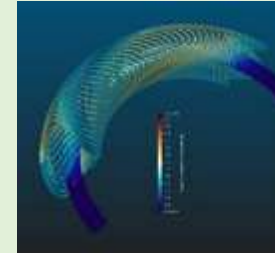
Main research lines for future ion therapy

1. Small synchrotron accelerators (rings)



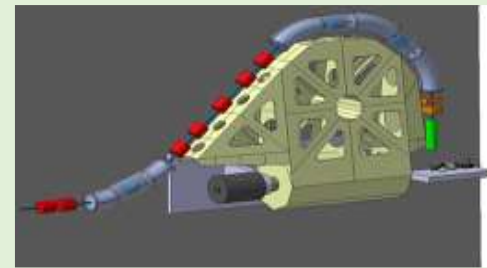
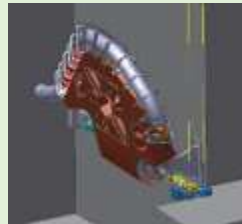
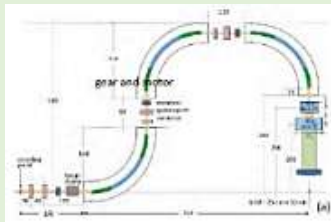
Reduced dimensions with improved performance (injection, extraction)

2. Superconducting magnets for small accelerators



High magnetic fields to bend particles on small orbits

3. Superconducting rotating gantries for ions



Precise beam delivery on multiple angles

Μελλοντικά Σχέδια

SEEIIST

South East Europe International Institute
for Sustainable Technologies

Επόμενη γενιά εγκαταστάσεων για έρευνα και θεραπεία καρκινικών όγκων με δέσμες ιόντων

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



- **SEEIIST** (South East Europe International Institute for Sustainable Technologies): a new international partnership aiming at the construction of a new Research Infrastructure for **cancer research and therapy** in South East Europe (10 member countries).
- SEEIIST is supported by the European Commission, to develop the facility design in collaboration with CERN and other partners.
- Goals are to develop a new advanced design and to build international cooperation and scientific capacity in a region that will join EU but is less developed and still divided, in the line of “science for peace”.

Πρόταση για κέντρο έρευνας και θεραπείας καρκινικών όγκων με δέσμες ιόντων στα Βαλκάνια

Επόμενη γενιά εγκαταστάσεων για έρευνα και θεραπεία καρκινικών όγκων με δέσμες ιόντων

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



first financial support of the [European Commission \(DG RTD\)](#)
and the EU funded [HITRIplus](#)
for state-of-the-art particle accelerator design and related technology



Architectural design, Kaprinis Architects

Επόμενη γενιά εγκαταστάσεων για έρευνα και θεραπεία καρκινικών όγκων με δέσμες ιόντων

Intensive design work in 2019/20 in collaboration between CERN and SEEIST, with the contribution of NIMMS partners and of the main European ion therapy centres has led to successful EU funded projects

A. Innovative SEEIST features:

1. Optimised for **50% research** and **50% patient treatment** (~400 patients/year);
2. Providing **20 times higher** beam intensity for carbon ions than present facilities;
3. Equipped with **flexible extraction** for operation in FLASH mode;
4. Equipped with **dual mode linear injector** capable of producing radioisotopes for cancer imaging and therapy.

B. Advanced SEEIST features (common to other advanced facilities):

1. Operation with **multiple ions**: protons, Helium, Carbon, Oxygen, Argon;
2. **Multiple energy** extraction for faster treatment;
3. Equipped with a **compact superconducting gantry** of novel design.



C. Conservative SEEIST feature:

The synchrotron adopts the well-established **PIMMS design** (known and available components, flexible layout for research);

D. Specific SEEIST features:

1. **Environmental strategy**: minimise energy consumption, strategy for energy generation;
2. Conceived as a **multiple-hub facility**, to federate partners in different countries.



Επόμενη γενιά εγκαταστάσεων για έρευνα και θεραπεία καρκινικών όγκων με δέσμες ιόντων

Intensive design work in 2019/20 in collaboration between CERN and SEEIIST, with the contribution of NIMMS partners and of the main European ion therapy centres has led to successful EU funded projects

Gantry at SEEIIST



Beam Delivery



Gantry at HIT

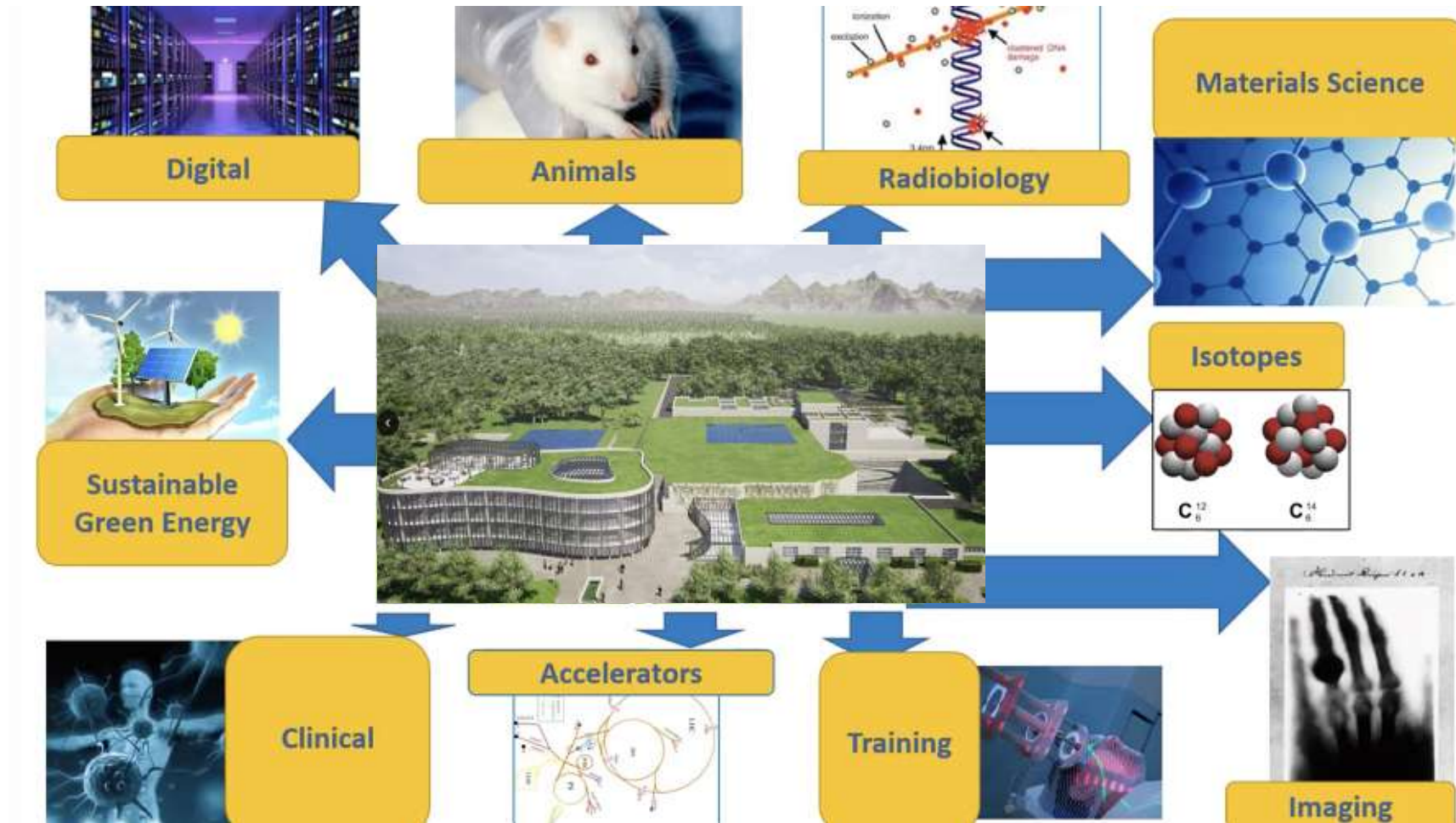


B. Advanced SEEIIST features (common to other advanced facilities):

1. Operation with **multiple ions**: protons, Helium, Carbon, Oxygen, Argon;
2. **Multiple energy** extraction for faster treatment;
3. Equipped with a **compact superconducting gantry** of novel design.

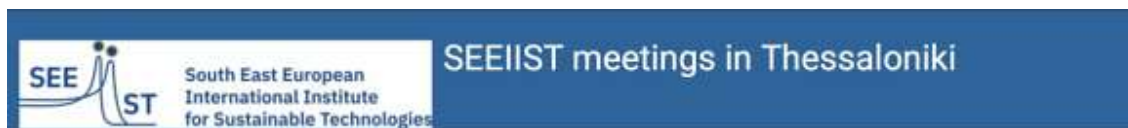
Επόμενη γενιά εγκαταστάσεων για έρευνα και θεραπεία καρκινικών όγκων με δέσμες ιόντων

Για να μεγιστοποιηθούν τα οφέλη, το SEEIST σχεδιάζεται ως μια εγκατάσταση με κόμβους σε διάφορες χώρες



Επόμενη γενιά εγκαταστάσεων για ερευνα και θεραπεία καρκινικών όγκων με δέσμες ιόντων

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



4-6 Apr 2022
Venue: Helexpo
Europe/Athens timezone

<https://indico.cern.ch/event/1103276/>

<https://m.youtube.com/watch?v=JaNQAWDLWz0&feature=youtu.be>

Overview

Venue

Agenda

- Timetable
- Program
- Material for Working Groups

Practical Information

- Accommodation
- City of Thessaloniki
- Excursion and Places of Interest
- Hotels & Restaurants
- Maps
- Visa Information
- COVID-19 Information

Instructions for Indico

Registration Form

Registrants List

SEEIIST Online
Information Event,
6/11/2020

Particle Therapy Online
Information Event,
06/04/2022

Articles and Photos

Contact

✉ Yiota.Foka@cern.ch

The main scientific goal of SEEIIST is the realisation of a **"Facility for Tumour Hadron Therapy and Biomedical Research"**. Such a Regional Center of Scientific Excellence will strengthen local scientific expertise for future projects and the development of a sustainable economy and social cohesion. The facility is expected to stimulate the development of complementary technologies, such as the use of alternative energy sources or the development of advanced digital systems, and to trigger spin-offs. To maximise benefits it is planned as a regionally distributed facility with hubs in different countries offering numerous opportunities for technology transfer and benefits to South-East European industry as well as international cooperation opportunities.

The **SEEIIST** project has entered the **Design Phase** thanks to the first financial support of the **European Commission (DG RTD)** and the EU funded **HITRIplus** project, where state-of-the-art particle accelerator design is developed in collaboration with the main European research centres **CERN** and **GSI-FAIR**.

The SEEIIST meetings in Thessaloniki will be in hybrid mode, preferably in person and will include the:

- Open Steering Committee Meeting
- Closed Steering Committee Meeting
- Legal Framework Working Group Meeting
- Site Selection Working Group Meeting



<https://indico.cern.ch/event/1103276/page/25237-articles-and-photos>

<https://www.hitriplus.eu/>

EU-funded project

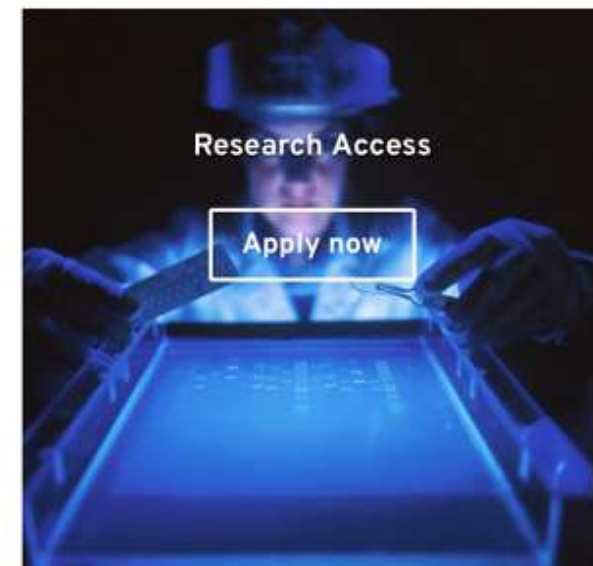
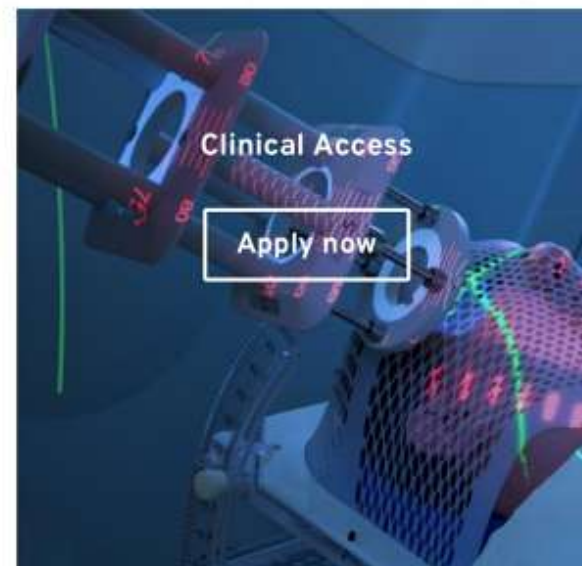
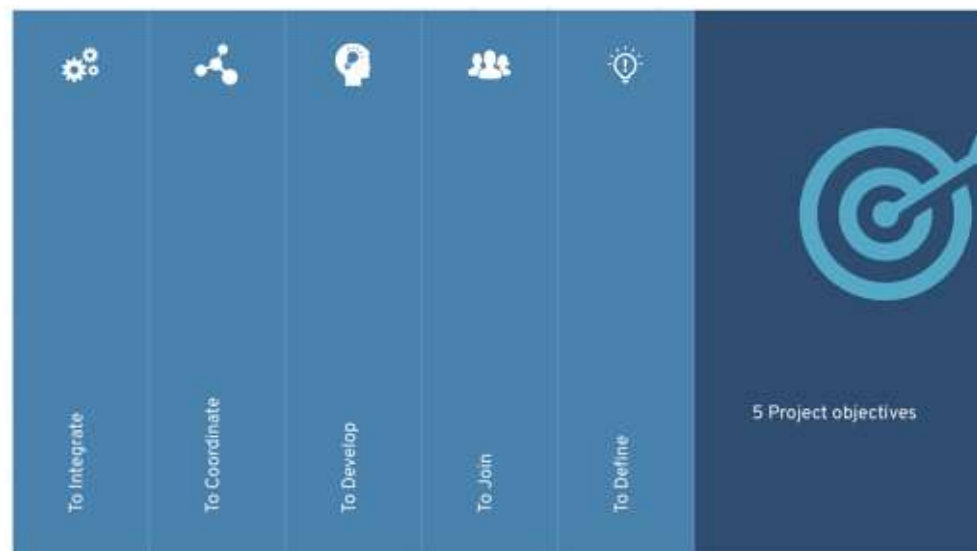


HITRIplus Project

ευκαιρίες
για επιστημονική ανάπτυξη
και κατάρτιση
σε σχετικούς τομείς

Clinical and Research programmes

Transnational Access opens to scientific community the five European facilities providing ion beams





HITRIplus Στόχοι

Main aims:

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

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)

HITRIplus Ανοιχτή Πρόσβαση: Transnational Access TNA

The **Clinical Access** gives the opportunity to clinicians/medical physicists/technicians referring patients to the hadrontherapy facilities to personally follow patient's treatment and follow up.

The **Research Access** will attract universities, research centres, and hospitals, which will connect all the groups to perform research activities with carbon ion beams. Industrial partners are also encouraged to take part in the research programme, to be involved in the development of new clinical procedures and new medical devices.

	CLINICAL	RESEARCH	TOTACCESS
CNAO	12	80	92
GSI	-	296	296
UKHDIT	10	72	82
MEDA	12	-	12
MIT	16	-	16
	50	448	498

Available and effective
Capacity Building
in SEE Countries
for Clinicians and Researchers

www.hitriplus.eu

Big opportunity for SEEIIST Members!!!

TNA: <https://www.hitriplus.eu/transnational-access-what-is-ta/>

FORM for CLINICAL TNA Access: <https://www.hitriplus.eu/transnational-access-ca/>

FORM for RESEARCH TNA Access: <https://www.hitriplus.eu/transnational-access-ra/>



In addition, 2 more schools are foreseen, 4-8 July 2022 and in 2023.

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

In order to facilitate sustainability and spreading to the max the acquired knowledge they all 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.

HITRIplus Σχολεία



<https://indico.cern.ch/event/1019104/>



Heavy Ion Therapy
– 1st online course
Masterclass

@Sarajevo-Online

2021/05/17

18:00

Join the
event

Add to
Calendar

First event of HITRIplus Project

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



<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

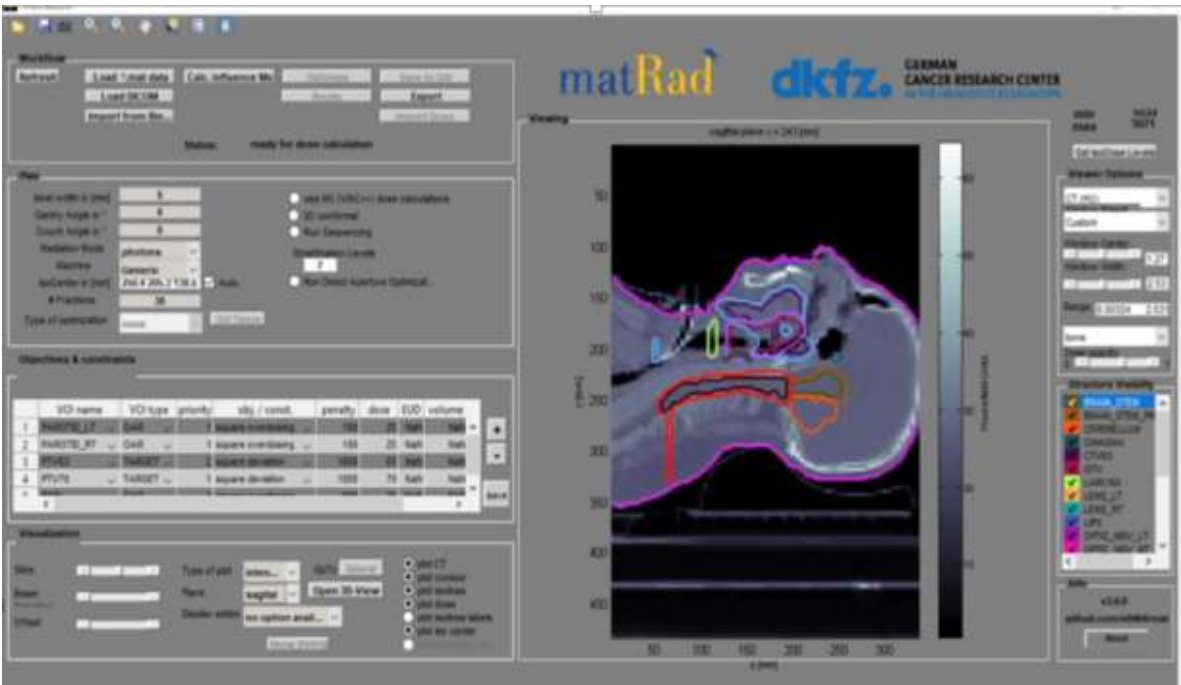
Information about upcoming modern techniques for cancer tumour therapy and new research avenues, where clearly the development of technology and the expertise of research laboratories is crucial.

HITRI
Heavy Ion Therapy Research Institute

Heavy Ion Therapy Masterclass School

HITRI
Heavy Ion Therapy Research Institute

Heavy Ion Therapy Masterclass School



multidisciplinary facets of heavy- ion therapy



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

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.

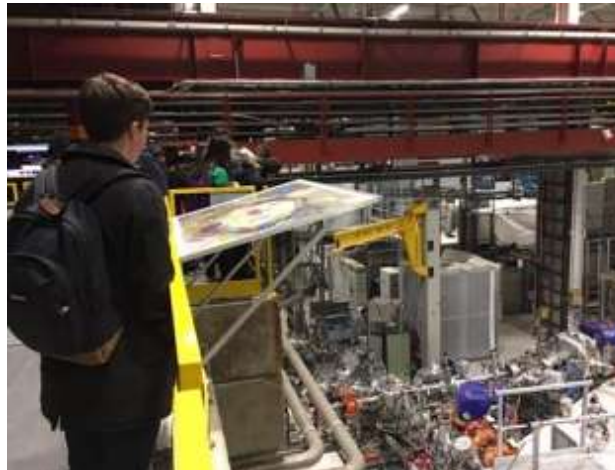
2-5 institutes per day performing
the same programme

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



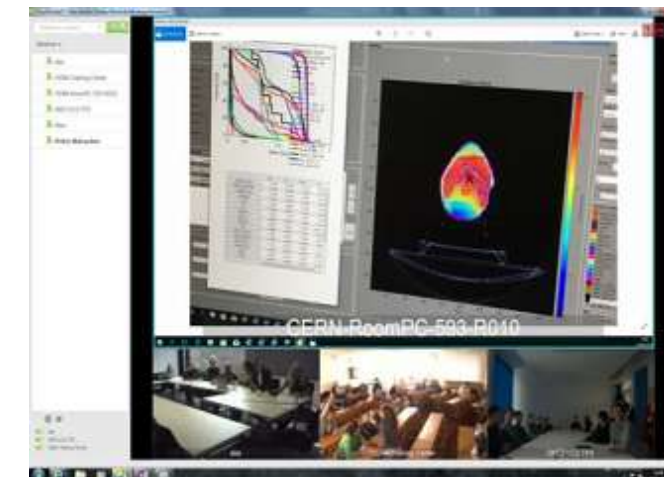
Local: Morning Visits



Local: Afternoon Hands-on



Common: Afternoon at 16:00 Video-Conference





Χαρακτηριστικά Στοιχεία HITM Σχολείου

“Original” format: appreciated by participants
inspired by Particle Therapy MasterClasses

Highlight:

Hands-on sessions, “do it yourself” guided by experts,
with real data and professional tools and methods

Pedagogical elements facilitating learning

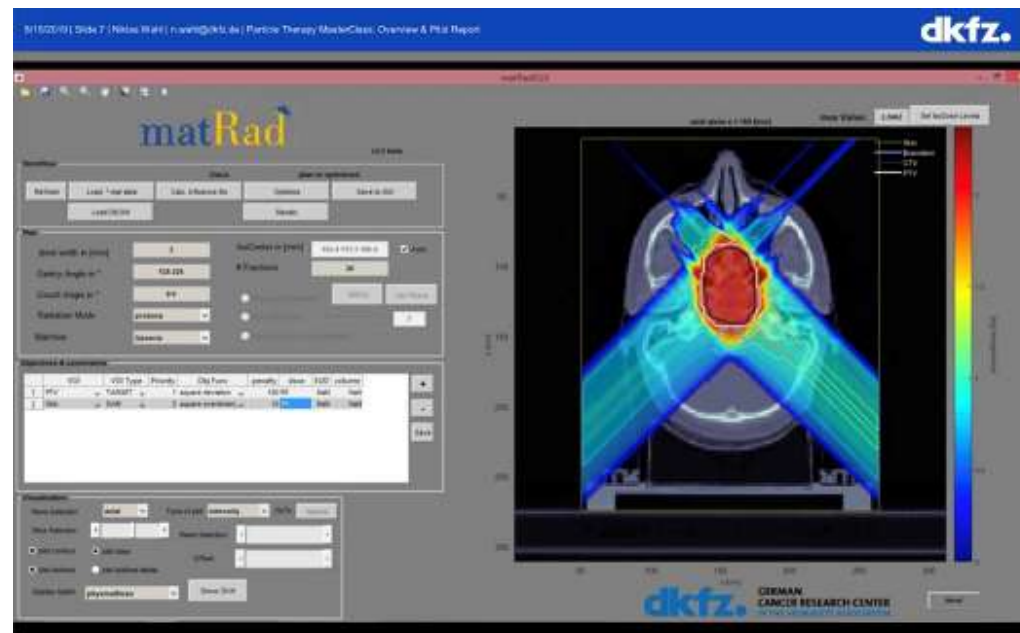
- Lectures in the morning
- Hands-on in the afternoon
- Students’ presentations and discussions of their results with experts
- Virtual visits to existing therapy centres guided by their experts, supported by web-cam or videos
- Every day started with videos while participants were connecting to give 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



Πρακτική Άσκηση Σχεδιασμού Θεραπείας

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

Home
Organizers and Sponsors
Objectives and Scientific Programme
Poster School
Poster Social Events
Agenda
└ Timetable
Registration Fees and Instructions
Registration Form
Participant List
Presentations Instructions
MatRad Instructions
Zoom Instructions
Photos Gallery
Connection Instructions
Contact
✉ hltm.adm@cern.ch



**180 participants delivered
matRad hands-on results**

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

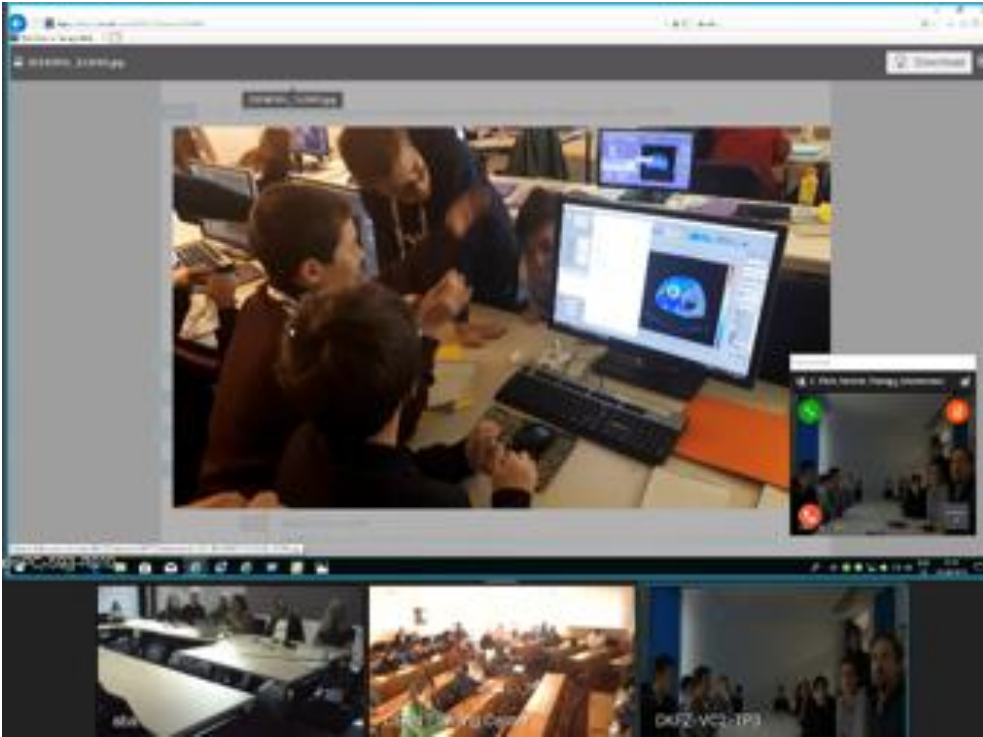
matRad - an open-source toolkit for
dose calculation and optimization

Hands-on matRad Treatment Planning

PTMC πιλοτικά τεστ το 2019

- Πρώτο τοπικό τεστ: GSI, 7th Φεβρουαρίου 2019
- Πρώτο διεθνές τεστ: CERN, DKFZ, GSI, 5th Απριλίου 2019

Συμμετοχή της ομάδας CURIEosity
από την Κρήτη, Ελλάδα



CERN, DKFZ, GSI

Θετική ανάδραση από τους μαθητές

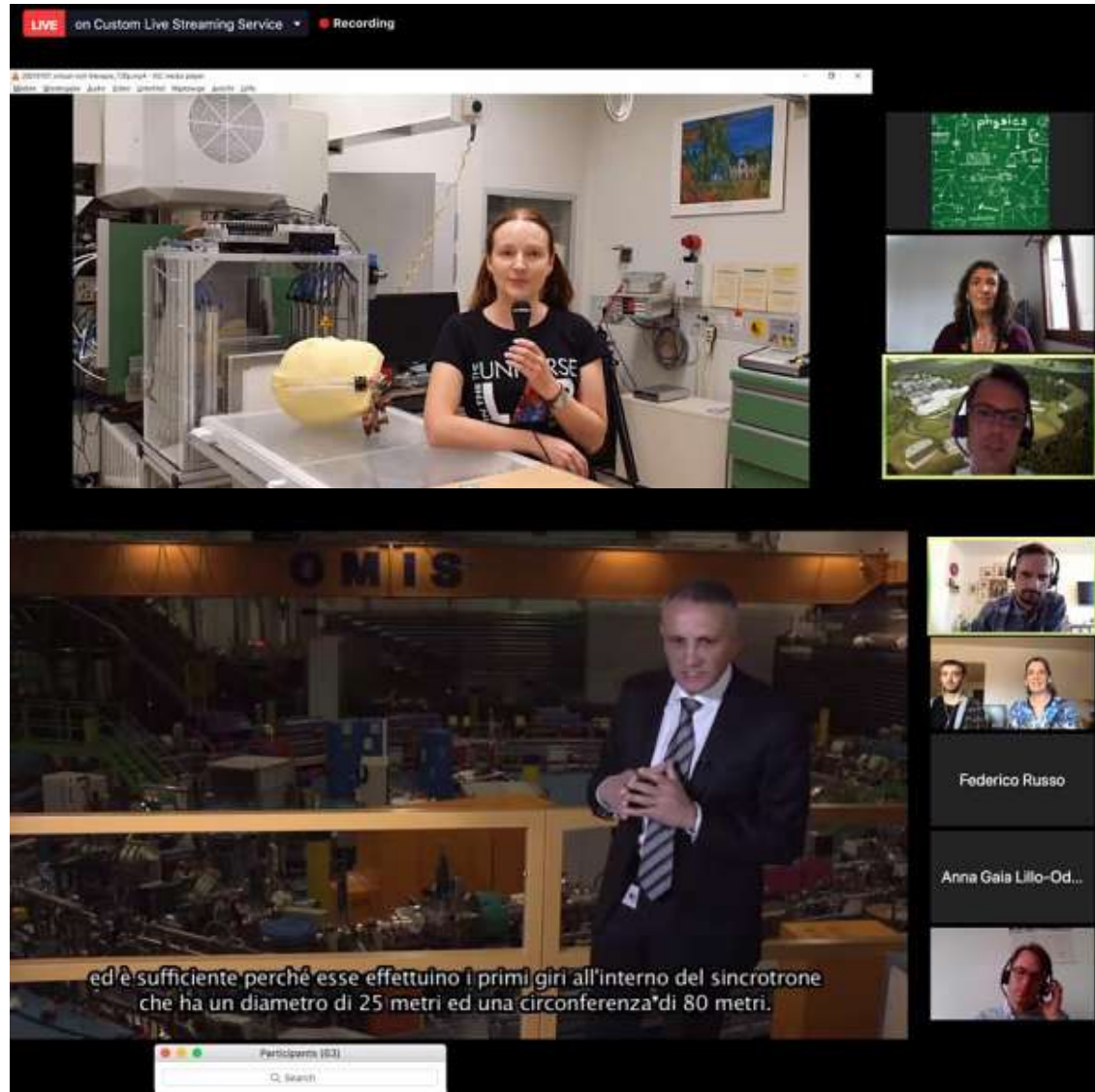
ΕΛΠΙΔΑ ΚΑΙ ΚΙΝΗΤΡΟ ΓΙΑ ΣΥΝΕΙΣΦΟΡΑ
ΣΤΗΝ ΜΑΧΗ ΚΑΤΑ ΤΟΥ ΚΑΡΚΙΝΟΥ



Εντάχθηκε στο πρόγραμμα International MasterClasses IMC: <https://physicsmasterclasses.org>

Virtual visits and video-conferences

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



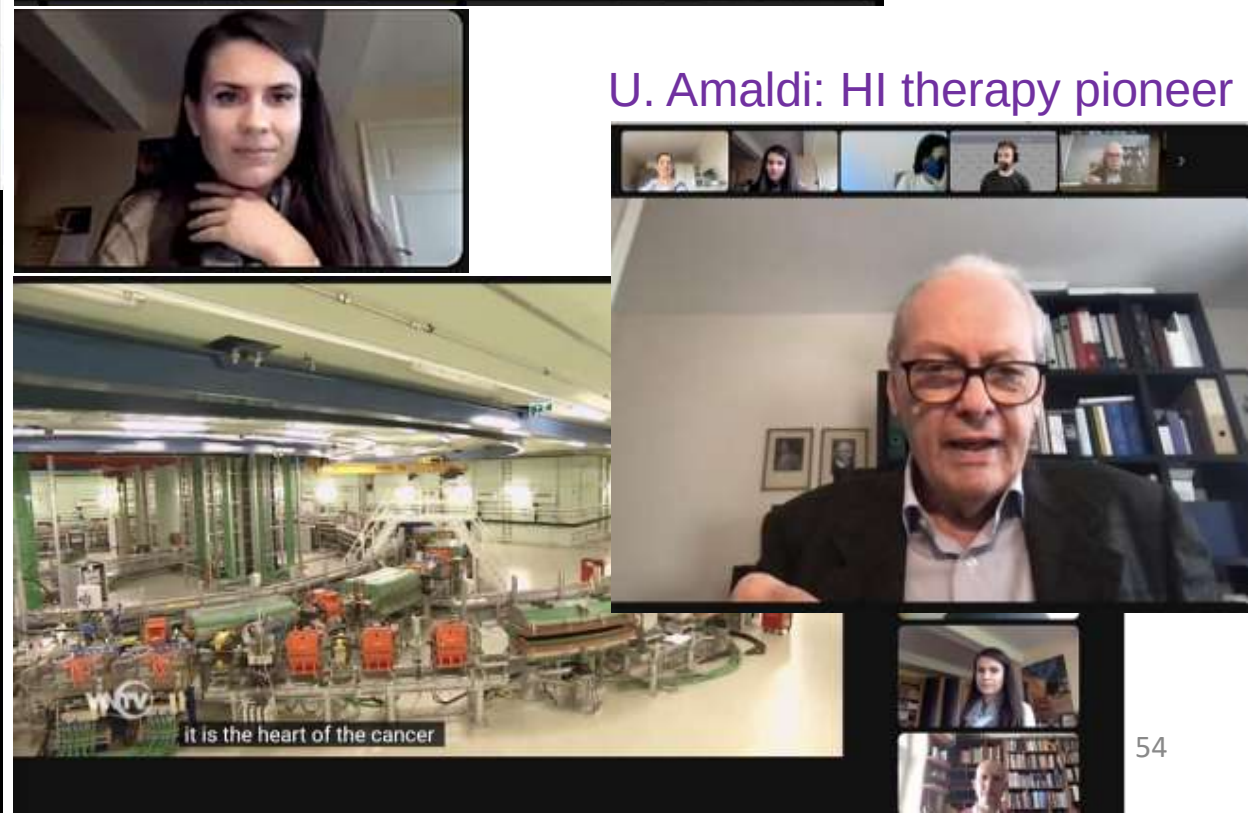
GSI moderators

CNAO moderator

medAustron moder.



U. Amaldi: HI therapy pioneer





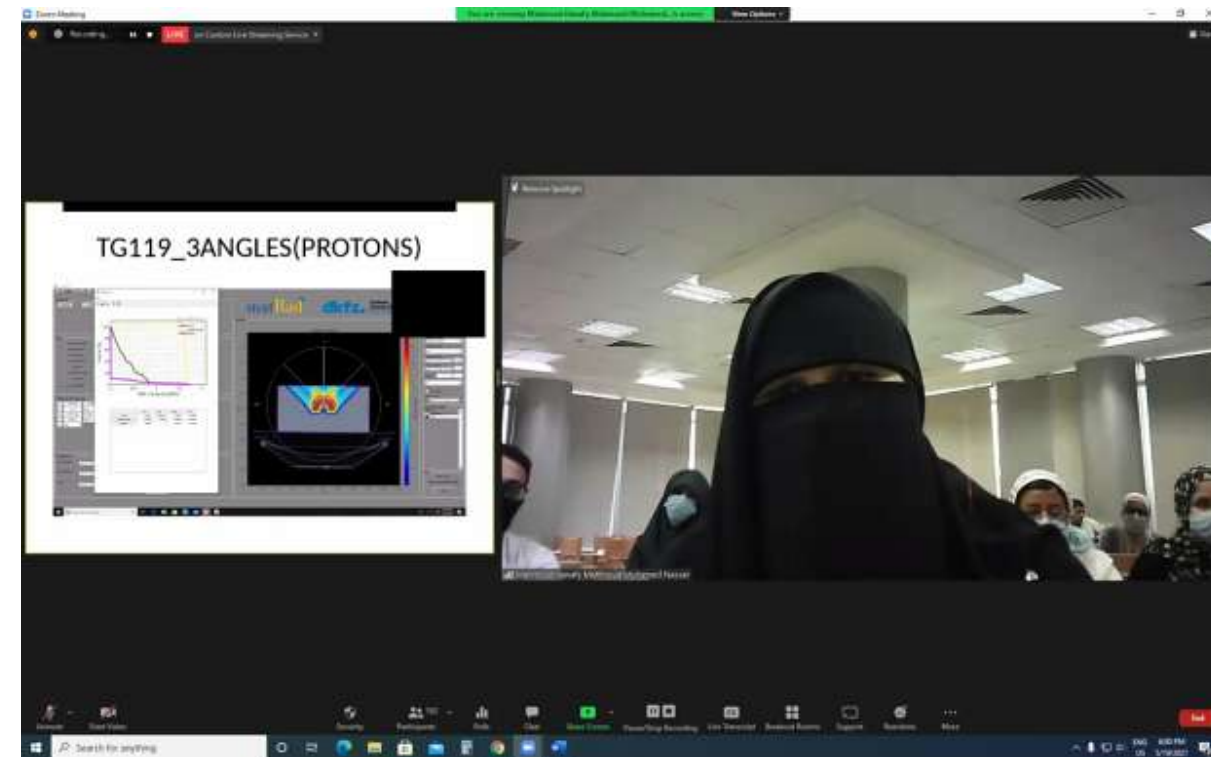
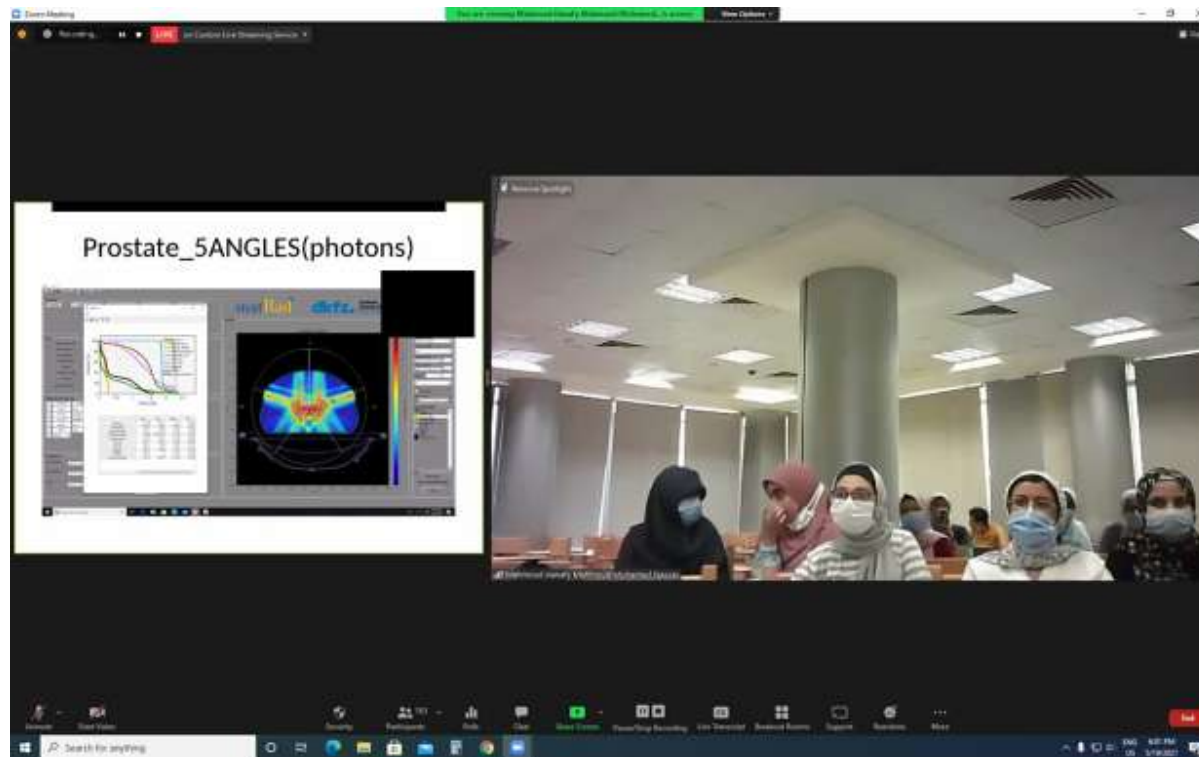
HITM school Opening Session

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





Diversity and sharing know-how



Heavy Ion Therapy Masterclass

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

HITRI 

MON	Introductory Drinks <i>Meeting the other attendees with drinks!</i> Speaker: Manjit discussing the ENLIGHT network Dress Code: Smart Casual
TUE	Language Cafe <i>Learn other languages & cultures!</i> Speaker: Mimosa - ion treatment for beginners Dress Code: Traditional
WED	Student Q&A <i>Ask advice & chat to current students</i> Speaker: CERN Knowledge Transfer Dress Code: Pyjama Party
THU	Tours, Games & Disco <i>Share music tastes & play games & quizzes</i> Dress Code: Impress Us.
FRI	Career Fair <i>Discussion with experts on career paths</i> Speakers: CERN, GSI, CNAO, DKFZ & Cosylab Dress Code: Formal Attire

HITMC school 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



Gender equality and students presentations

Statistics

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

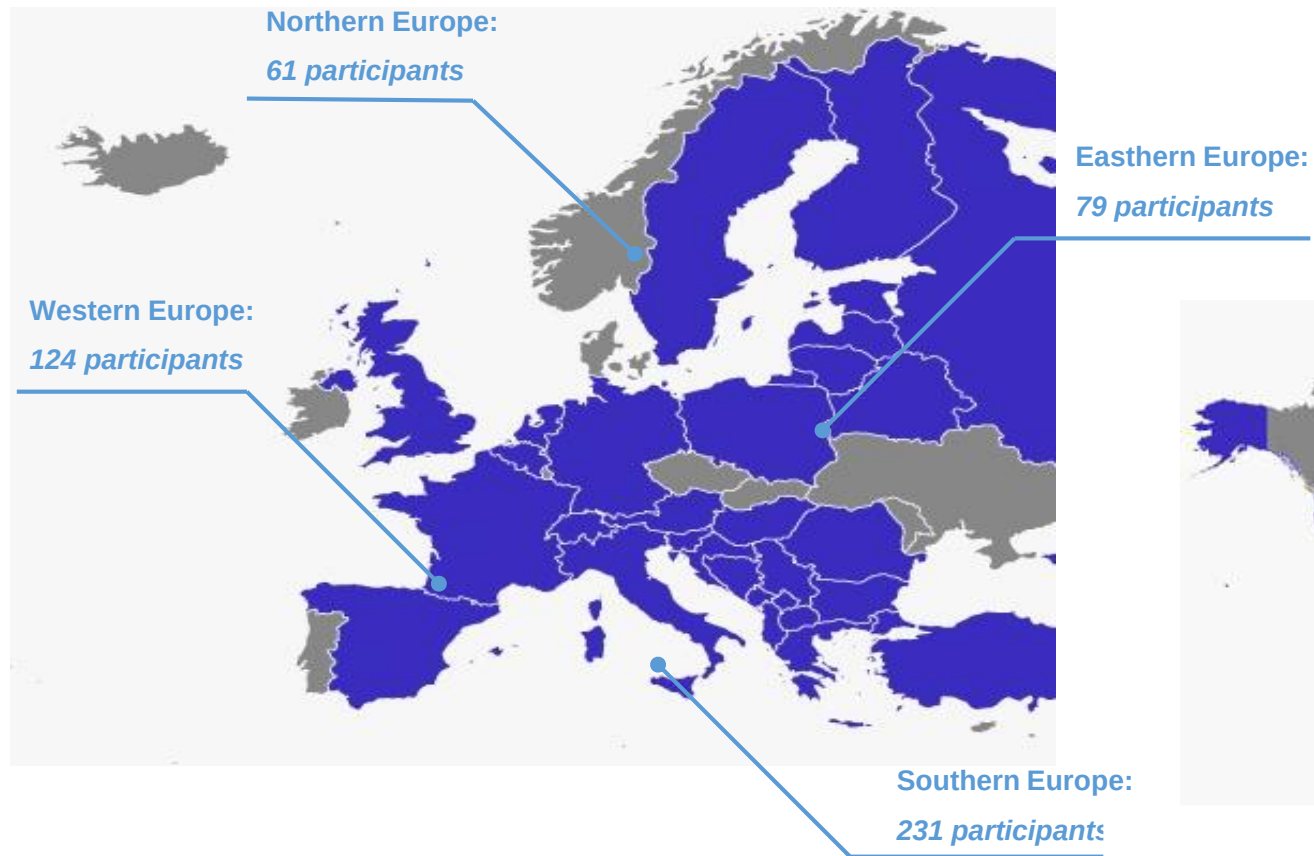
Timetable: <https://indico.cern.ch/event/1024183/>

The collage consists of four panels:

- Left Panel:** A scientific presentation slide titled "TRAX MC code" and "Microscopic simulation". It shows several plots of particle tracks and energy deposition. The HITRI logo is in the bottom left.
- Second Panel:** A video feed of a female speaker with long dark hair, wearing a patterned top, speaking into a microphone.
- Third Panel:** A list of participants for the event, titled "Participants (269)". The list includes:
 - Aristeidis Mamaras (Host)
 - Albana Topi (Co-host)
 - Amar Kapic (Co-host)
 - Damir Skrijelj (Co-host)
 - Hans-Peter Wieser (Co-host)
 - mariusz sapinski (Co-host)
 - Nicholas Sammut (Co-host)
 - WEBCAST (Co-host)
- Right Panel:** A screenshot of a "PTMC Quiz!" game interface. It shows three podiums with the following scores:
 - Michele Colucc: 2nd place, 6667 (7 out of 7)
 - Aa77: 1st place, 6675 (7 out of 7)
 - Stella: 3rd place, 6577 (7 out of 7)
 To the right of the quiz screen are three small video feeds of participants: Damir Skrijelj, Ylona Foka, and Fehima.



Expanding in Europe and beyond



European countries:

➤ 495 participants

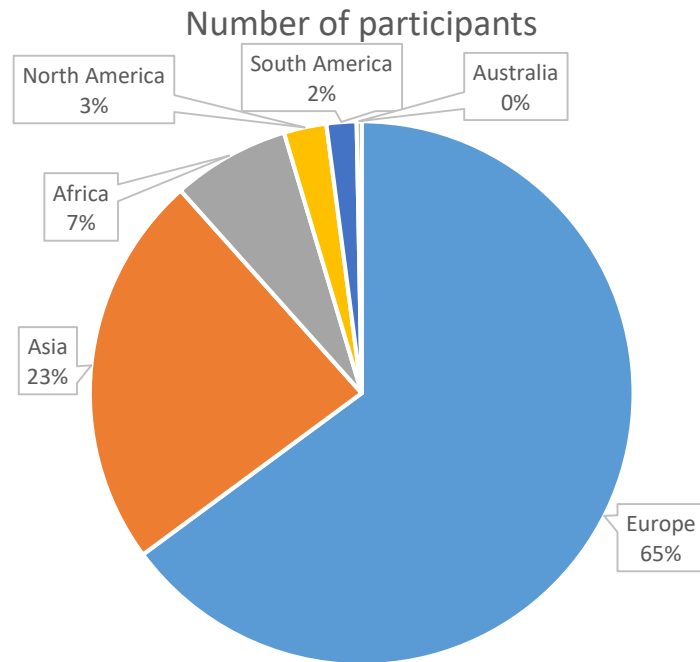
Non-European countries:

➤ 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

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 (SEI/IST)
- J. Seco (DKFZ)
- M. Vretenar (CERN)
- N. Wahl (DKFZ)
- H.P. Wieser (LMU)

Scientific Assistants

- A. Mamas (AUT/CERN)
- A. Kapić (EPFL/CERN)
- D. Škrijelj (UNSA/DKFZ)
- R. Taylor (ICL/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:
Registration deadline:

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

Recordings and presentations

available in the timetable

Total: 1050 participants

Breakdown of participants

Statistics

Total: 35.5 h

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

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

Participants of online PTMC in IMC2021

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

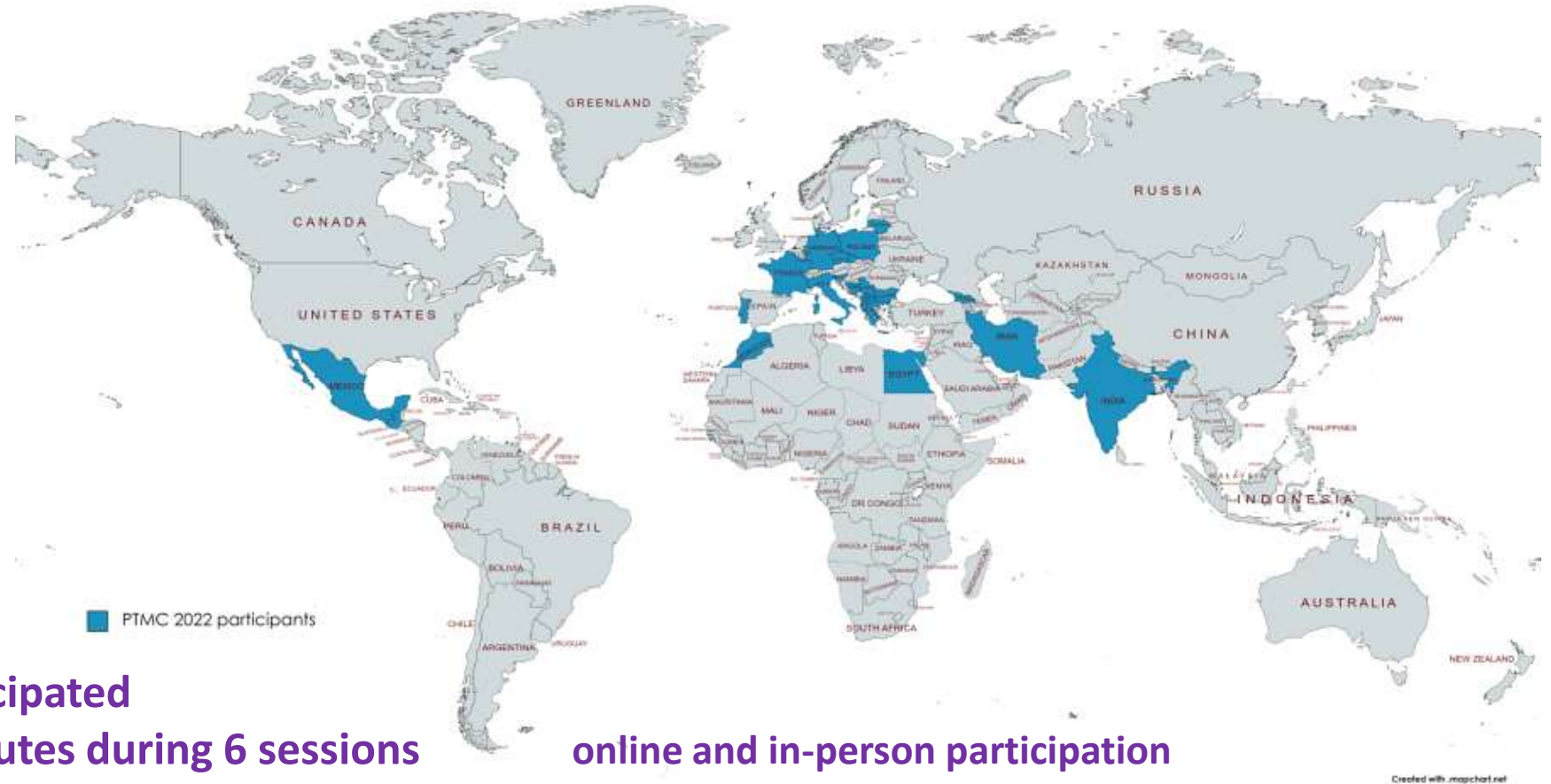


PTMC2021 online:
more than 1500 students participated
from 20 countries and 37 institutes during 6 sessions



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

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

PTMC in Greece

PTMC2021 online: through Library of Veroia

Total of 366 live views

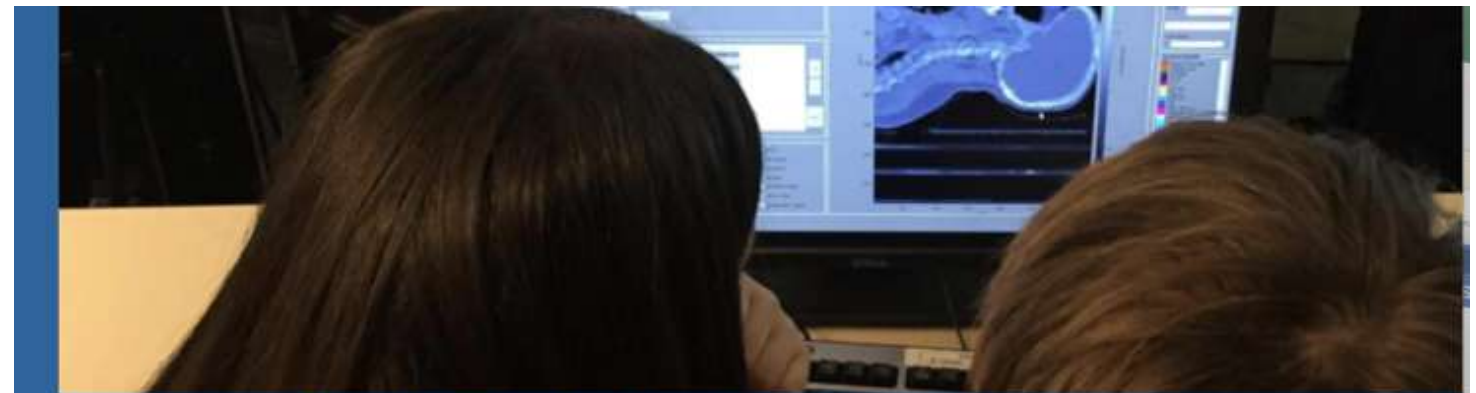
from at least 20 major regions of Greece



PTMC2022 online: more than 150 participants for hands-on

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

Publicity: Library of Veroia extended networks and national press



International Particle Therapy MasterClass

AUTH TUTORS

9 April 2022
AUTH
Europe/Zurich timezone

Παναγιώτης Κατζάνης,
Αριστείδης Νικολαΐδης,
Βασιλεία Ρεπακή,
Ελευθερία Ιωαννίδου

Overview

PTMC 2022

Registration

Participant List

PTMC main page

Contact

✉ yiota.foka@cern.ch

✉ p.foka@gsi.de

✉ amamaras@physics.auth.gr

«Επιστήμονες για μία ημε

διαδικτυακό Masterclass για μαθητές λυκείου από τους ερευνητές του CERN και GSI

για τη χρήση της Φυσικής επιστήμης πάνω στην Ιατρική Θεραπεία

9 Απριλίου 2022

Τα ερευνητικά κέντρα CERN και GSI, το Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης, το ερευνητικό κέντρο ΔΗΜΟΚΡΙΤΟΣ και το Γενικό Νοσοκομείο Παπαγεωργίου Θεσσαλονίκης με την υποστήριξη του Veria TechLab της Δημόσιας Κεντρικής Βιβλιοθήκης της Βέροιας, και της Περιφέρειας Κεντρικής Μακεδονίας παρουσιάζουν το **Σάββατο 9 Απριλίου 2022**, ένα μοναδικό Masterclass για

hands on particle physics

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

PTMC in SEE countries

Use PTMC to support capacity building in SEE
Promotion through the SEEIST PR team

Almost all SEEIST members in PTMC2021
and more in PTMC2022



MASTERCLASS in Particle Therapy

*Focusing on the treatment of
cancer tumours with charged particles*

PTMC in SEE countries

Use PTMC to support capacity building in SEE
Promotion through the SEEIIST PR team

**Almost all SEEIIST members in PTMC2021
and more in PTMC2022**

Aims:

- establish (national) networks
- involve host institutes, medical communities....
- complement current bottom-up with top-down approach involving relevant education/science ministries/channels
- international event:
bring in contact students around the world,
highlight benefits of international collaborations



MASTERCLASS in Particle Therapy

*Focusing on the treatment of
cancer tumours with charged particles*



Aims and expectations

- Attract high-school students to physics/STEM
- Cultivate confidence through the hands-on (I can do it !)
- Handle prejudices, Support female students
- Create groups of Uni assistants/tutors that learn better in order to teach
- Enhance awareness of public, Demonstrate a return to society from fundamental research
- Prepare future generations aware of importance of fundamental research and its applications

Acknowledgements PTMC

matRad Developers

Wahl, Niklas

Bangert, Mark

Hans-Peter Wieser

DKFZ Heidelberg

LoC: Wahl, Niklas

Katrin Platzer, Malte Ellerbrock

Noa Homolka Amit Ben Antony Bennan

GSI

LoC: Yiota Foka

GSI Biophysics:

Christian Graeff, Radek Pleskac

GSI ALICE, EMMI :

Ralf Averbeck, Malzacher, Peter

GSI IT :

Thorsten Kollegger, Behnert, Katharina

Osdoba, Sascha

Sponsors : Edmond Offermann



CERN (staff and users)

CERN: tutors

Loc Org: Nikolaos Charitonidis

Alexander Gerbershagen

Evangelia Dimovasili

Elena Benedetto

CERN/ARIES: Maurizio Vretenar, Valerie Brunner

CERN/ENLIGHT: Manjit Dosanjh Petya Georgieva

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

Amila Avdic

Amra Ibrahimovic

Mirsad Tunja

Damir Skrijelj

Online mode, web pages, training

Aris Mamaras (AUTH), Damir Skrijelj (UNSA)



General Coordination :

p.foka@gsi.de

yiota.foka@cern.ch

Acknowledgements PTMC

PTMC2022 core team

matRad Developers

Wahl, Niklas
Bangert, Mark
Hans-Peter Wieser

DKFZ Heidelberg

LoC: Wahl, Niklas

Katrin Platzer, Malte Ellerbrock
Noa Homolka Amit Ben Antony Bennan

GSI

LoC: Yiota Foka

GSI Biophysics:
Christian Graeff, Radek Pleskac
GSI ALICE, EMMI :
Ralf Averbeck, Malzacher, Peter
GSI IT :
Thorsten Kollegger, Behnert, Katharina
Osdoba, Sascha

Sponsors : Edmond Offermann



Aristeidis Mamaras

Greece

MSc student, AUTH/CERN

Damir Škrijelj

(B&H)

MSc UNSA/DKFZ/medAustron

Amar Kapić

Montenegro

PhD student, EPFL/CERN

Deianira Fejzal

Albania

MSc student, Uni Brescia

Verania Echaide Navaro

Mexico

PhD student, UNAM

General Coordination :

p.foka@gsi.de

yiota.foka@cern.ch



Online Scientific Info Event on Particle Therapy

Information event for scientific/medical communities in Greece: <https://indico.cern.ch/event/1138945/>

6 April 2022

Under the auspices of AUTH

Speakers:

DKFZ German Cancer Research Center

CNAO therapy centre

GSI, CERN, IAEA

and AUTH

Introductory info event

6 November 2020

<https://indico.cern.ch/event/968289/>

**Presentations and
recordings available**

Perspectives for cancer tumour research and therapy with ions

Wednesday 6 Apr 2022, 16:00 → 19:30 Europe/Athens

Online

Description The aim is to present and inform the scientific and medical communities in Greece, about the status and recent progress in cancer tumour therapy using ions, further potential and opportunities of this method, as well as future perspectives, including capacity building.

This event follows a focus meeting, 4-6 April, dedicated to the initiative proposing "A Facility for Tumour Therapy and Biomedical Research in South East Europe" pursued by the "South East Europe International Institute for Sustainable Technologies" opening up possibilities for innovative scientific research and patient treatment.

Videoconference PT info [Join](#)

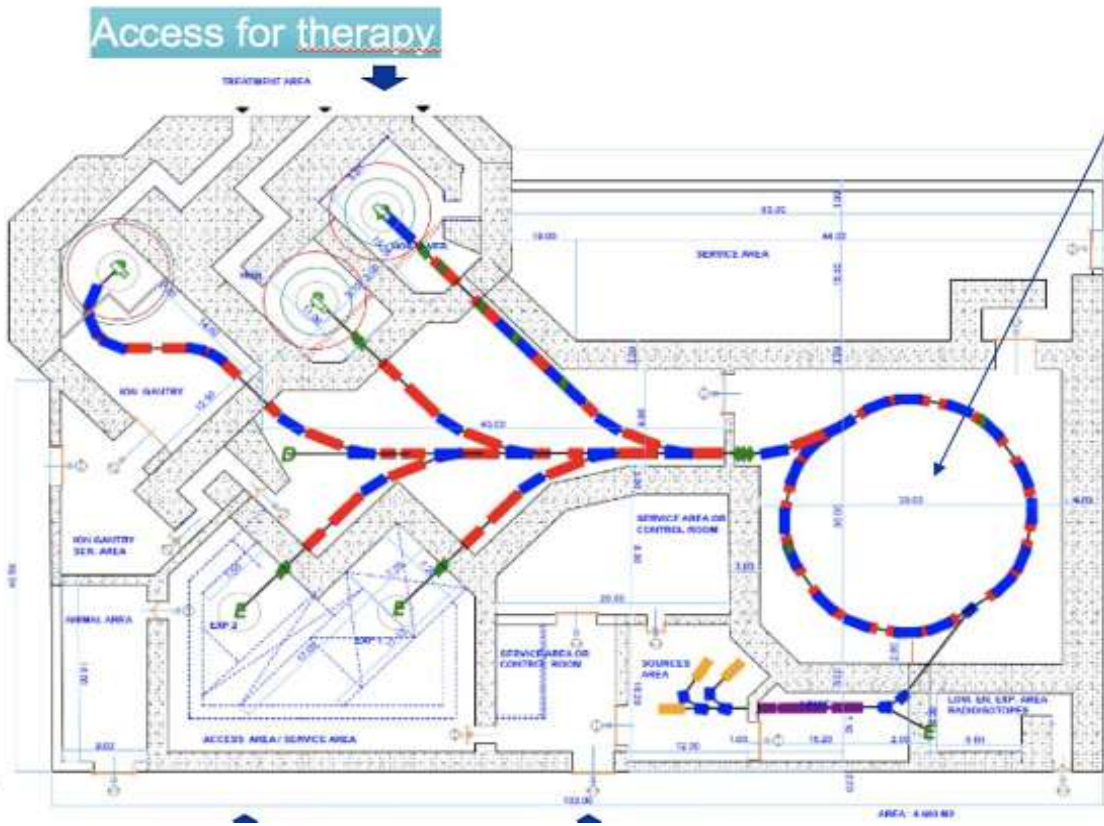
Registration You are registered for this event. [Check details](#)

16:00	→ 16:20	Welcome and opening remarks	🕒 20m
16:25	→ 16:45	Particle Therapy: status and perspectives Speaker: Joao Seco (German Cancer Research Center (DKFZ))	🕒 20m
16:50	→ 17:10	Cancer therapy with ions, pioneering experience from GSI Speaker: Christian Graeff (GSI)	🕒 20m
17:15	→ 17:35	CNAO ion cancer therapy centre Speaker: Sandro Rossi (Fondazione CNAO)	🕒 20m
17:40	→ 18:00	Real life experience on cancer tumour treatment with ion beams Speaker: Dr Maria Rosaria Fiore (CNAO)	🕒 20m

Online event and radio-isotope production

One of the speakers from AUTH young generation:
Aris Mamaras

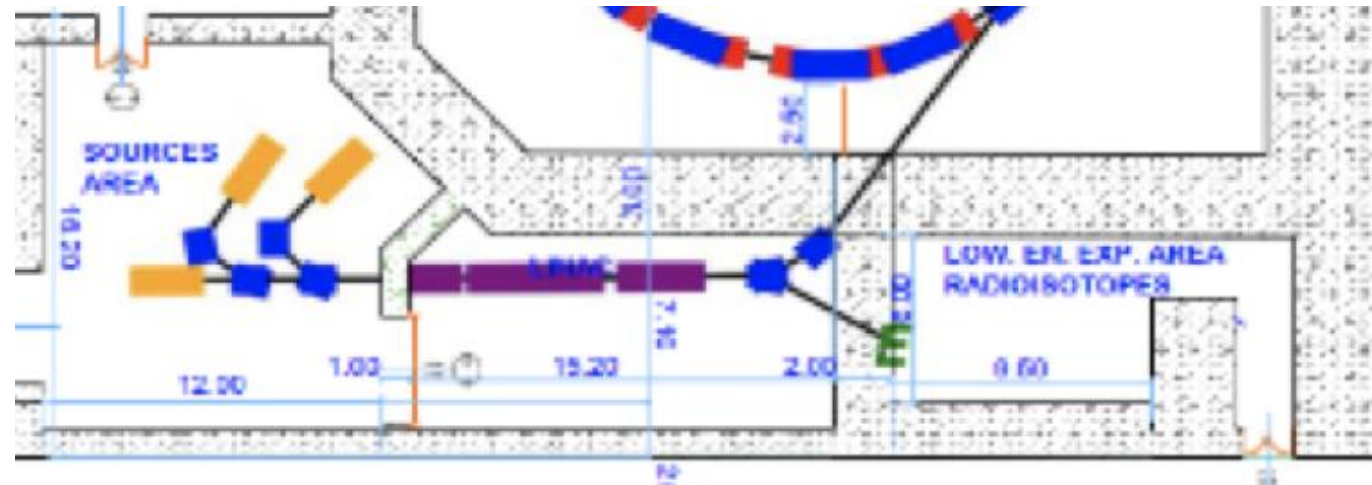
**SEIIST 2D plans of accelerating structures and
beam delivery systems (bunker)**



Radio-isotope production exploiting linear accelerators

project exploring

- the use of linear accelerators for radioisotope productions
- the use of the linac injector for radioisotope production



Submission of EU proposal: STRONGER4CANDER
Coordinator: AUTH

forming tight groups
continuing collaborations

Workshop on Ions

for Cancer Therapy, Space Research and Material Science



Workshop Main Topics

28-30 of August at Great Arsenali

Particle therapy status

- Centres worldwide
- Treatment planning and imaging novel methods
- Challenges, new R&D directions

Space research and dosimetry

Nanotechnology, electronics and material research

Modelling and benchmarking of experiments

Novel accelerators and training

Public Events

26 of August - science fair at Neorio Moro

27 of August - public talks at Great Arsenali

30 of August - coffee with scientists at Neorio Moro



**Chania,
Crete, Greece**

**26 - 30
August
2017**



Workshop

Location Archamps, France

Venue: European Scientific Institute (ESI)

Dates: 19-21 June 2018

Ideas and technologies for a next-generation facility for medical research and therapy with ions



MAIN TOPICS:

- ▶ EXISTING FACILITIES
- ▶ CURRENT INITIATIVES
- ▶ NEW TECHNOLOGIES
- ▶ DESIGN PARAMETERS
- ▶ TECHNICAL OPTIONS

<https://indico.cern.ch/e/ions2018>

photo credit: ESI/ESI Project and Medical Research Study

Συνέδρια και ενημερώσεις για κοινό

Συνέδρια για experts

Θέμα: οφέλη για την κοινωνία από την βασική έρευνα

Workshop in Sarajevo

Sponsored by:

- Central European Initiative (CEI)
- "Three Physicists" Foundation

Attract SEE and WE companies, initiate collaborations



SEEIIST meets Industry

16–18 Sep 2020
Sarajevo City Hall
Europe/Sarajevo (timezone)

New Proposed Dates: 1st week of October 2022

Important information:

Following the evolution of covid-19 pandemics, in particular in SEE region, and related travel restrictions, with great regret, we have to announce that the "SEEIIST meets Industry" conference has to be postponed again.

Several options are considered in terms of format and dates and we'll inform you on new plans around early September.



SEEIIST

meets industry

LOCATION: Sarajevo, Bosnia and Herzegovina
VENUE: City Hall
DATES: 1-3 April 2020



CONFERENCE TOPICS

- Modern ion facilities for cancer research and therapy
- Technological and industrial opportunities
- SEE industrial capacity
- Perspectives in SEE

SEEIIST South East European International Institute for Sustainable Technologies
this event is co-financed by the CEI Cooperation Fund

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

	International Advisory Committee:	Programme Committee:	Organizing Committee:	Assistants:
IZATION	U. Amaldi (CERN, Italy)	M. Bauer (HEPtech)	D. Huseinovic (JINR, SRB)	A. Avdic (JINR, SRB)
	F. Bordry (CERN, Switzerland)	J. Burger (COVLAB, Slovenia)	A. Gazbegovic-Bosnjadze (JINR, SRB)	A. Castejon (JINR, SRB)
	S. Damjanovic (SEEIIST Association)	M. Cella (CERN, Switzerland)	S. Odzak (JINR, SRB)	A. Dzafinovic (JINR, SRB)
	M. Dauterle (GEM & FAIR, Germany)	M. Donagh (ENLIGHT, UK & CERN, Switzerland)	M. Cihodari Husid (JINR, SRB)	E. Dzafinovic (JINR, SRB)
	P. Guiseppe (GEM & FAIR, Germany)	T. Engel (GEM & FAIR, Germany)	T. Huseinovic (JINR, SRB)	A. Sefirnovic (JINR, SRB)
	T. Haberer (JINR, Germany)		A. Nikolic (JINR, SRB)	A. Kopic (JINR & CERN, Switzerland)

Οφέλη από επιταχυντές για την Κοινωνία

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.

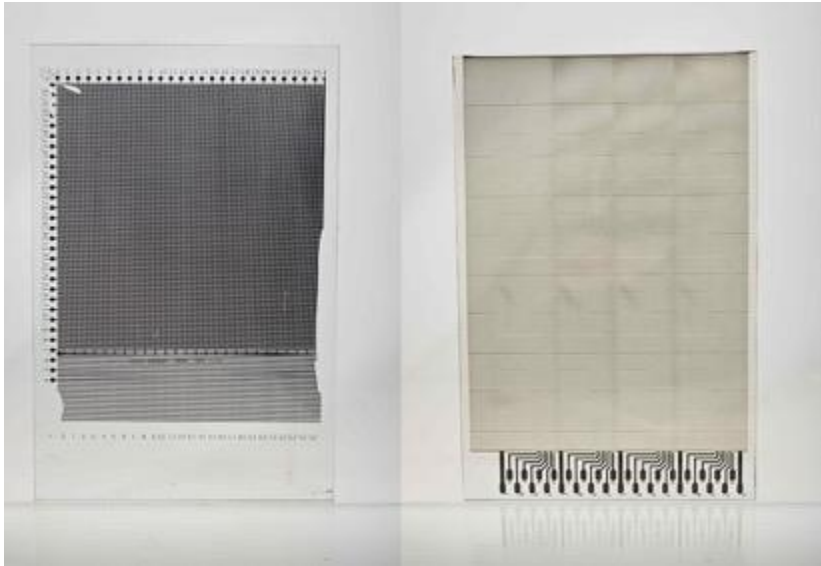
Research		6%
	Particle Physics	0,5%
	Nuclear Physics, solid state, materials	0,2 - 0,9%
	Biology	5%
Medical Applications		35%
	Diagnostics/treatment with X-ray or electrons	33%
	Radio-isotope production	2%
	Proton or ion treatment	0,1%
Industrial Applications		<60%
	Ion implantation	34%
	Cutting and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

**Οφέλη για την Κοινωνία
από
Θεμελιώδη Έρευνα**

Οφέλη για την κοινωνία

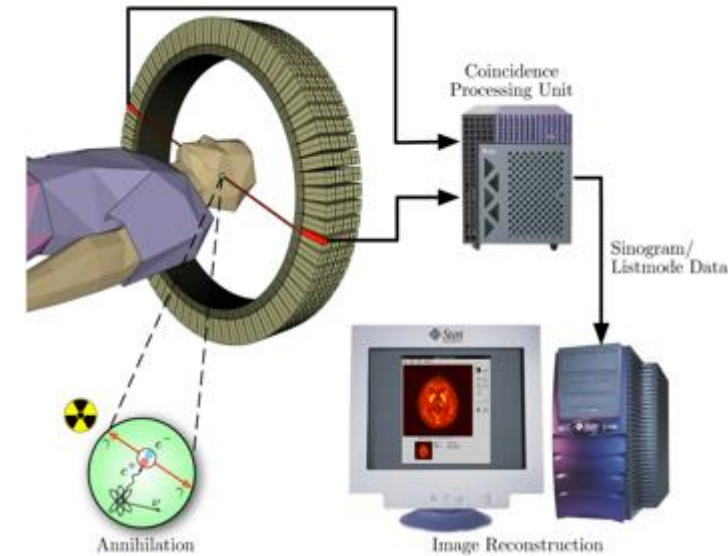
Αν και η έρευνα για τα βασικά επιστημονικά ερωτήματα της Φυσικής δεν αποσκοπεί στην παραγωγή “προϊόντων” άμεσης χρησιμότητας, εντούτοις **πολλές εφευρέσεις ωφέλιμες για τον απλό άνθρωπο ξεκίνησαν από την έρευνα της φυσικής στο CERN.**

Οθόνη Επαφής (touchscreen) World Wide Web (WWW)



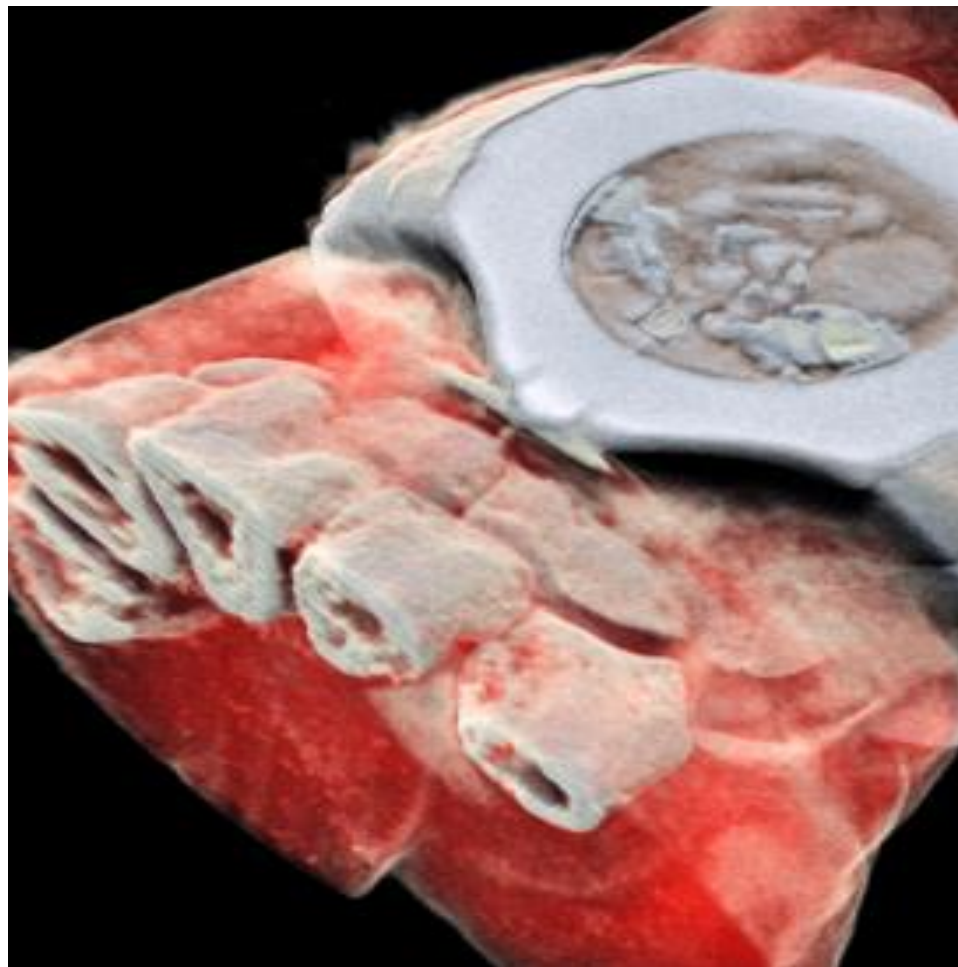
Tim Berners-Lee

PET scan



Ο σκοπός των ερευνητικών κέντρων είναι η βασική έρευνα, η κατάκτηση γνώσης.

Έγχρωμες ακτινογραφίες



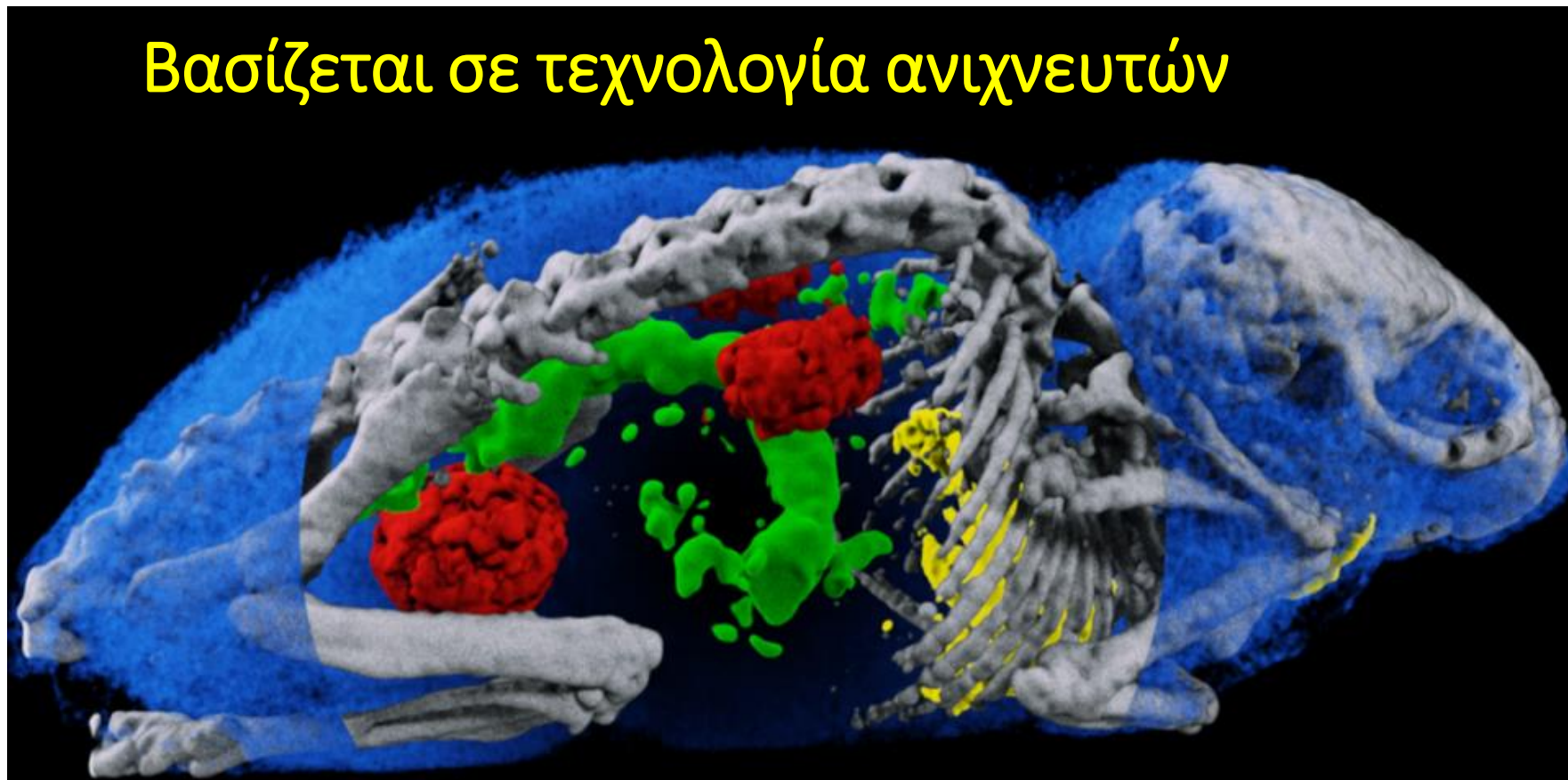
Από την πρώτη ακτινογραφία, στην πρώτη έγχρωμη ακτινογραφία
Rontgen 1895, to CERN technology 201

Έγχρωμες ακτινογραφίες

Από την ανίχνευση σωματιδίων με ανιχνευτές silicon pixel
στην έγχρωμη «ακτινογραφία» (Medipix)



Βασίζεται σε τεχνολογία ανιχνευτών

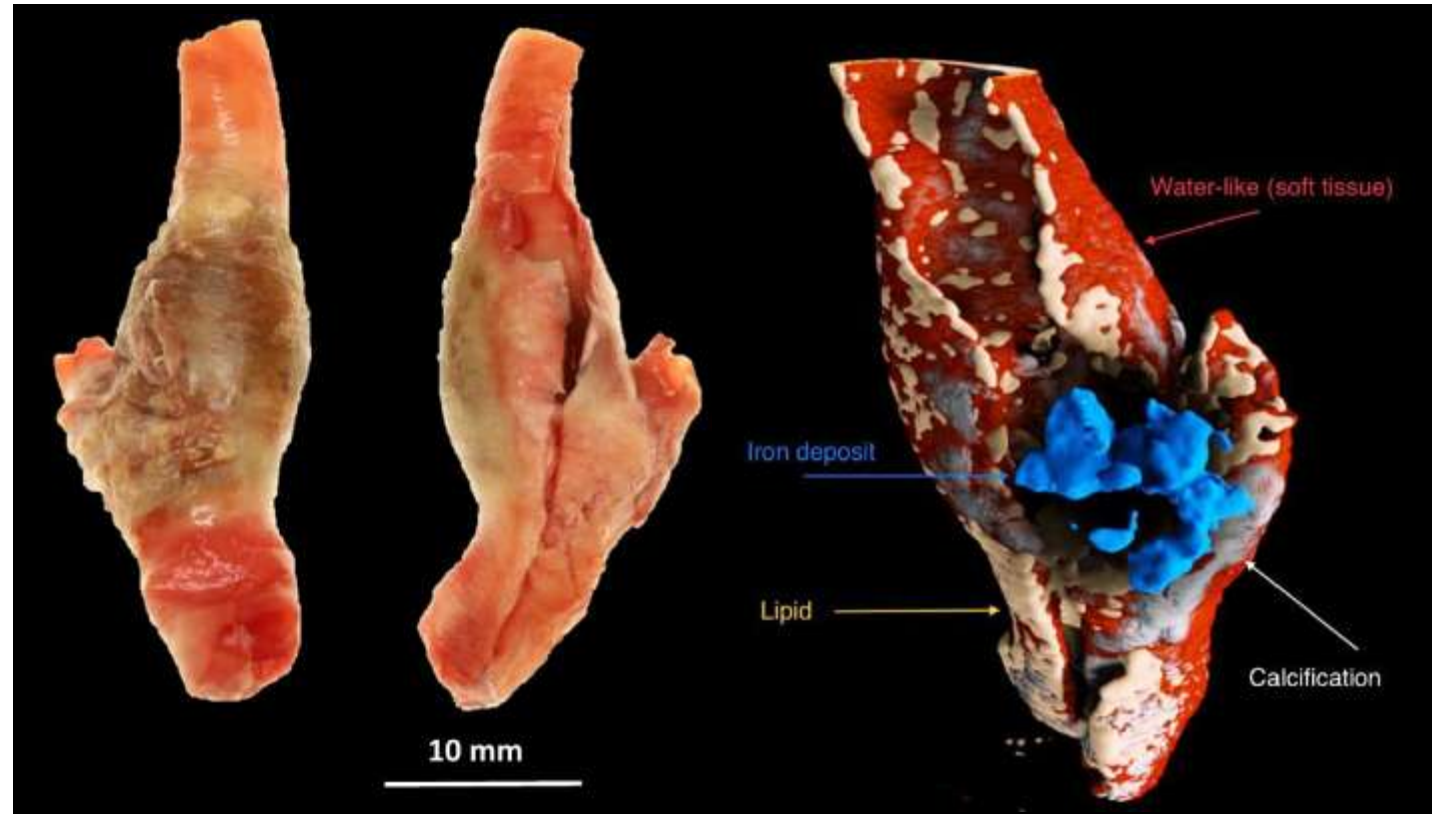


The water has been partly cut away to reveal the
bone, gold, gadolinium and iodine

Images presented and the European Congress of Radiology, Vienna, March 2017. MARS BioImaging Ltd

Έγχρωμες ακτινογραφίες

Μοριακή απεικόνιση



Καρδιαγγειακές ασθένειες: αιτία των 37% των θανάτων στην ΕΥ. *Steven Giesege, Uni. Canterbury*

MARS Bioimaging



- 3D colour X-ray scanner using CERN Medipix technology arrived at the Lausanne University Hospital (CHUV) to start clinical trials.



CT scanner πρωτονίων ALPIDE ALICE

ALPIDE: A New Methodology for Proton CT

Success Story



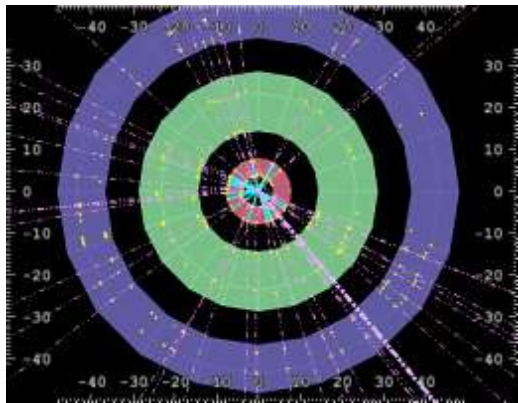
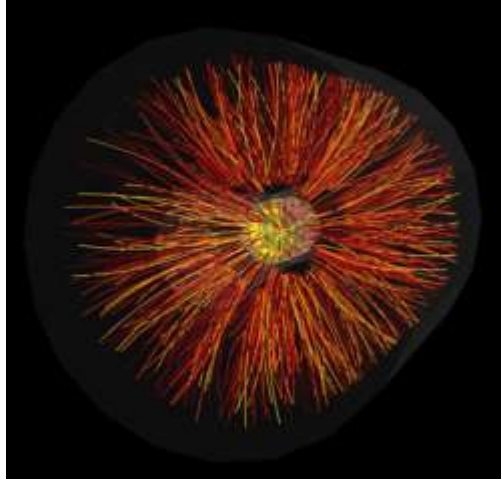
ALPIDE: Μια νέα μεθοδολογία για CT πρωτονίων

Ανιχνευτής ALPIDE:
A new Monolithic Active Pixel Sensor

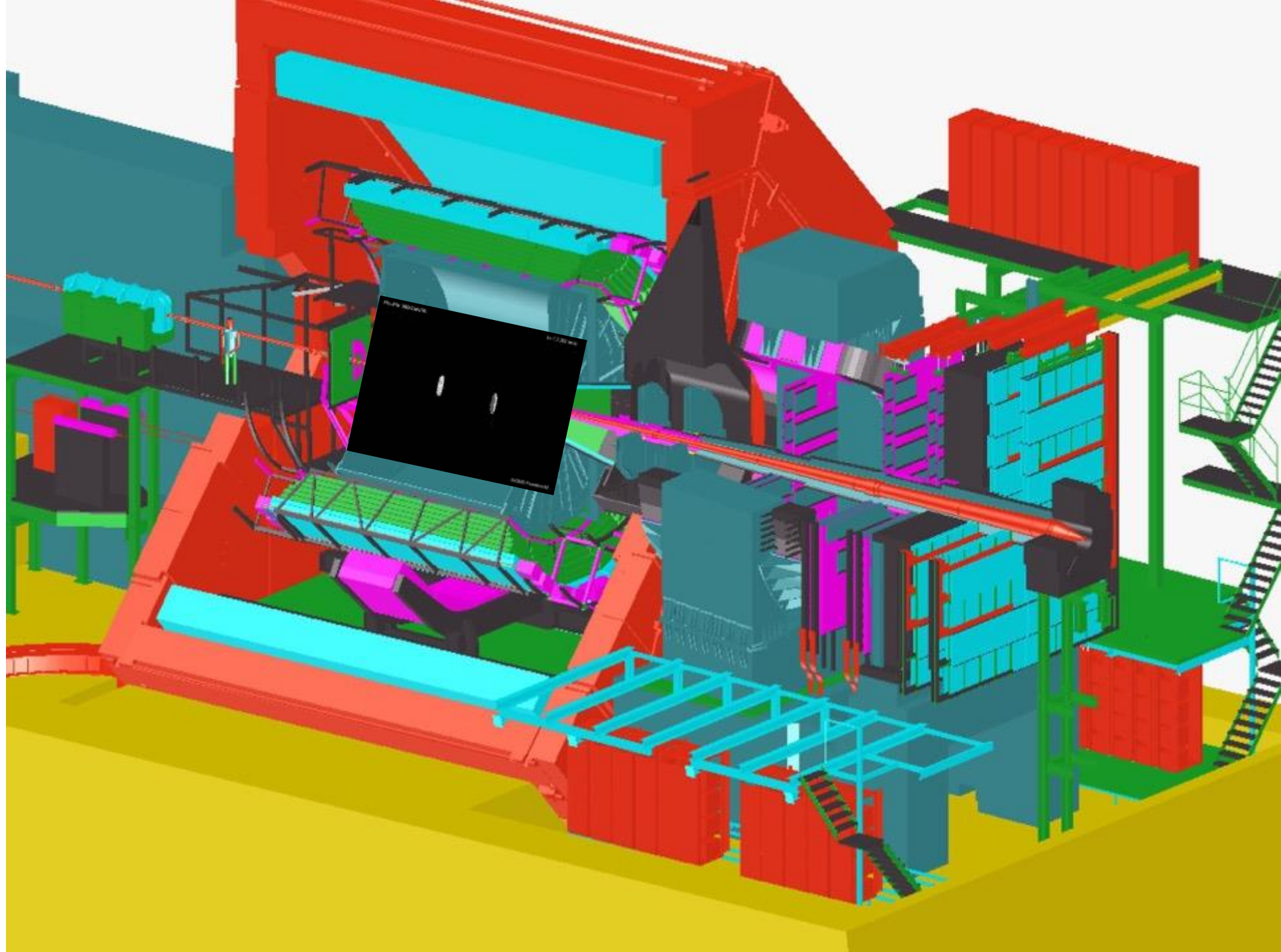
Application Domains: Medtech

A new Monolithic Active Pixel Sensor, originally developed to upgrade the ALICE inner tracking system during the second long shutdown of LHC, is on its way to Bergen University for a very different application – Proton Computed Tomography (Proton CT). The University will use the technology for research and development of a Proton CT proof-of-concept project using the high time and space resolution of the ALPIDE chip. Proton CT is a technique based on the measurement of a proton's position/trajectory and energy before and after traversing an object to reconstruct an image of the object. Unlike conventional X-ray CT systems, where the technology is widely understood, proton CT still faces some technological challenges

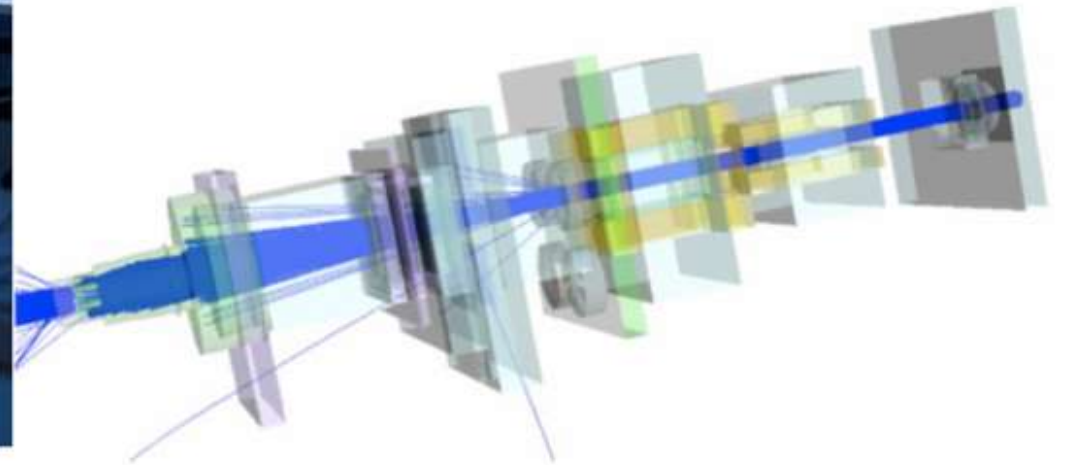
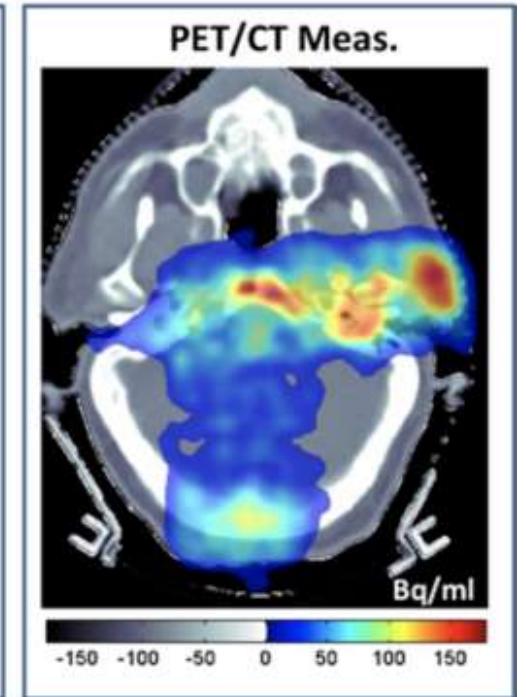
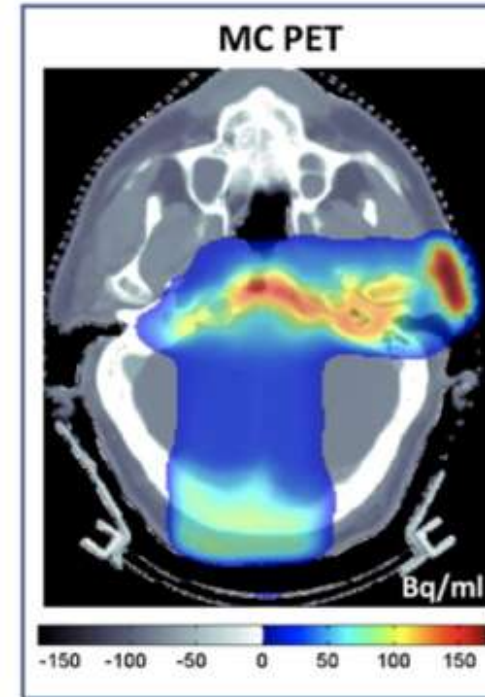
Πείραμα ALICE ηλεκτρονική κάμερα



*First LHC event
reconstructed online*



Simulations for hadron therapy



Big Data for health

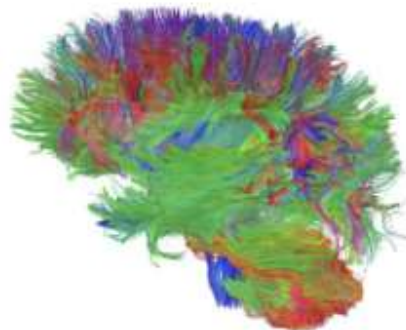


CERN Openlab

BioDynaMo — The Biology Dynamic Modeller



- Platform for high-performance simulations of biological dynamics
- Involves detailed physical interactions in biological tissue
- Highly optimised and parallelised code
- To be run on hybrid (multi-core, manycore) cloud environments
 - Cortical column: 10k neurons - brain cancer
 - Cortical sheet: 10m neurons - epilepsy
 - Cortex: 100m - 10bn neurons - schizophrenia



1

The GeneROOT Project

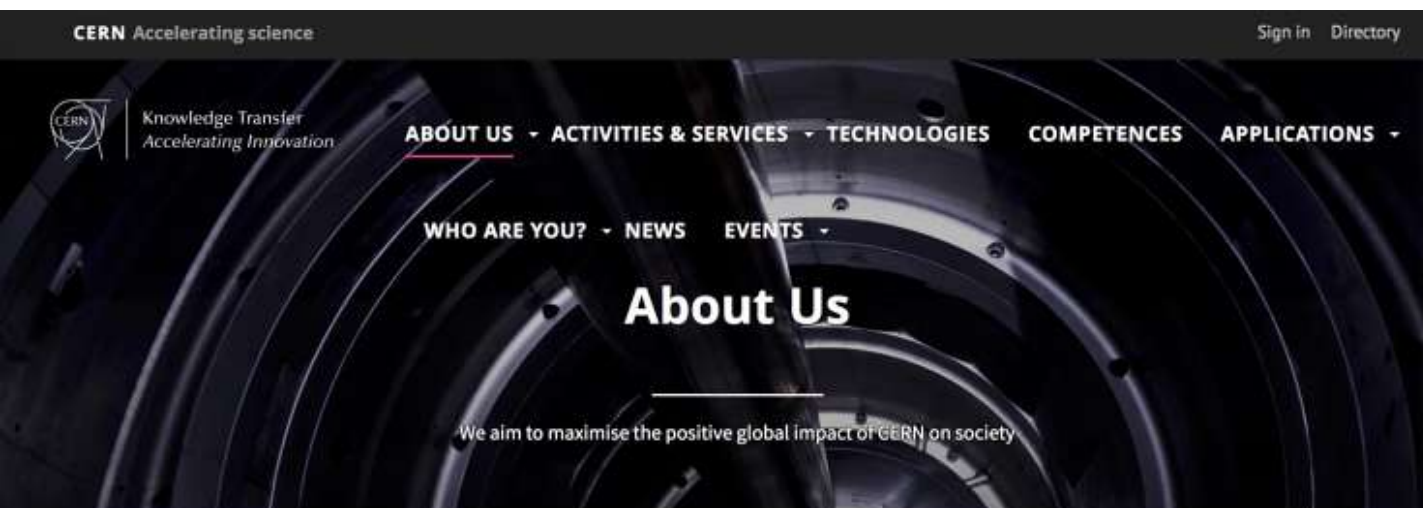


- Based on data from the TwinsUK project, the biggest UK adult twin registry (more than 11000 twins, 300 TB genomics data)
 - Formal interface: King's College London
 - Behind KCL: entire consortium working on Twins UK (~ 50 institutes)
- Evaluate if the optimised ROOT file format and analysis features are more efficient for this type of studies than BAM and standard genomic analysis tools
- Evaluate Seagate Kinetics key/value storage facility for this type of cases



1

Information in Knowledge Transfer pages



<https://kt.cern/news>

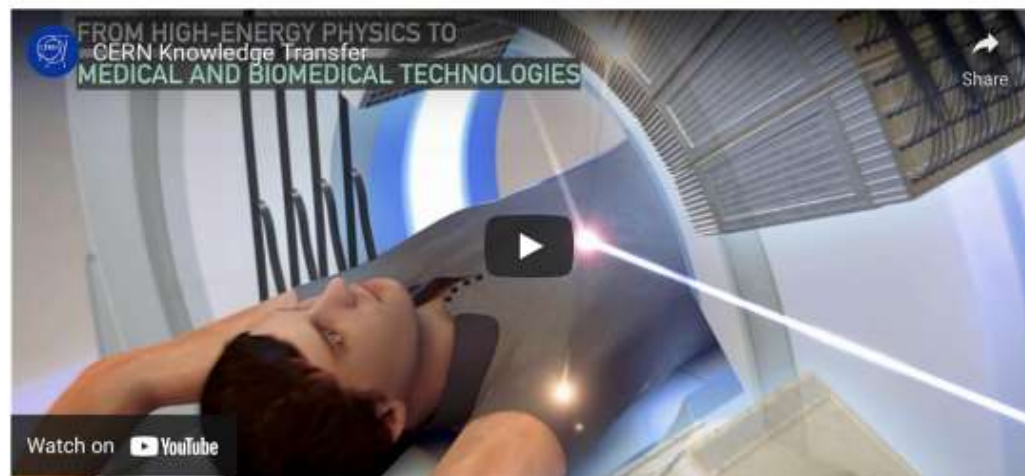
Our Mission

“ Places like CERN contribute to the kind of knowledge that not only enriches humanity, but also provides the wellspring of ideas that become the technologies of the future. ”

— Fabiola Gianotti, Director-General of CERN

Our mission

The Knowledge Transfer group at CERN aims to engage with experts in science, technology and industry in order to create opportunities for the transfer of CERN's technology and know-how. The ultimate goal is to accelerate innovation and maximise the global positive impact of CERN on society. This is done by promoting and transferring the technological and human capital developed at CERN. The CERN KT group promotes CERN as a centre of technological excellence, and promotes the positive impact of fundamental research organisations on society.



ABOUT US

- › [Our Mission](#)
- › [Our Team](#)
- › [Organisational Chart](#)
- › [Annual Report](#)
- › [Press Kit](#)
- › [Newsletter](#)
- › [KT Partners @CERN](#)
- › [External Coverage](#)

UPCOMING DEADLINES

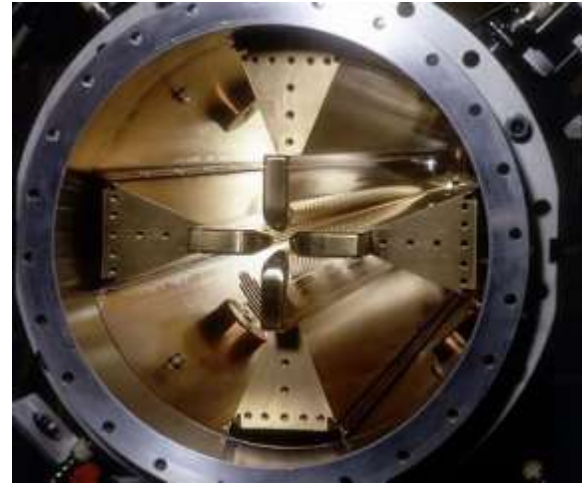
BSBF 2022 - Register now
30 April, 2022

Innovative Business

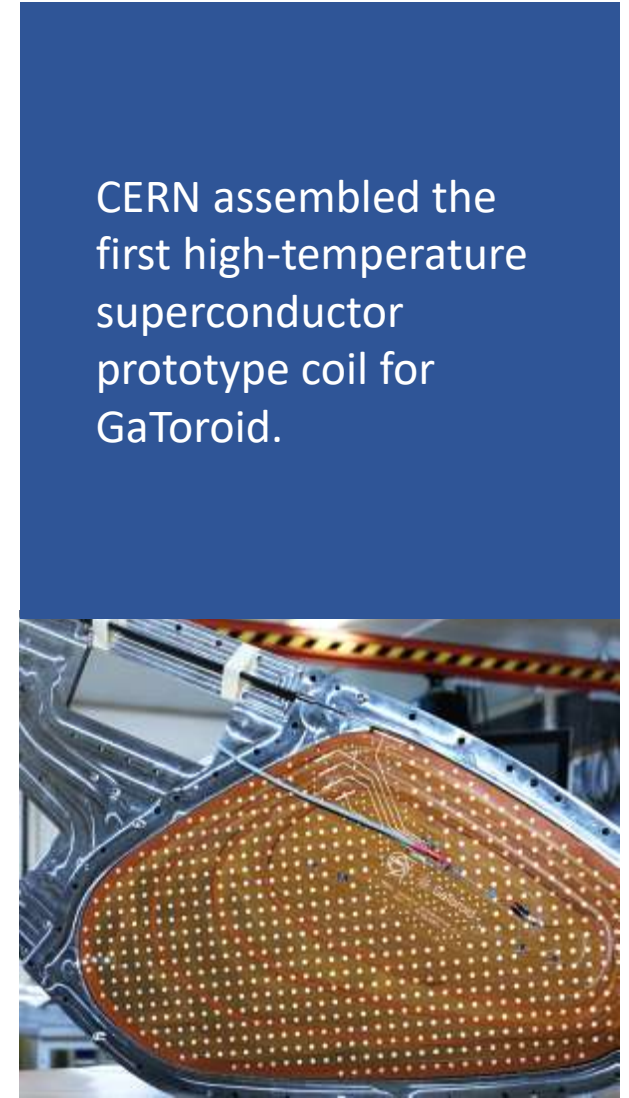


CERN's MEDICIS facility produced the first samples for targeted alpha therapy.

CERN and SEEIIST have produced a design report of an innovative facility based on a room-temperature synchrotron.



CERN and CIEMAT completed the first out of four modules of a RFQ for a future carbon-ion therapy linear accelerator.



CERN assembled the first high-temperature superconductor prototype coil for GaToroid.

<https://kt.cern/news>

Aerospace Applications

- Partnership with ESA in the field of quantum technology and artificial intelligence models for earth observation (QUAI4EO).
- The ESA-supported CHIMERA project to adapt the CHARM irradiation facility for heavy ion testing.





"AS HUMANS VENTURE INTO SPACE, THE RADIATION LEVELS INCREASE, AND SO DOES THE NEED FOR RELIABLE DOSE MONITORING."

Florence Clément, project manager of the Lumina experiment, CNES/CADMOS

Lumina

- Astronaut Thomas Pesquet activated Lumina, a CERN tested optical fibre-based dosimetry experiment, on board the International Space Station.



Financial Markets

- CERN data analysis tool ROOT protects commodity and financial markets from fraud, in partnership with CORMEC and Wageningen University.
- Partnership with Jumptrading to improve speed and scalability of CERN Virtual Machine File System for worldwide software distribution.

Ευκαιρίες για Νέους

Ευκαιρίες για νέους στο GSI/FAIR

GET_INvolved Programme

WHAT Specific



Internships

for enrolled students in Bachelors/Masters degree in science and engineering.



Traineeships

for students having a Masters degree in science and engineering.



Research Experience

for enrolled PhD students or recent doctorates (postdocs) or equivalent.



Contact us – Join the journey!



Web:

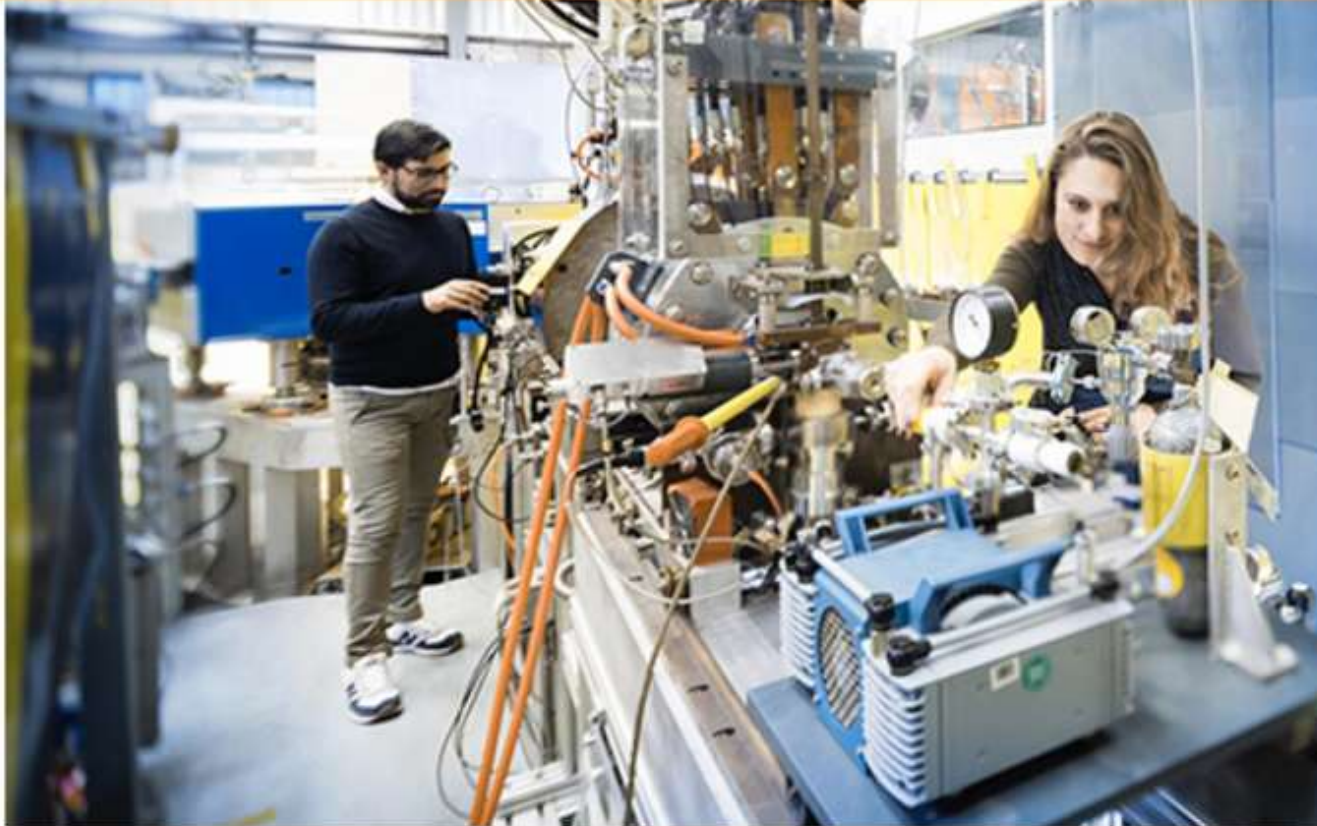
www.gsi.de/get_involved
www.fair-center.eu/get_involved

email:

Pradeep.Ghosh@fair-center.eu

enquiries/support:

international@gsi.de
international@fair-center.eu



Studies and career

FAIR and GSI employ about 1.580 people. In addition approximately many external scientists per accelerator facility and the experimental sites. Join us and strengthen our teams.

Job Offers of GSI and FAIR

International Summer Student Program at GSI-FAIR

July 25 - Sep. 15, 2022

RESEARCH LIVE for UNDERGRADUATES

experience research in a major accelerator laboratory

During the summer months of 2022 GSI and its graduate school HGS-HiRe organize an International Summer Student Program (ISSP) which is offered to students on the advanced undergraduate and Master level with at least three years of study completed upcoming summer: i.e. students during their last-year Bachelor or Master studies in physics or related natural science and engineering disciplines from Europe or GSI/FAIR partner countries. Since spring 2010 the Summer Student Program is organized within the program canon of the Helmholtz Graduate School for Hadron and Ion Research (HGS-HiRe).

The application term is closed and will be reopened during the month of December for the next year's Summer Program.



Summer Students 2019

■ **Green IT Cube becomes research and transfer center — 5.5 million euros EU funding for the supercomputing center of GSI and FAIR**



Finanziert von der
Europäischen Union
NextGenerationEU

Dieses Projekt wird aus Mitteln des Europäischen Fonds für regionale Entwicklung als Teil der Reaktion der Union auf die COVID-19-Pandemie finanziert.

Ευκαιρίες για νέους στο CERN

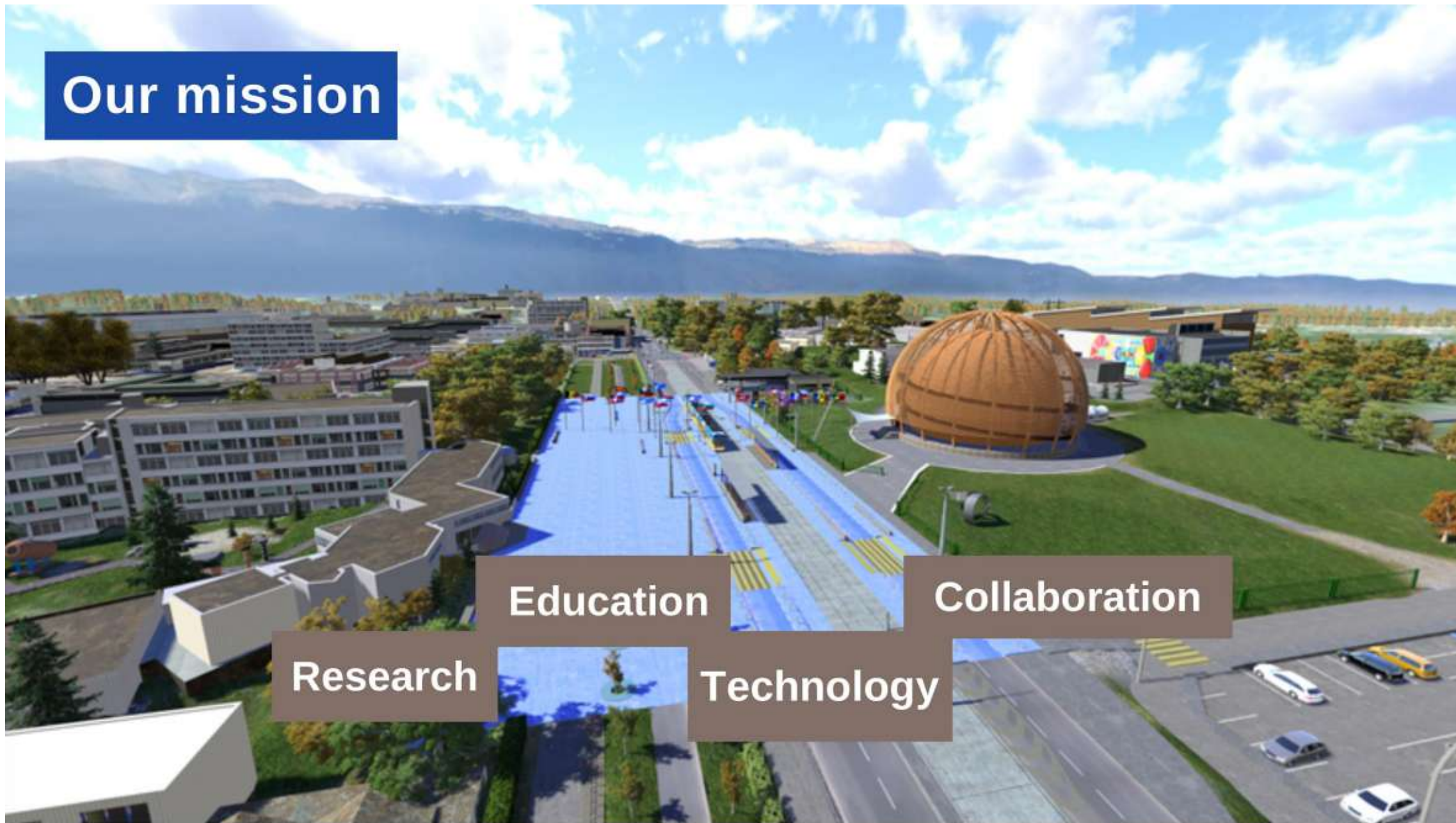
Our mission

Education

Collaboration

Research

Technology



How can YOU take part?

■ Ευκαιρίες για νέους

- Summer students
- Doctoral students
- Technical students
- Administrative students
- CERN fellows
- High School Teachers' Programme
- Positions (HR Department) web pages
- Visits
- Virtual visits
- Participation in masterclasses
- Beamline for schools competition

careers.cern

**Contact
Us**

CERN| Talent Acquisition
recruitment.service@cern.ch



CERN_JOBS



CERN_JOBS



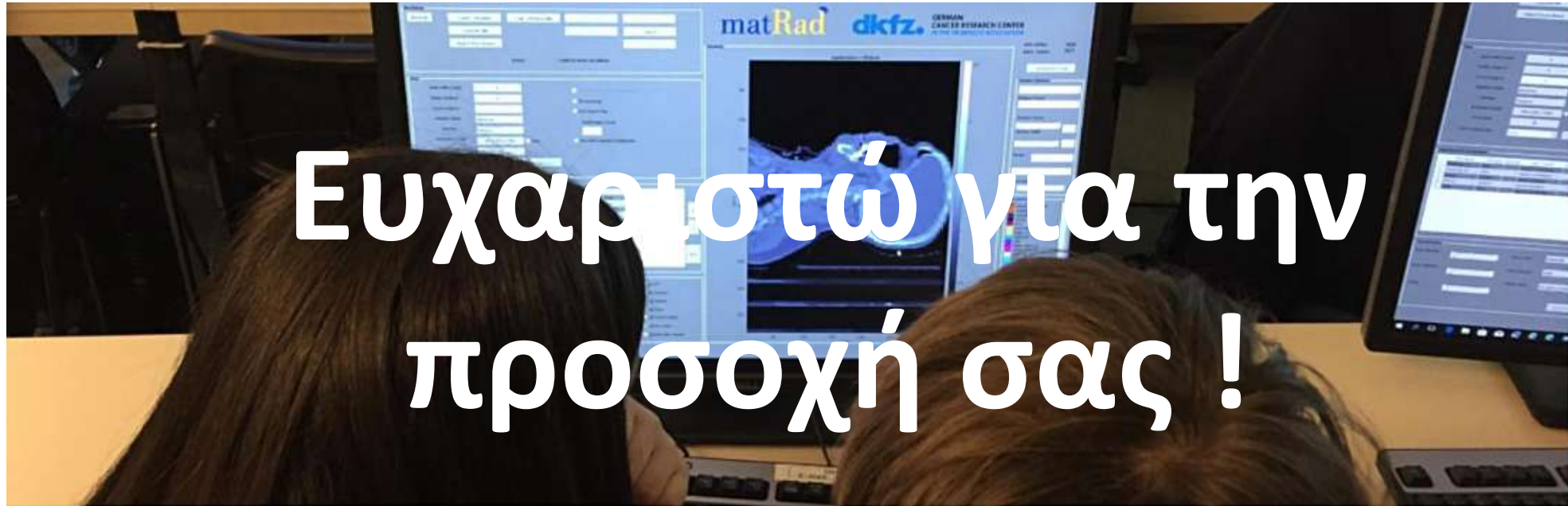
@CERN



CERNJOBSTV



Υποστηρίζοντας ανάπτυξη ικανοτήτων για την επιδίωξη κοινών έργων
στον αγώνα κατά του καρκίνου.



Ευχαριστώ για την
προσοχή σας !

General Coordination : p.foka@gsi.de yiota.foka@cern.ch

Backup Opportunities at CERN

Technical Student Programme

Project examples

Mechanical Engineering

- Human Robot Interface Development
- HL-LHC collimators technical support

Applied Physics

- Electron Cooling studies in AD and ELENA
- Vacuum design and simulations for a Hollow Electron Lens in the LHC

IT, Mathematics, Robotics

- Full-Stack Developer
- Evolution of Software Development Tools

Material and Surface Science

- Thermo-mechanical characterization of advanced materials up to 2000°C
- Vacuum compatibility studies of mild steel

Electrical or Electronics Engineering

- FPGA development for radiation testing
- Modeling of LHC superconducting magnet circuits

General and Civil Engineering

- Geographical Information System for FCC

Technical Student Programme

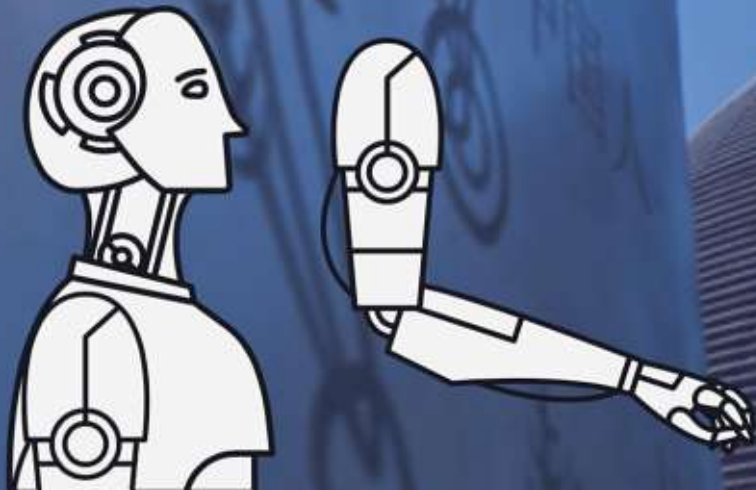
c.200 positions/year

Fields: Applied physics, engineering, computing

Length: 4 to 12 months

Eligibility: 18 months of undergraduate studies

Features: A technical project with a CERN supervisor, and a living allowance, incl. health insurance



$$E=mc^2$$



Summer Student Programme



c. 300 positions/year

Fields: Physics, engineering, computing

Length: 8 to 13 weeks, during the summer

Eligibility: 3 years of full-time undergraduate studies

Features: High-quality lecture programmes, visits, and workshops

Doctoral Student Programme

c.80 positions/year

Fields: Applied physics, engineering, and computing

Length: 6 months - 3 years

Eligibility: Enrolled in a doctoral programme

Features: A technical project, leading to a PhD thesis
co-supervised by the university thesis advisor and
a CERN staff member

A living allowance, incl. health insurance.



Fellowships

c.250 positions/year

Fields: Physics, engineering, computing, administrative - from recent graduate engineers to post-doc research physicists

Length: 2-3 years

Eligibility: BSc, MSc or PhD

Features: Employment contract, attractive salary and benefits, training, and networking



Staff positions

c.150 positions/year

Fields: Physics, engineering, computing, and administrative

Length: Up to 5 year initial limited duration contract

Eligibility: From apprenticeship to PhD

Features: Relocation, installation benefits, training (language courses, technical training)



cern.ch/virtual-hadron-therapy-centre