

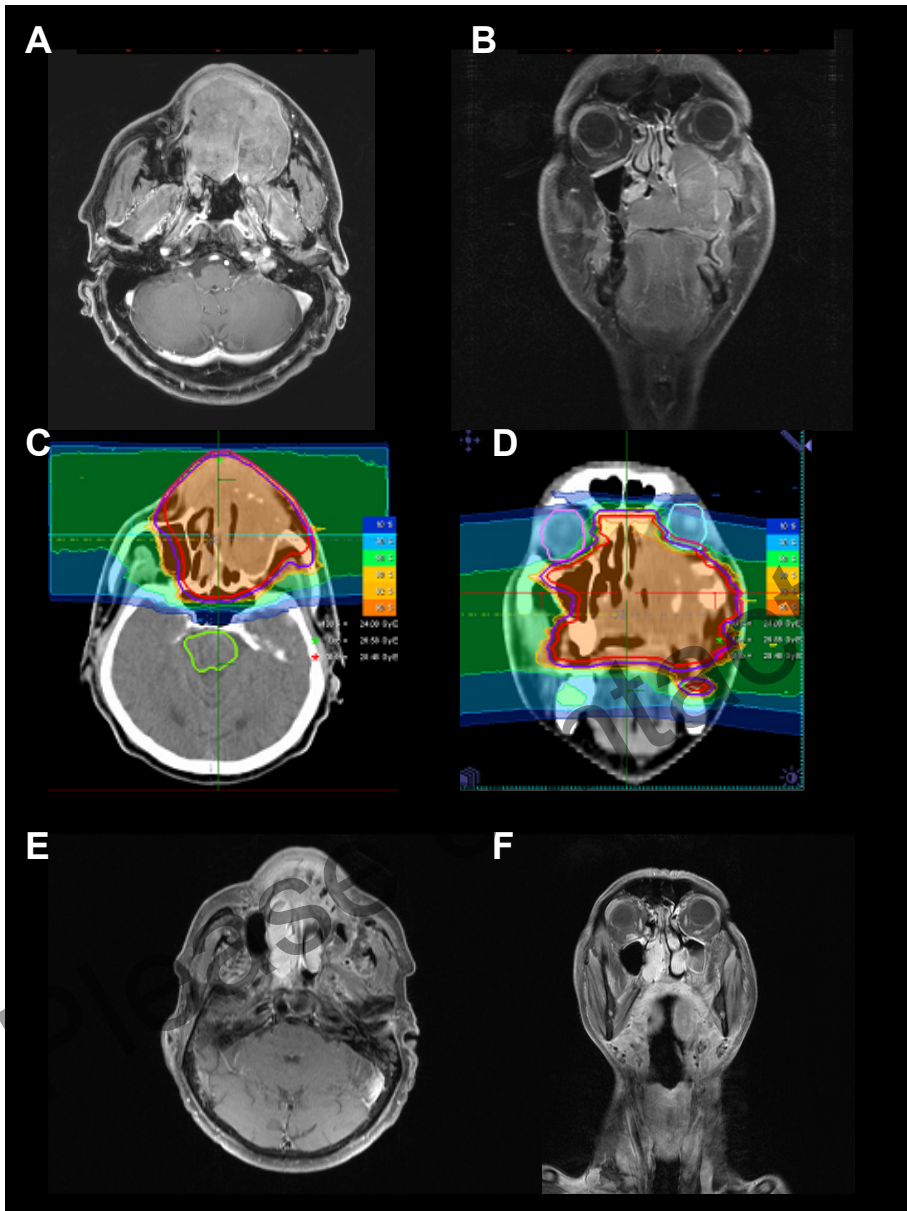


Particle Therapy – Status in Europe

Prof. Dr. Stephanie E. Combs

Professor and Chair, Department of Radiation Oncology

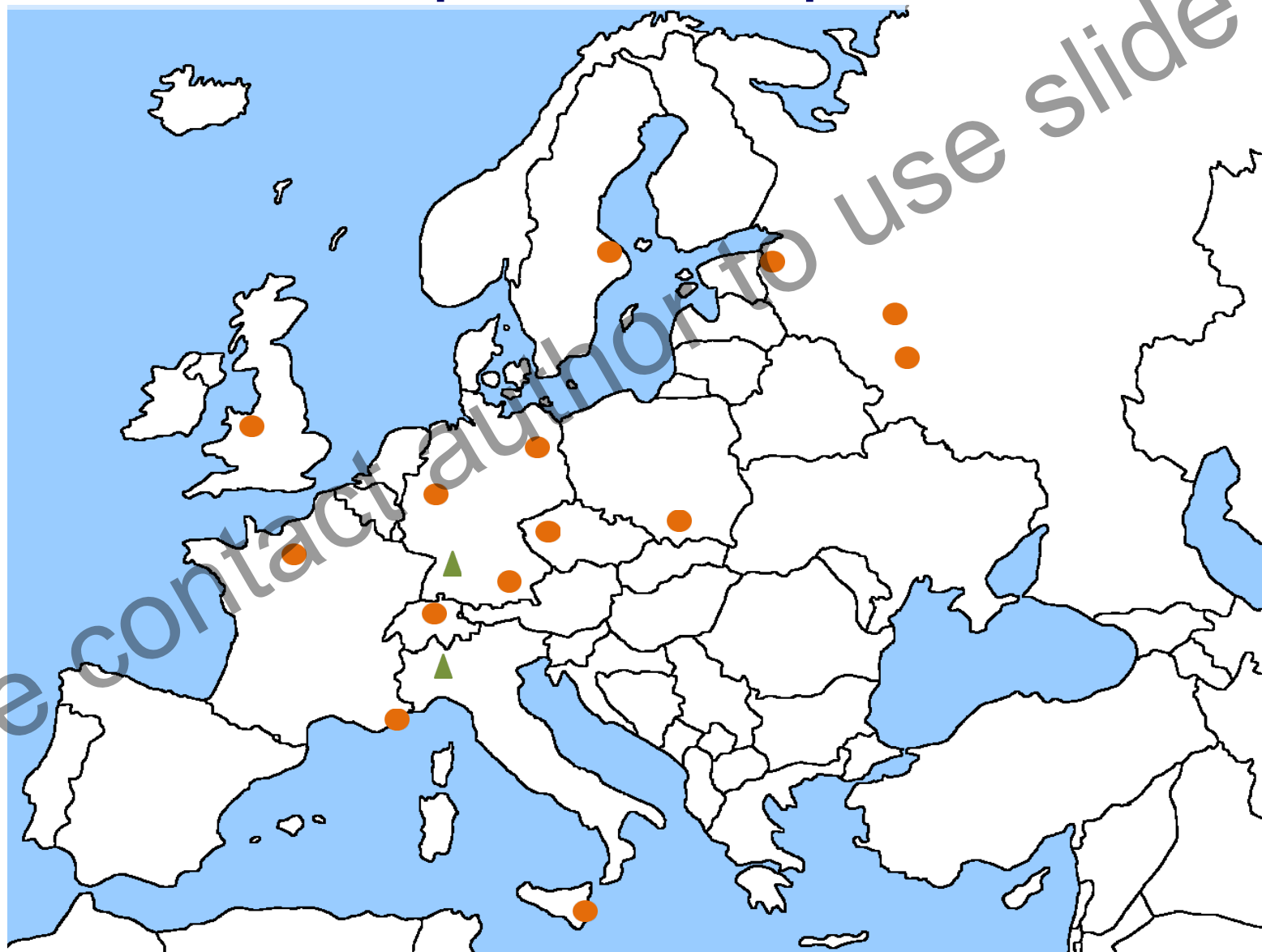
Klinikum rechts der Isar, Technische Universität München



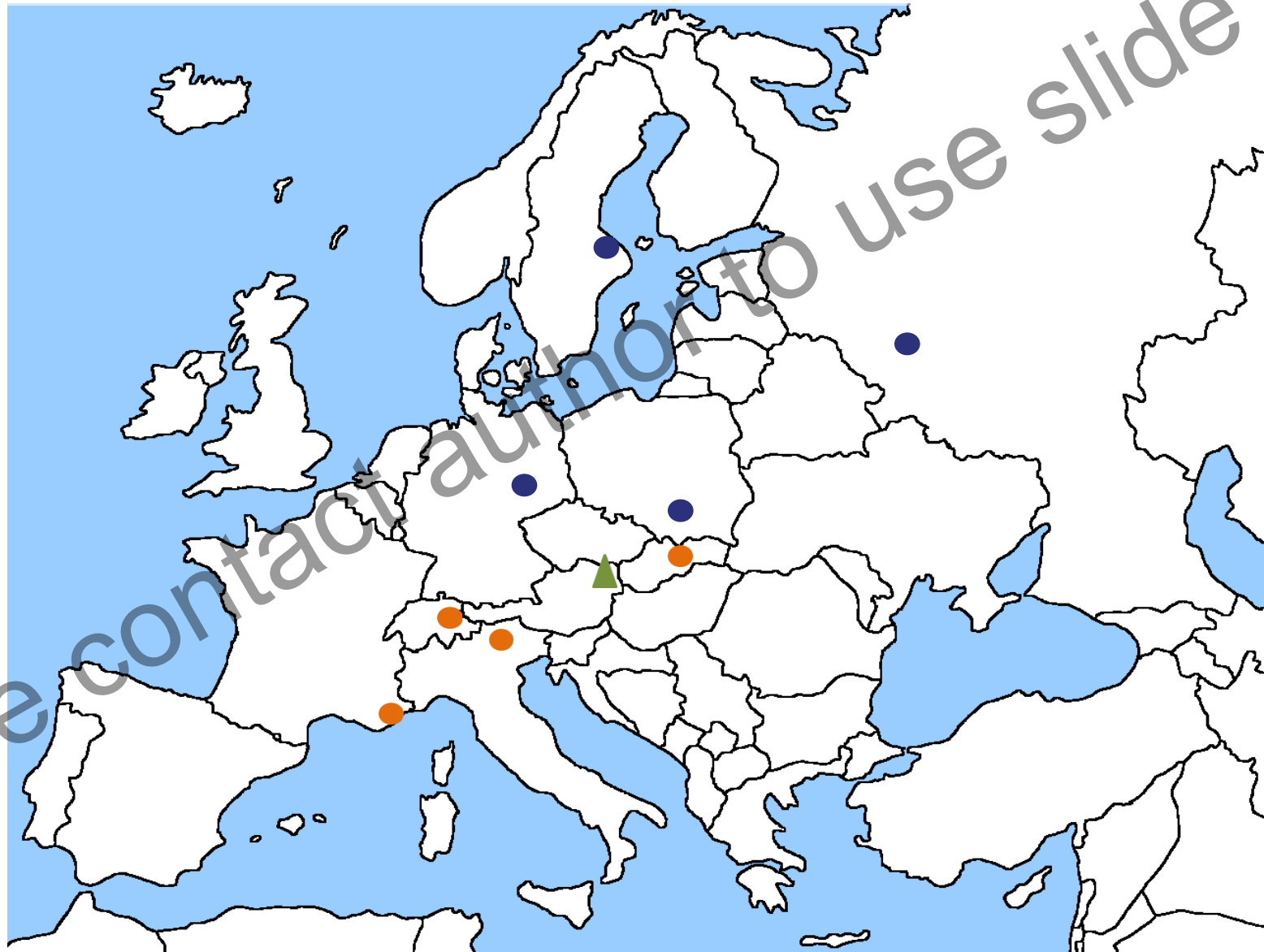
Treatment response in a 67 years old patients with an **adenoid-cystic carcinoma**.




Imaging for treatment planning (A, B), dose distribution for the carbon ion boost applied with 18 Gy E in single doses of 3 Gy E (C,D) in combination with photon IMRT up to 50 Gy, and MR-imaging performed 6 weeks after treatment (E,F).

Facilities in operation - Europe



Facilities under construction- Europe

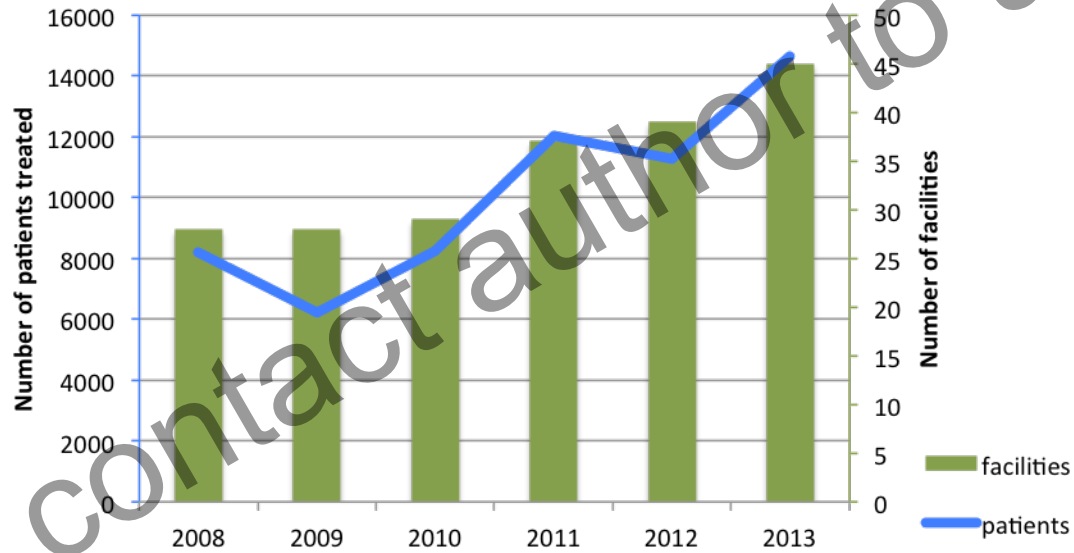


-  P centres
-  C-ion centres
-  Dual-ion centres

Facilities in operation	2007	2008	2009	2010	2011	2012	2013
Canada	P1	P1	P1	P1	P1	P1	P1
Czech Rep.	-	-	-	-	-	P1	P1
China	P1	P1	P1	P1 C1	P1 C1	P1 C1	P1 C1
England	P1	P1	P1	P1	P1	P1	P1
France	P2	P2	P2	P2	P2	P2	P2
Germany	P1 C1	P1 C1	P2	P2 D1	P2 D1	P2 D1	P3 D1
Italy	P1	P1	P1	P1	P1 C1	P1 D1	P1 D1
Japan	P4 C1 D1	P4 C1 D1	P4 C1 D1	P3 C1 D1	P5 C2 D1	P5 C2 D1	P8 C2 D1
Poland	-	-	-	-	P1	P1	P1
Russia	P3	P3	P3	P3	P3	P3	P3
South Africa	P1	P1	P1	P1	P1	P1	P1
South Korea	P1	P1	P1	P1	P1	P1	P1
Sweden	P1	P1	P1	P1	P1	P1	P1
Switzerland	P2	P2	P2	P1	P1	P1	P1
USA	P6	P6	P6	P8	P10	P11	P13
Total protons	25	25	26	26	31	33	39
Total C-ions	2	2	1	2	4	3	3
Total dual	1	1	1	1	2	3	3

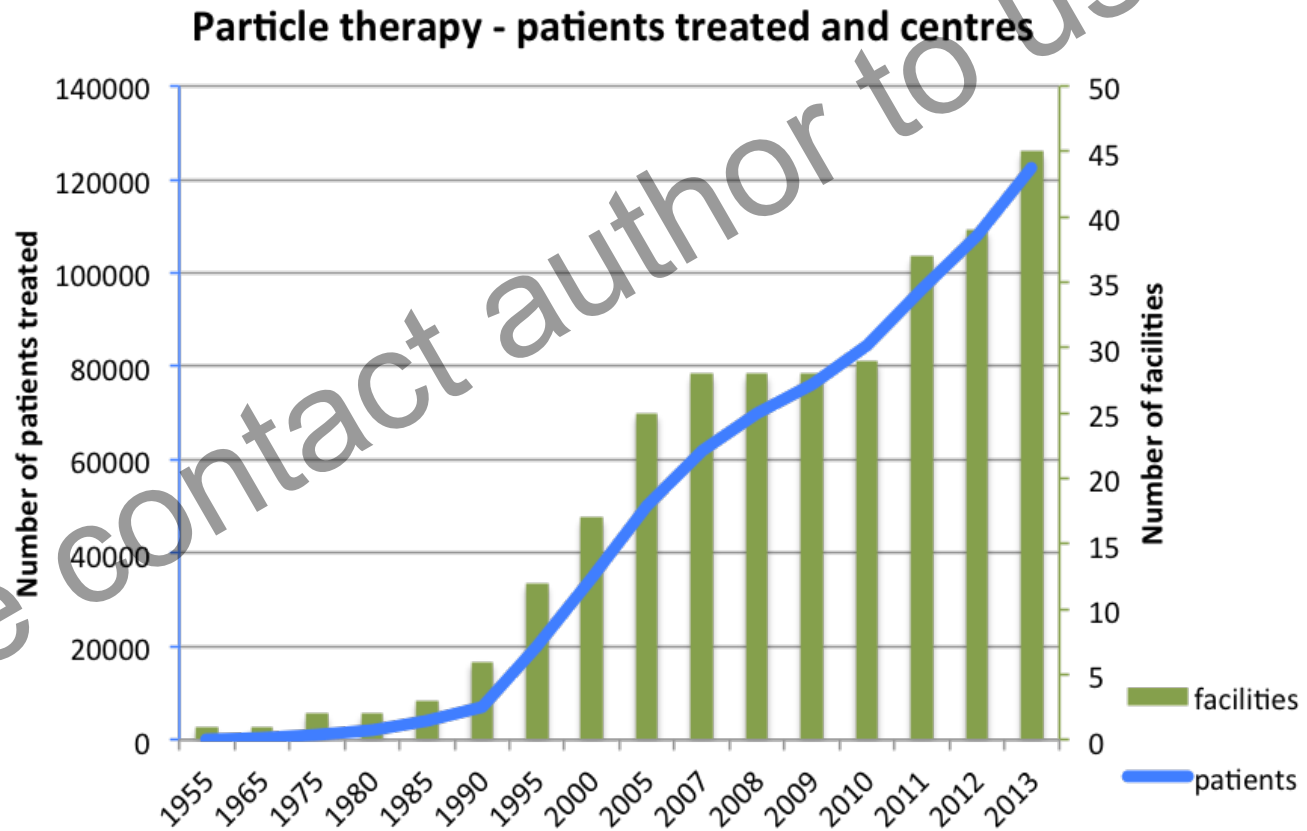
P = proton, C = carbon-ion, D = dual ion centres

Particle therapy - patients treated and facilities



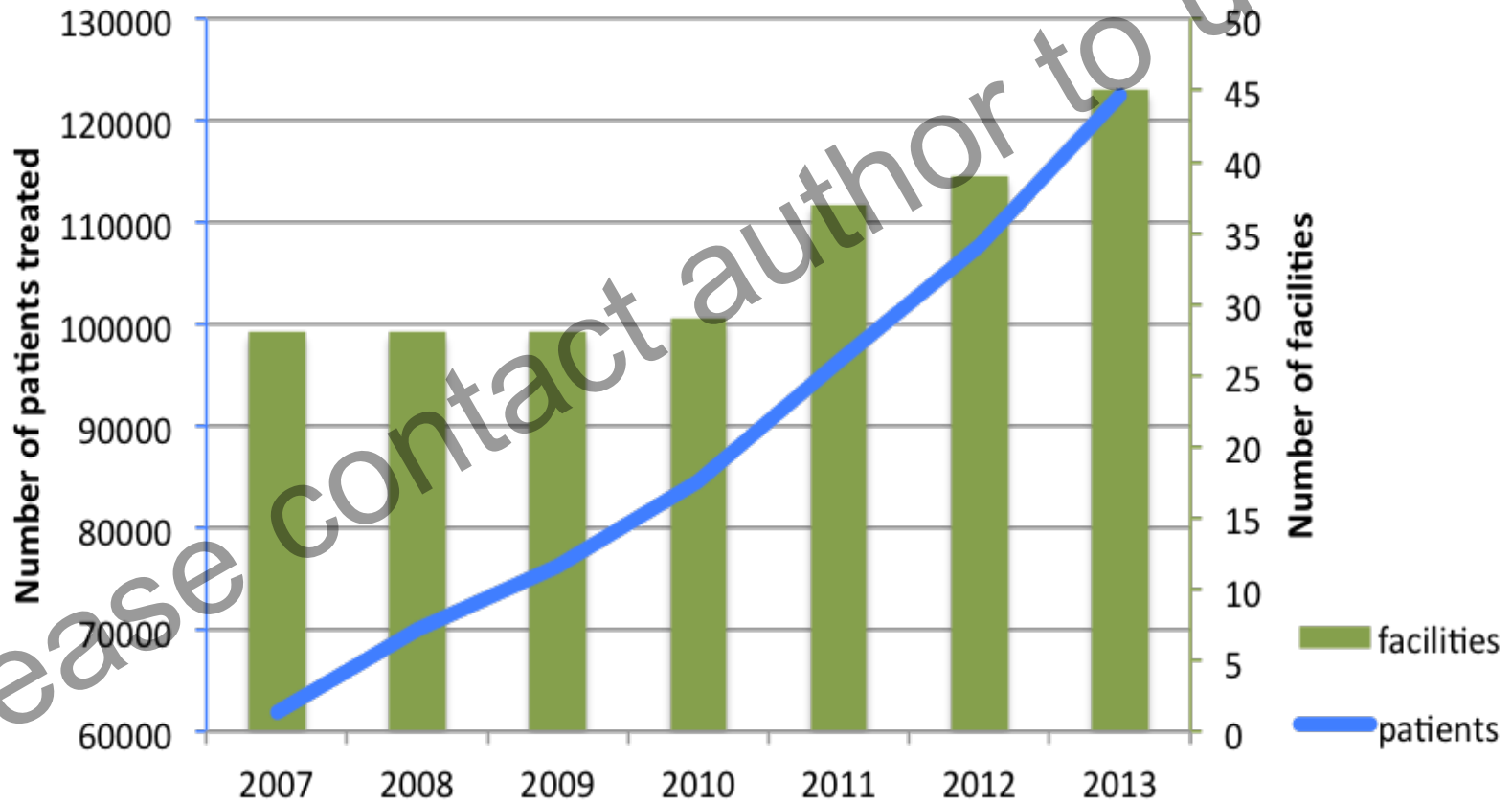
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Total number of patients treated



Total number of patients treated

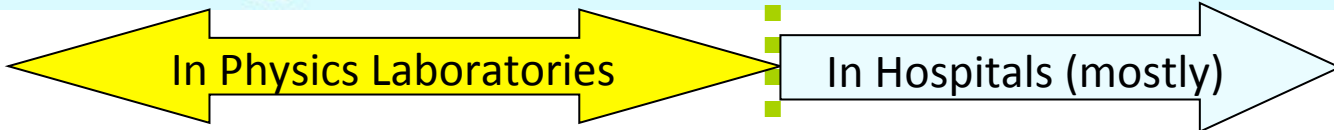
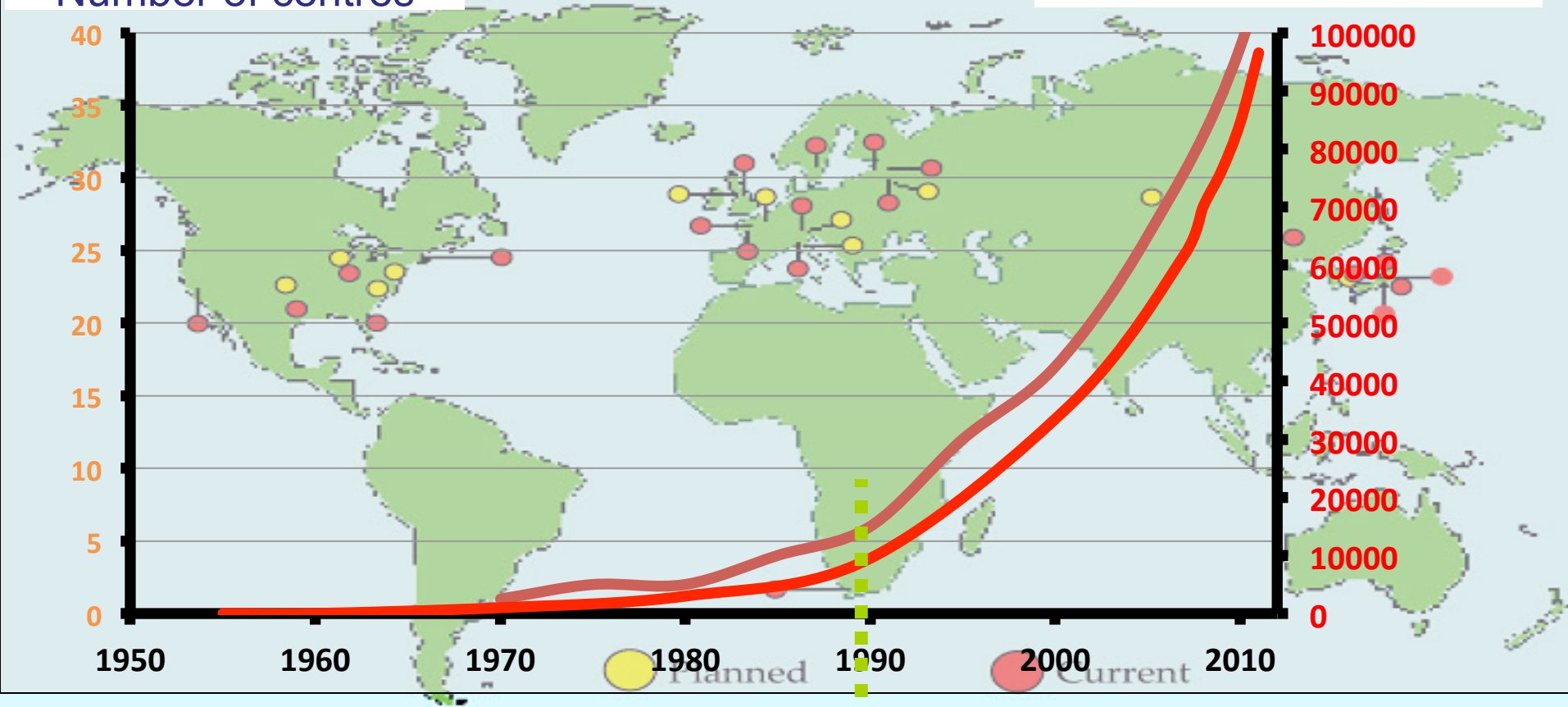
Particle therapy - patients treated and centres



CPT worldwide

Number of centres

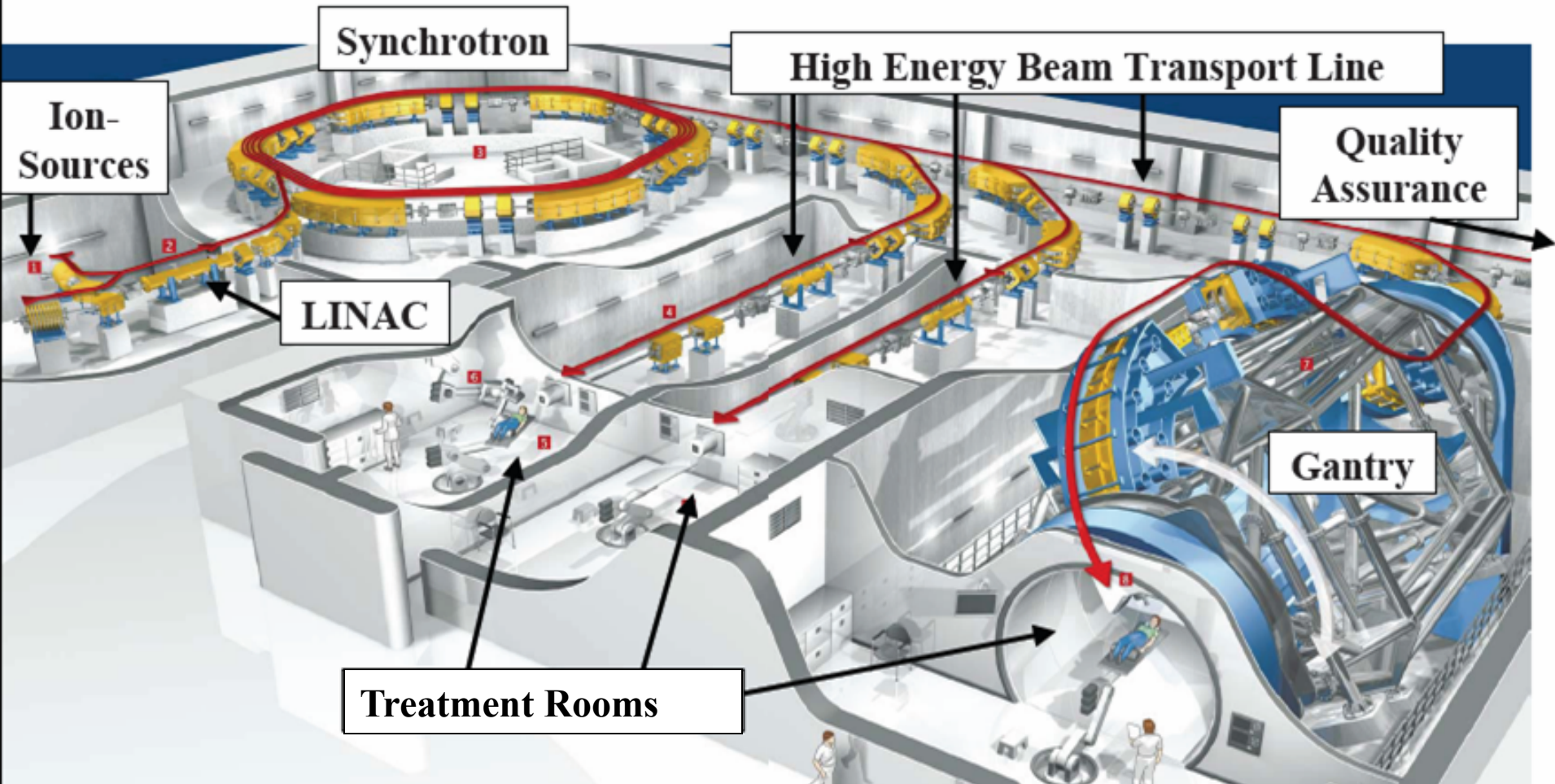
Number of patients



83,667 protons, 96,537 total (Dec 2011)

After Janet Sisterson, MGH

Heidelberg Ion Therapy Center (HIT)



CNAO = Centro Nazionale di Adroterapia Oncologica



Sandro Rossi
Technical Director



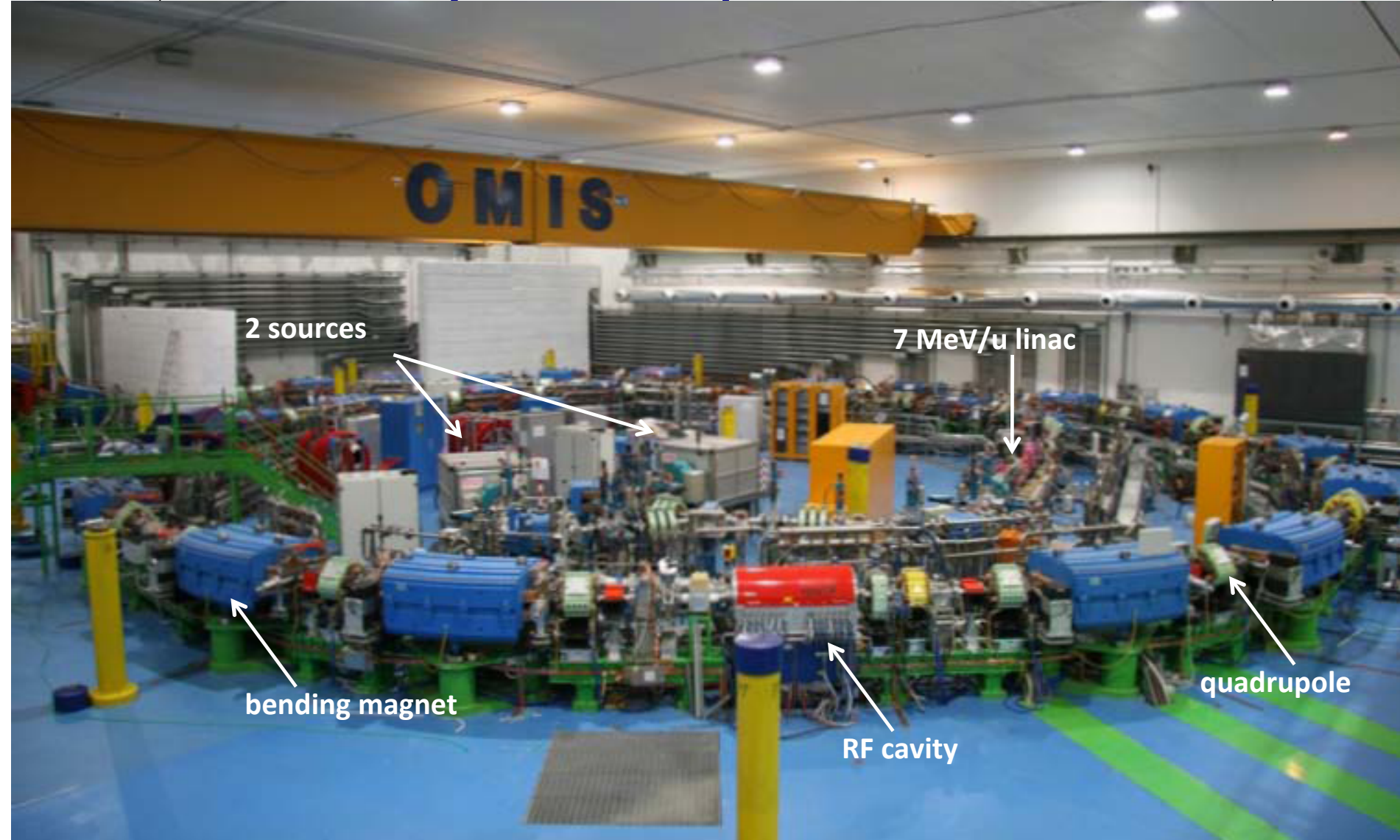
Roberto Orecchia
Medical Director



Synchrotron building

Hospital building

CNAO Synchrotron: proton/ carbon ions



2 sources

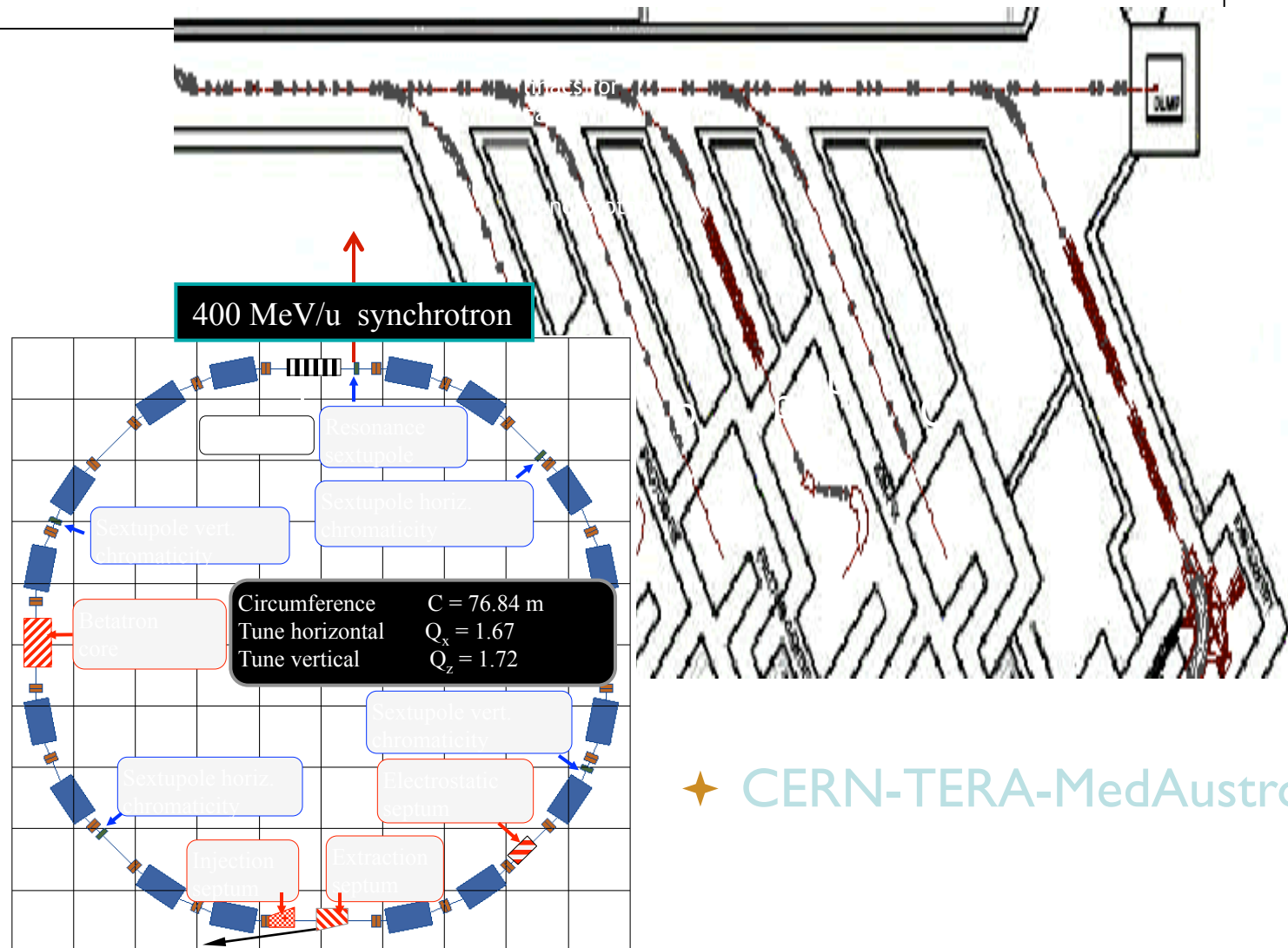
7 MeV/u linac

bending magnet

RF cavity

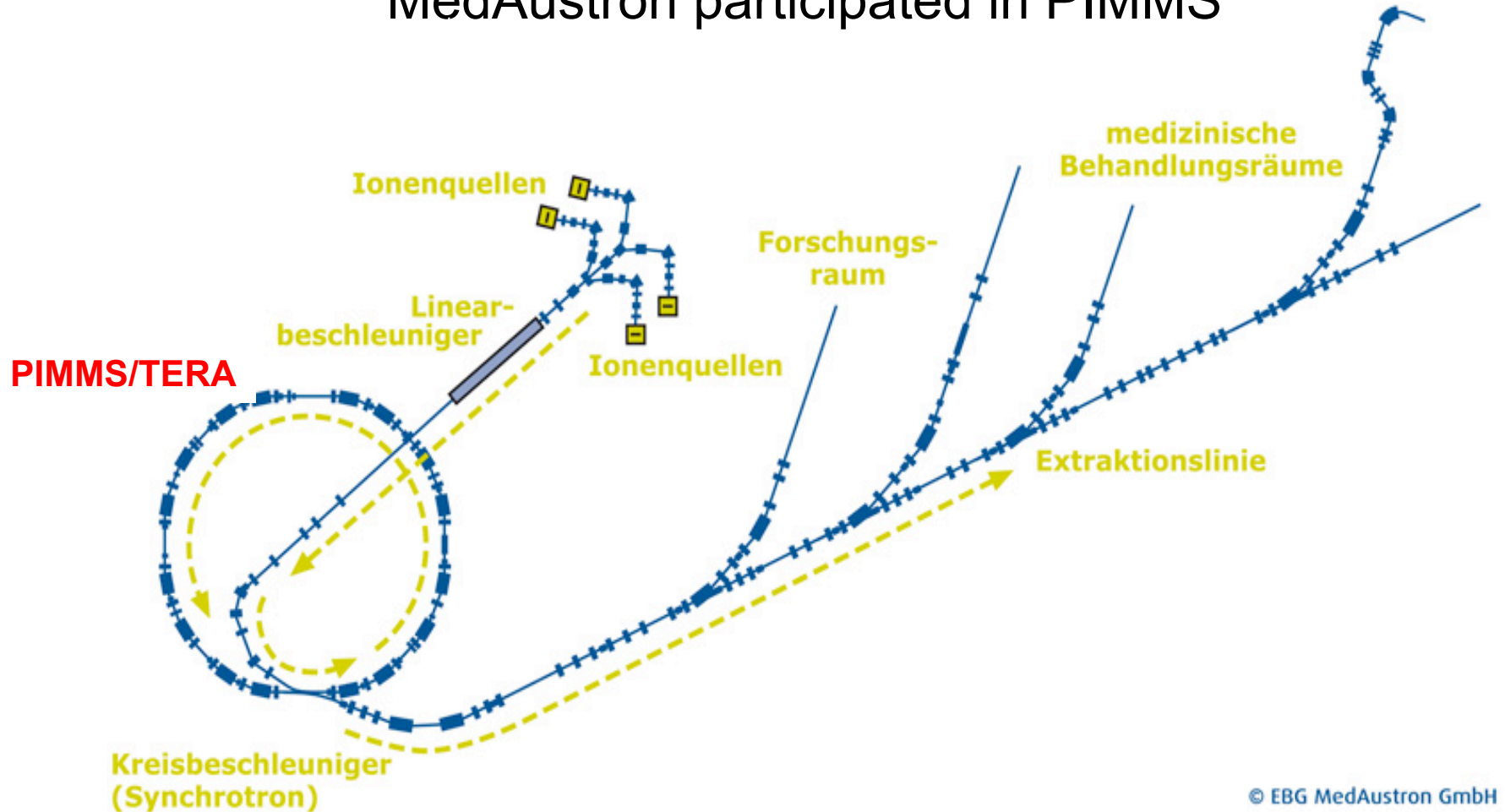
quadrupole

PIMMS at CERN (1996-2000)



✦ CERN-TERA-MedAustron

MedAustron participated in PIMMS



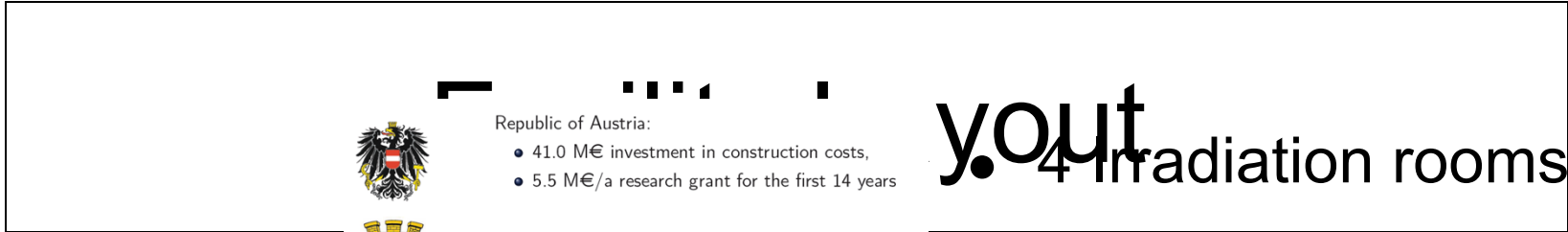
MedAustron has bought from CNAO Foundation the construction drawings for 3.2 million Euro (by agreement with CERN-CNAO-INFN)

Particle Therapy Centers.....

- Trento – Proton Facility, commissioning under way
- MedAustron – Proton and Carbon Ion – end of 2015 begin of pat. Treatment
- Dresden – proton facility single room – begin patient treatment this year (2014)

Some recent impressions of





- Republic of Austria:
- 41.0 M€ investment in construction costs,
 - 5.5 M€/a research grant for the first 14 years

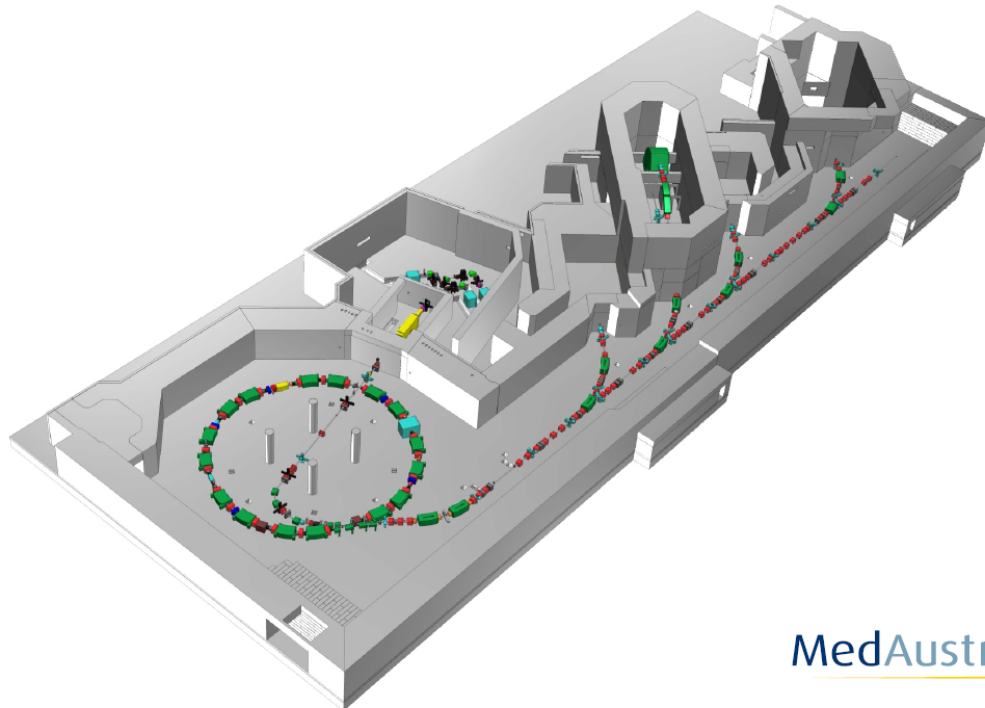


- Lower Austria:
- 3.7 M€ investment in construction costs



- Wiener Neustadt:
- 1,9 M€ investment in construction costs,
 - site with a size of 3.2 hectares

Accelerator Layout



y.out

4 Irradiation rooms

- 2 x Horizontal BL
- Horizontal + vertical BL
- Proton only gantry
- Protons
- intensity per pulse $< 10^{10}$
- Energy 60 – 800 MeV
- Carbon ions
- intensity per pulse $< 4 \times 10^8$
- Energy 120 – 400 MeV / A

MedAustron

Organisation Structure EBG and PEG MedAustron



EBG: Aufsichtsratsvorsitzender: Schneeberger
CEOs: Friedrich, Mösslacher,
Medical Director: R. Mayer



PEG CEO: Schreiner

- + Dec 2010: environmental impact assessment
- + March 2011: first stone laying
- + Dec 2011: building shell
- + Oct 2012: moving to the new building

- 2013: accelerator installation
- 2014: synchrotron commissioning and installation of medical equipment
- 2015: medical commissioning and trial operation, first patient treated end of 2015
- 2016: facility ready for non-clinical research
- 2020: full capacity – up to 1200 patients/year

EBG MedAustron GmbH

- construction of the facility and clinical operation of ion-beam therapy, i. e. clinical research
- 100 % owned by the province of Lower Austria

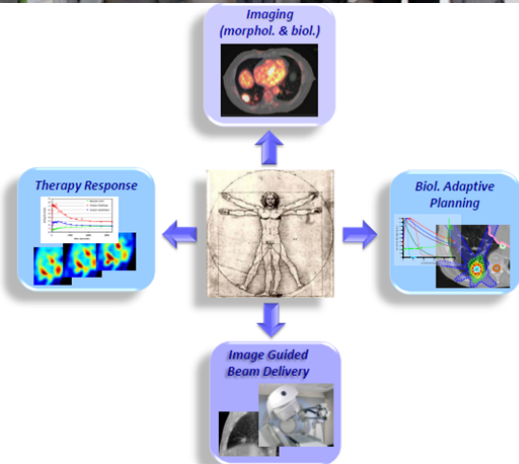
PEG MedAustron GmbH

- organisation and implementation of non-clinical research projects
- 67 % republic of Austria and 33 % province of Lower Austria

Research for MedAustron
 building up systematically research
 competency
 and structures for hadron research
 combined with photon research has
 started recently:



Opening ceremony CD Lab / March 2012



Research through FC, FP5, FNLIGHT

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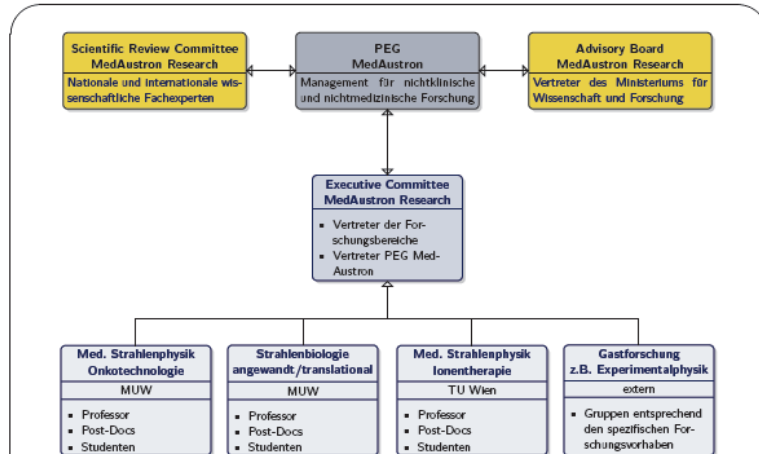
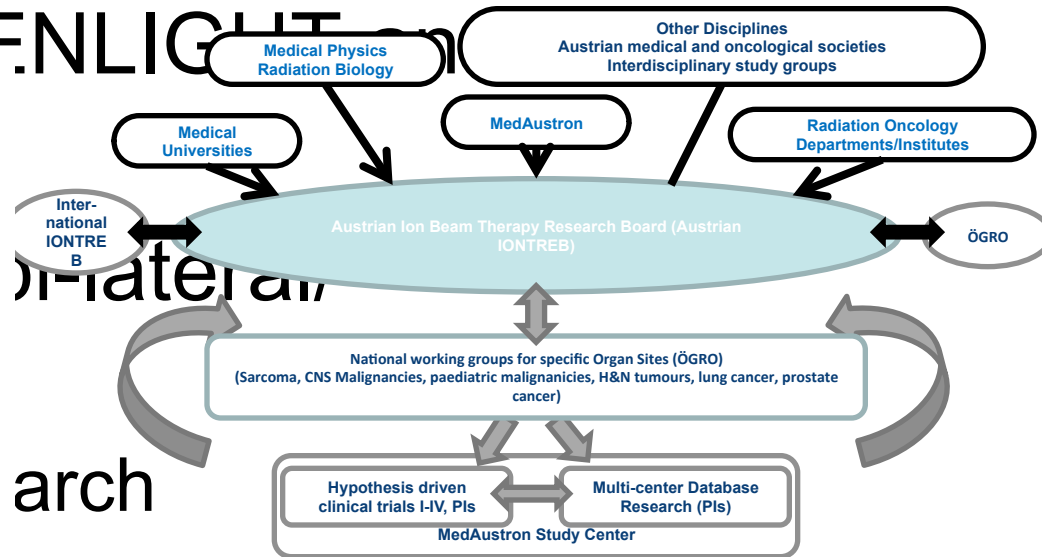


Abbildung 2: Organisationsstruktur für die Durchführung von nichtklinischen und nichtmedizinischen Forschungsvorhaben bei MedAustron unter Verwendung der Bundesressourcen.



Particle Therapy Centers.....

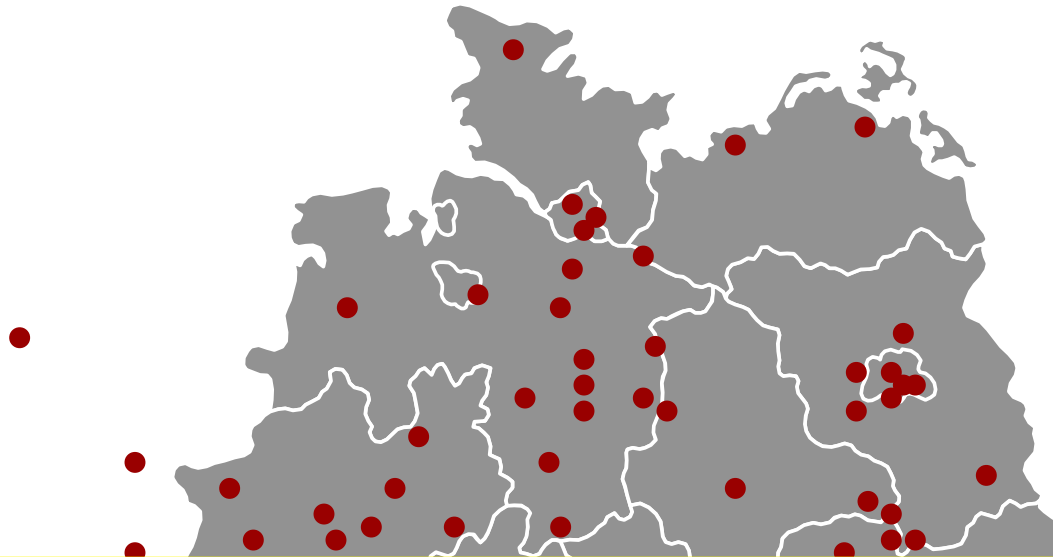
- Marburg – not yet in operation for clinical treatment, to be run by HIT Heidelberg
- Orsay continuously treating patients
- PSI in Villigen, CH, treating patients with protons and implementing novel gantry technology
- Sweden/Uppsala under construction
- Several others in planning etc.



ENLIGHT: An effective network for hadron-therapy

Manjit Dosanjh – CERN and ENLIGHT

Patient Referral for Carbon Ion Radiotherapy



450 Patients at GSI
Patients at HIT
since 11/2009

Requirement:

Strong interaction with referring centers,
cooperation, common projects (PARTNER,
ULICE, ENLIGHT etc.)

ESTRO Hadron Therapy Group: 2000/2001

- In 2000 PIMMS study was presented in Vienna. After this the ESTRO HT group was proposed for creating a joint platform covering the different aspects of heavy ion therapy for the different projects in Europe which should lead to a closer European cooperation.....
- ESTRO HT Group met on the occasion of Med AUSTRON international advisory board meeting in 2001.

*Jean-Pierre Gerard (President of ESTRO),
Germaine Heeren (ESTRO), Richard Poetter (MUW)
key in catalysing*

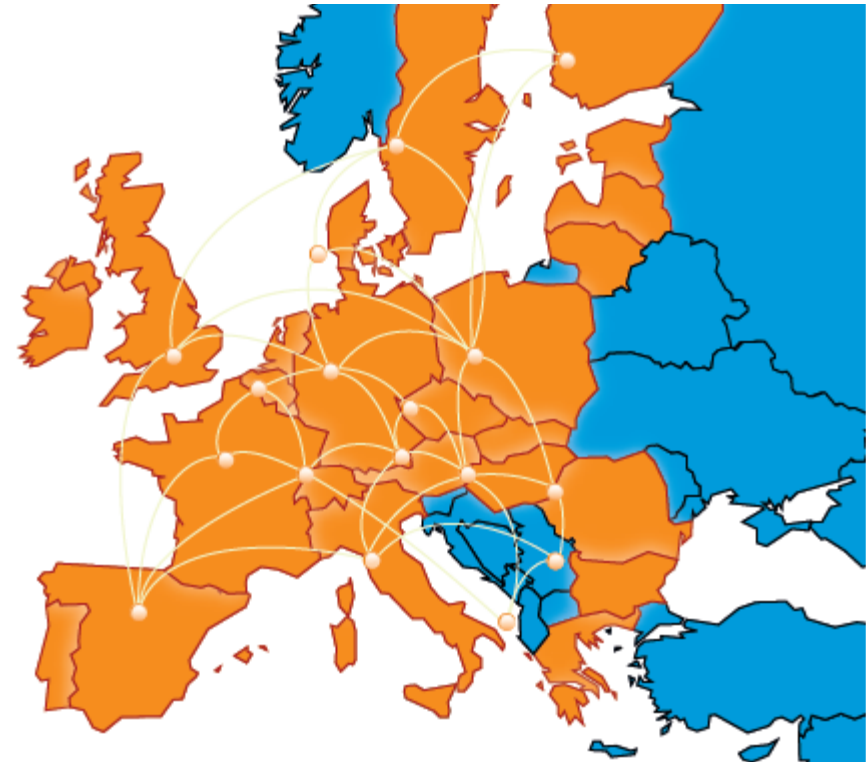


The ENLIGHT Network

The **ENLIGHT** Network:

Was established in 2002 to coordinate European research in hadron therapy;

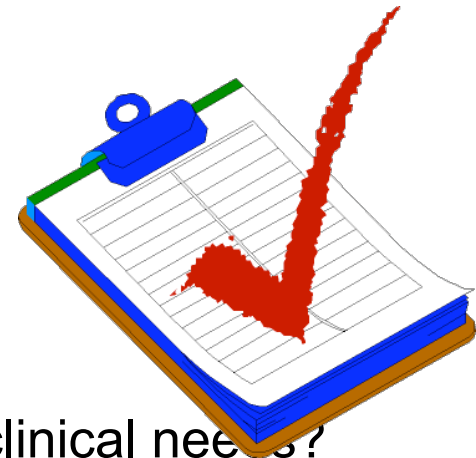
It was funded by the European Commission between 2002 - 2005



Challenges for the network

Multidisciplinary and cutting-edge technologies:

- Clinical /Epidemiology Studies
- Radiobiology
- Treatment planning for Particle Therapy
- Adaptive ion therapy and moving organs
- Novel imaging PET/other detector systems
- Study for compact gantry designs
- Cheaper, compact facilities
- Differing needs and interests of the groups
- A heterogeneous group
- How to balance between basic research and the clinical needs?
- Many partners. How to collaborate effectively and make progress with the key objectives?



Total funding of 24,6 M Euros



2008-2012

- Marie Curie Initial Training Network
- 12 institutions
- 29 trainees



2009-2013

- Infrastructure for hadron therapy
- 20 institutions



2010-2014

- R&D on medical imaging for hadron therapy
- 16 institutions

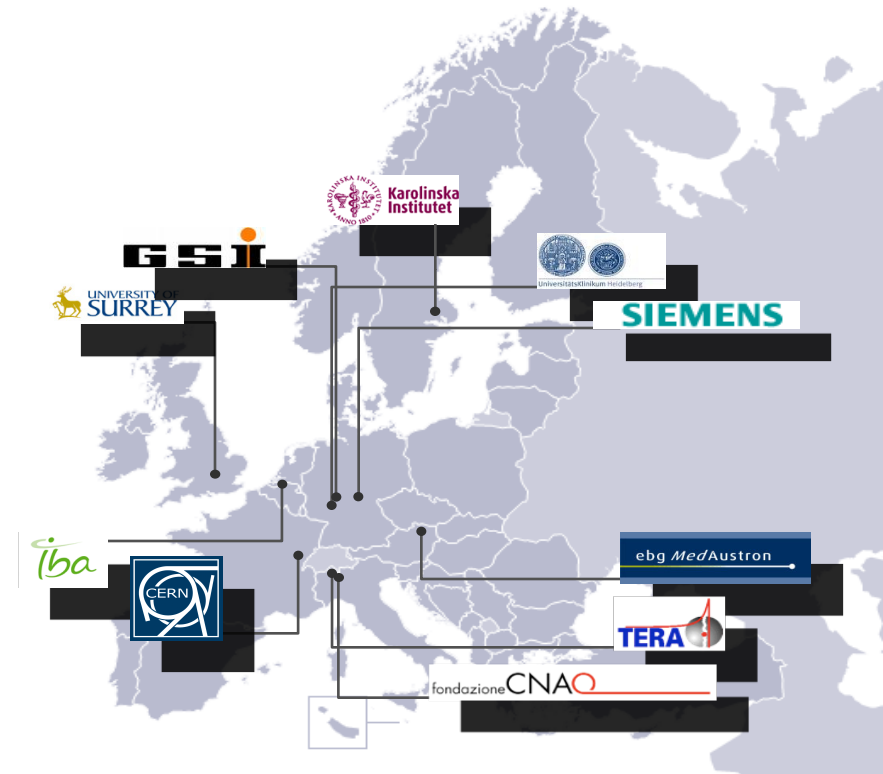


2011-2015

- Marie Curie ITN
- 12 institutions
- 16 trainees

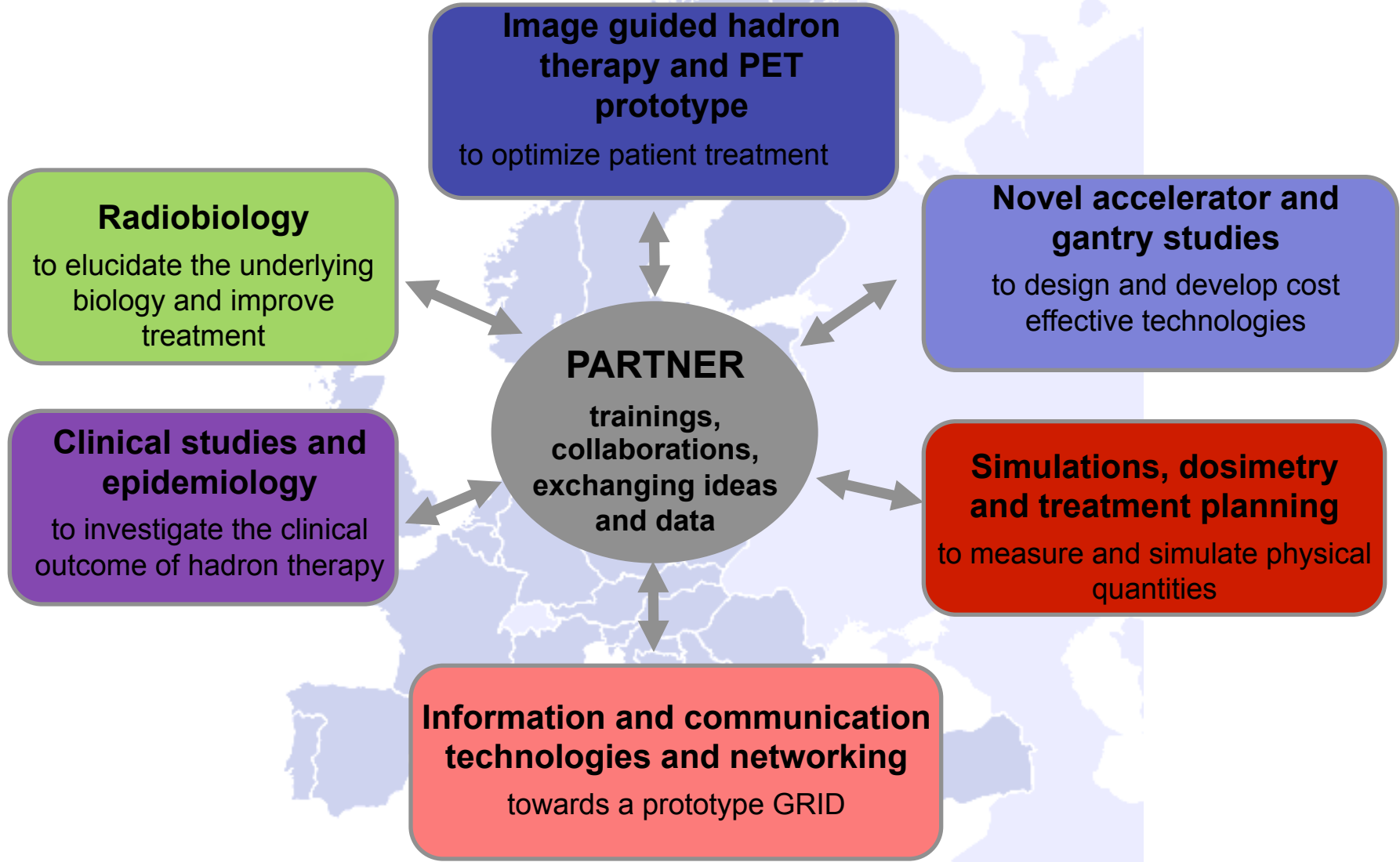
PARTNER – a success story

- Particle Training Network for European Hadrontherapy
- 10 academic institutes, research centres, 2 leading companies
- 29 young researchers

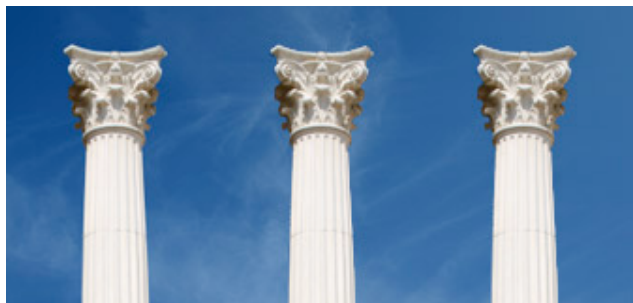


Outcome :

- Now working around the World
- Open access PARTNER-JRR



ULICE



- Transnational access to beam time at HIT and CNAO successfully implemented
- Joint research activities: New gantry design being finalized
- Networking

Training courses at HIT and CNAO etc etc

10 years of ENLIGHT Collaboration



- Common mu
- Identify cha
- Share know
- Share best
- Harmonise
- Provide tr
- Innovate
- Lobbying

Coordinat



CERN



- > 150 institutes
- > 400 people
- > 25 countries