



Farnesina

Ministero degli Affari Esteri
e della Cooperazione Internazionale



Istituto Nazionale di Fisica Nucleare



中华人民共和国科学技术部
Ministry of Science and Technology of the People's Republic of China

INFN for Medical Physics

some examples in advanced radiotherapy

Giuseppe Battistoni

Rome – 6 7 December 2018

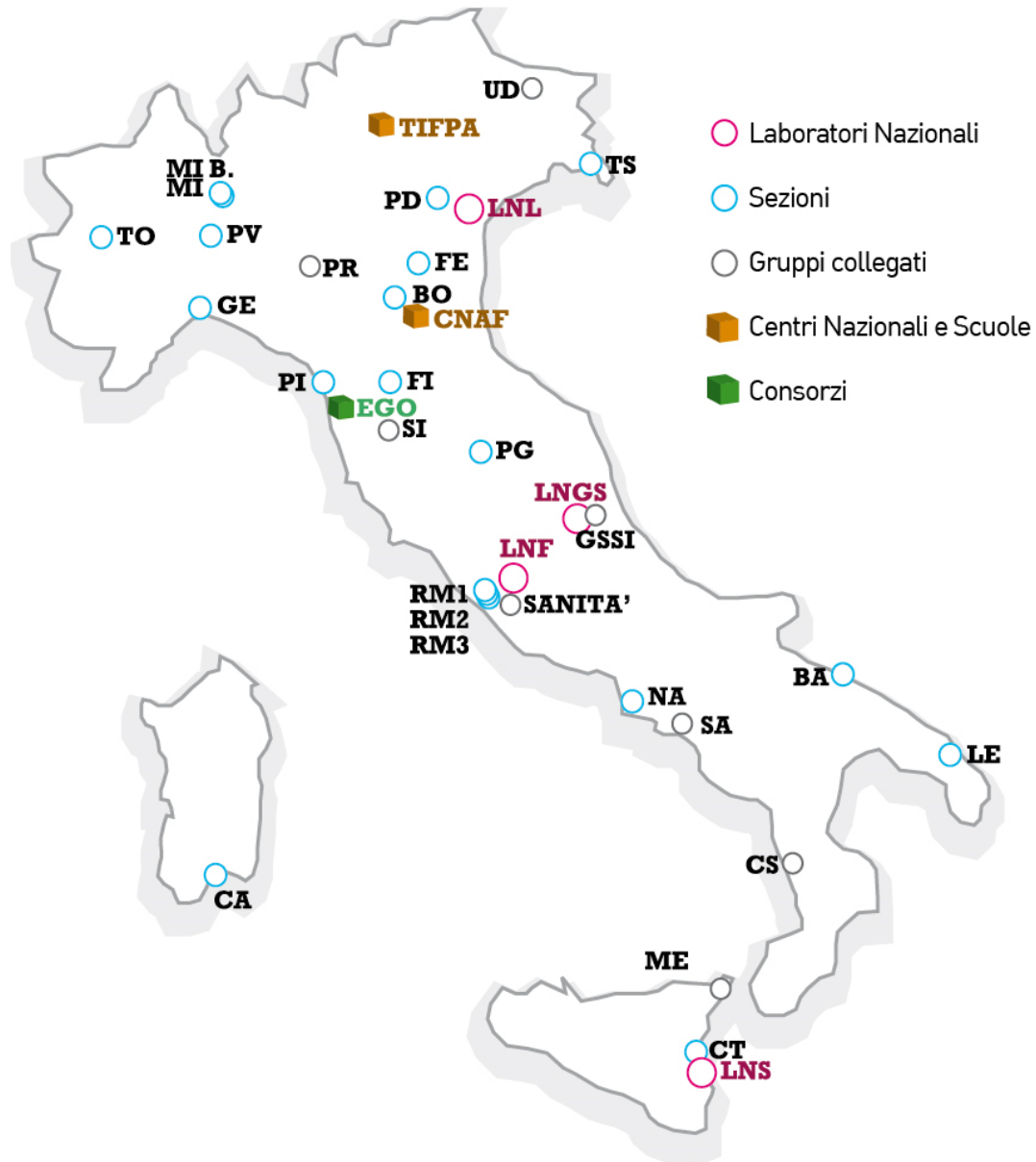
NEU_BEAT workshop

INFN headquarters

Istituto Nazionale di Fisica Nucleare



Istituto Nazionale di Fisica Nucleare



Founded in 1951, is responsible for coordinating and financing research in the fields of:

- subnuclear physics
- nuclear physics
- astroparticle physics
- their applications, including medicine.

Advanced Radiotherapy:

- Hadron Therapy
- BNCT: Boron Neutron Capture Therapy

INFN employs ~5,000 scientists

INFN R&D and Tech. Transfer for the applications in medicine

Research & Development: Managed by INFN Commission V (CSN5)

- activity run by INFN personnel alone or in partnership with other institutions: Universities, other Research Institutes (italian or foreign), Medical institutions.
- For all applied research the interest of End Users (in this case: medical community including medical physicists) is fundamental
- **Funding: from INFN budget and/or External Funding**

Only from Ministry of University and Research

From other Research Institutions, Regional Funds, etc.

Technology Transfer: Managed by INFN Comm. for Tech. Transfer

- Activity devoted to the transfer of already achieved R&D results.
- Management of Intellectual Property and relative agreements with partners (Universities, etc.)
- INFN budget for a few KT grants

External funding and Final User involvement become of course a strong requirement


Additional opportunities

- **INFN can participate as associate to Research Projects headed by Clinical Research Institutes** *(funded by Ministry of Health: not possible for INFN to access directly to this source)*
- **EU projects**
- **Funding from other Italian Ministries**

Also, as far as political and organizational matters are concerned:

Important relationships of INFN with “Istituto Superiore di Sanità” which is the Italian institution under the control of Ministry of Health for research and certification in medicine

R&D for Medical Physics: areas covered in INFN

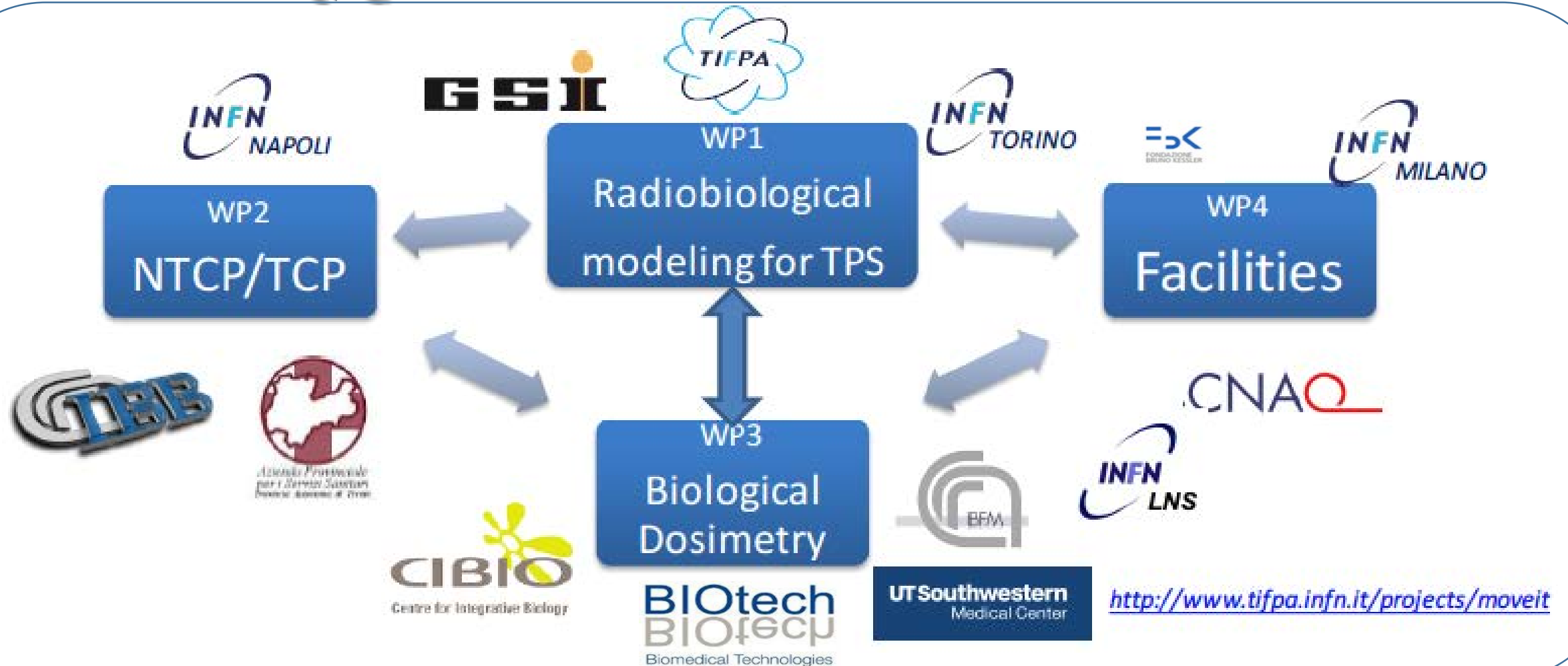
- Particle therapy
- Radiobiology  *Also in-vivo exp. radiobiology, in partnership with authorized institutions*
- BNCT
- Combined Radiotherapy/Magnetic Hyperthermia
- Dosimetry
- Breast CT
- Imaging
- PET/SPECT, NMR
- Radioisotopes
- Particle Accelerator technology for medical applications
- MC simulations for medical physics (GEANT4 + FLUKA)

 *Already in collab. with CERN. Example of activity covering at the same time “core” physics research and applied R&D, including medicine*

An example of INFN project with multiple relationships

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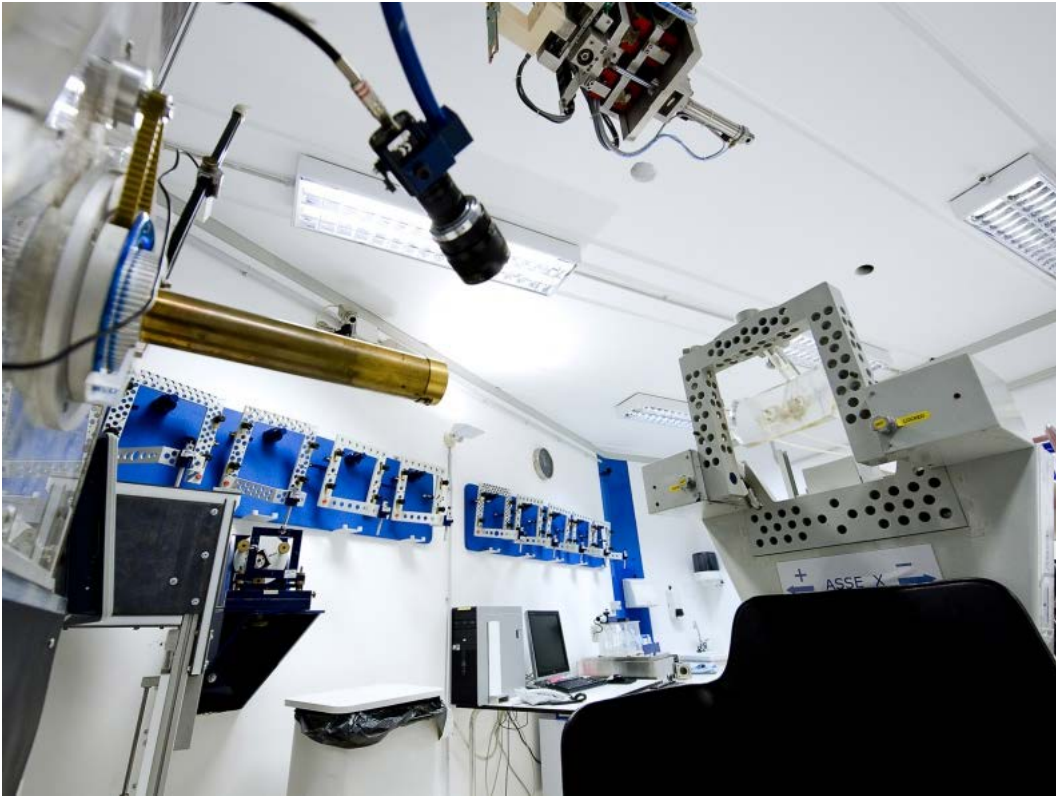
Modeling and Verification for Ion beam Treatment planning



Proton therapy at *Laboratori Nazionali del Sud*



CATANA Treatment room
Proton therapy of eye melanoma
since 2002



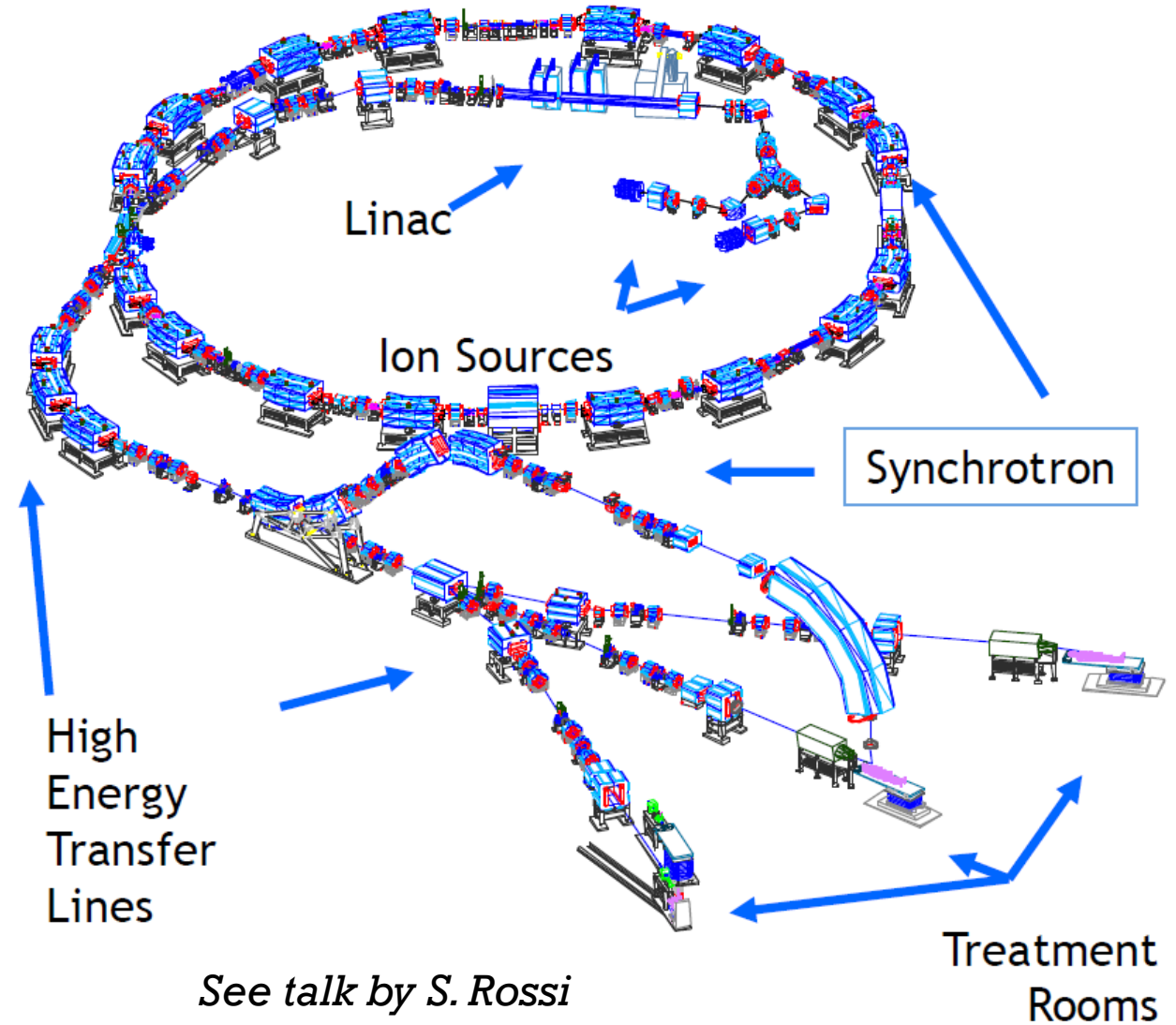
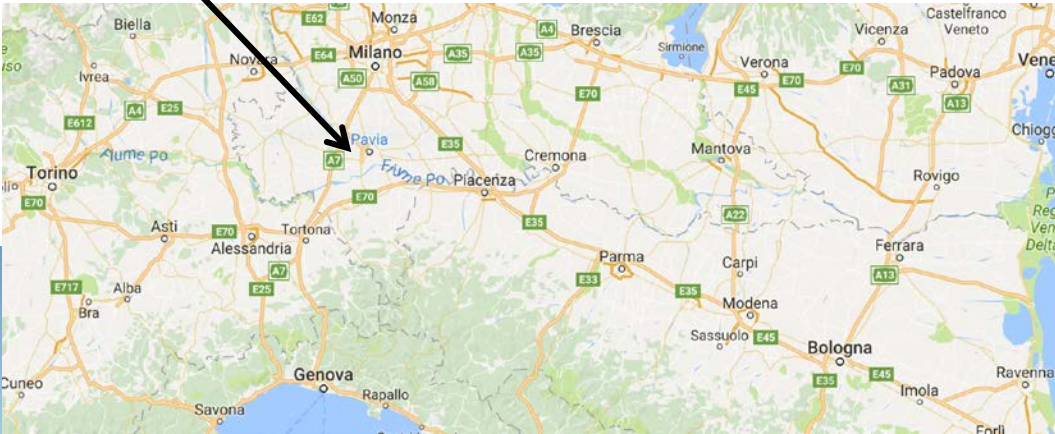
1° INFN particle therapy facility in coll. with
Clinica Oculistica Università di Catania
Istituto di Radiologia Università di Catania

Centro Nazionale di Adroterapia Oncologica

National Centre of Oncological Hadrontherapy

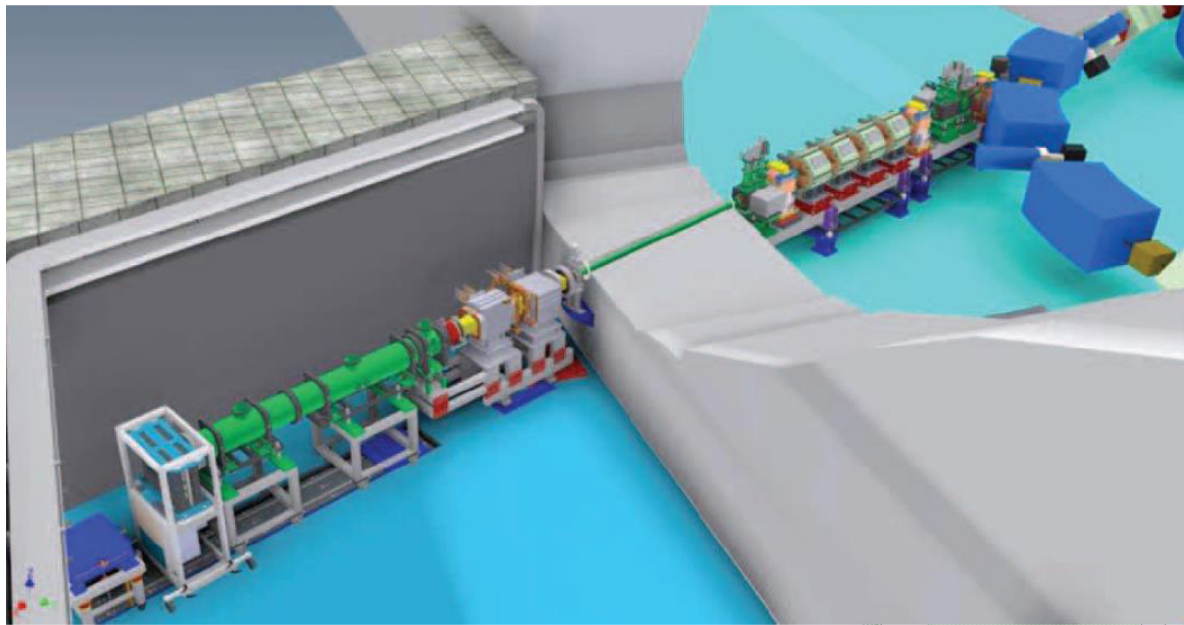
(Pavia)

fondazione **CNAO**
Centro Nazionale di Adroterapia Oncologica per il trattamento dei tumori

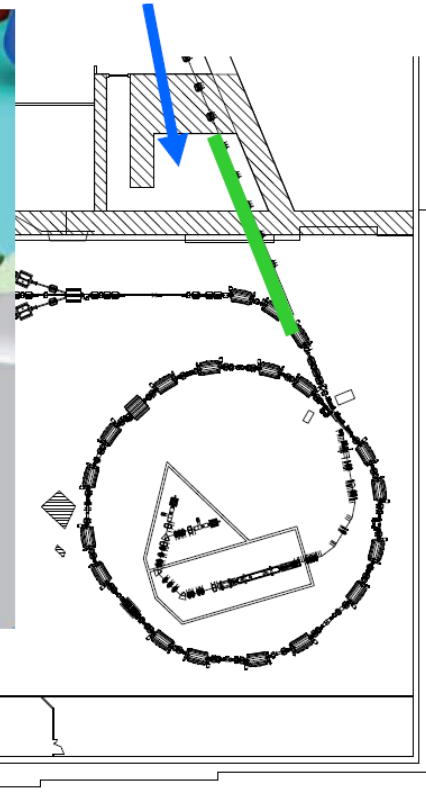




Additional beam line under construction for radiobiology research



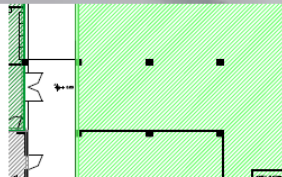
Experimental room



Phase II:

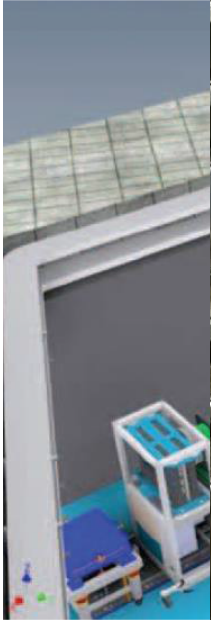
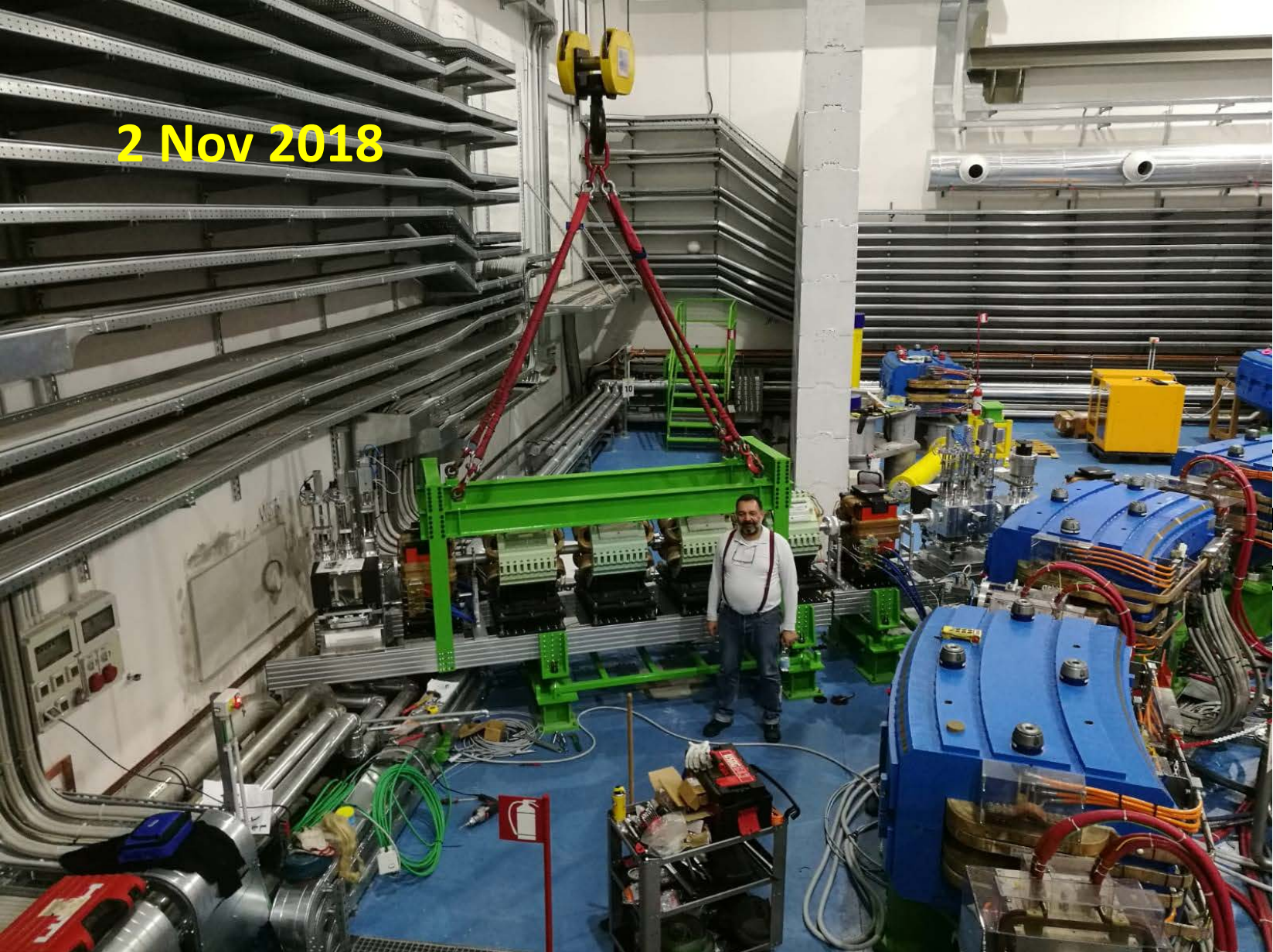
Addition of a 3rd source for the acceleration of other ion species: from He to Ar

Strong collaboration
with INFN



Additional beam line under construction for r

2 Nov 2018



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n of a 3rd source
acceleration of other
species: from He to Ar



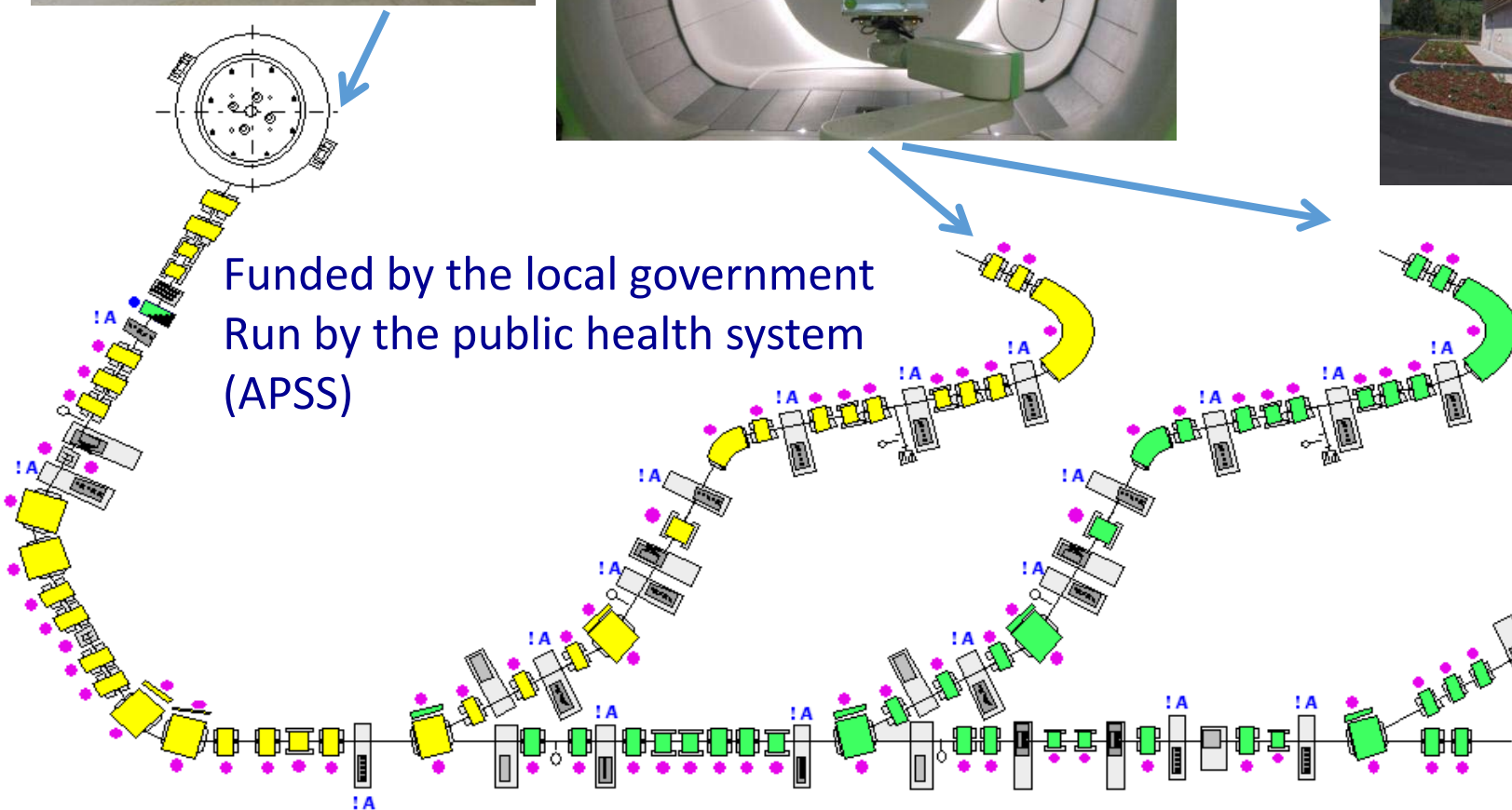
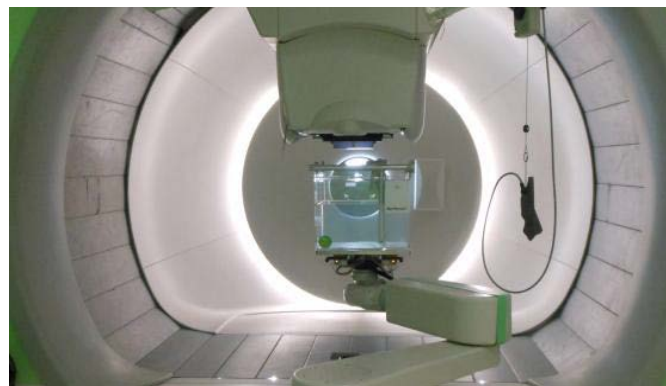
Trento Institute for
Fundamental Physics
and Applications

proton therapy in Trento



Commercial cyclotron

Two scanning-only 360° gantries



Funded by the local government
Run by the public health system
(APSS)

Activities in collaboration:
Detectors
Dosimetry
Radiobiology
Nuclear Physics for Particle Therapy
Computing for Particle Therapy
Innovative Treatment Planning

Experimental Research area



Advanced Ion Source for Hadrontherapy

Example of project
co-financed with
regional funds also
in partnership
with industries

INFN-Laboratori
Nazionali del Sud

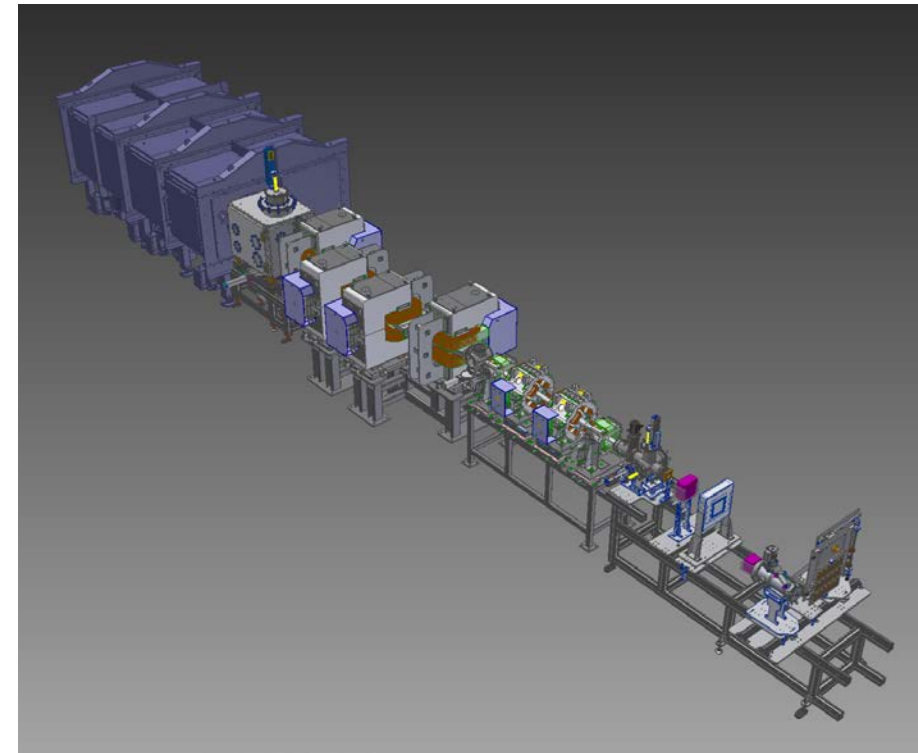


Experimental setup

ELIMED:

ELI-Beamlines MEDical and multidisciplinary applications

- Design and development of a transport beamline for the next generation of laser-driven beams
- Design and development of diagnostic and dosimetric devices to measure the absolute and relative dose and the characteristics of laser-driven beams
- The final beamline and experimental room installed at the ELI-Beamlines facility (Prague, CZ), **INAUGURATED TWO WEEKS AGO**





Comunicazione

📅 27 NOVEMBRE 2018

PROTONI ACCELERATI AL PLASMA: A PRAGA CON ELIMED SI TESTA IL FUTURO DELL'ADROTERAPIA



Mostre e installazioni

Eventi



Trattare i tumori con fasci di particelle (ioni e protoni) accelerati sfruttando laser di altissima potenza non convenzionali e la tecnologia al plasma. È questa la sfida scientifica e tecnologica che testerà l'infrastruttura ELIMAIA (ELI Multidisciplinary Applications of Laser-Ion Acceleration) inaugurata oggi, 27 novembre, a Praga insieme alla sua componente chiave: ELIMED (ELI-Beamlines Medical and multidisciplinary applications) la linea di fascio della prima sala per attività precliniche del nuovo centro di adroterapia in costruzione a Praga. ELIMED è stata realizzata dai Laboratori Nazionali del Sud (LNS) dell'Istituto Nazionale di Fisica Nucleare (INFN) nell'ambito del progetto europeo ELI (Extreme Light Infrastructure). Una



INFN in BNCT

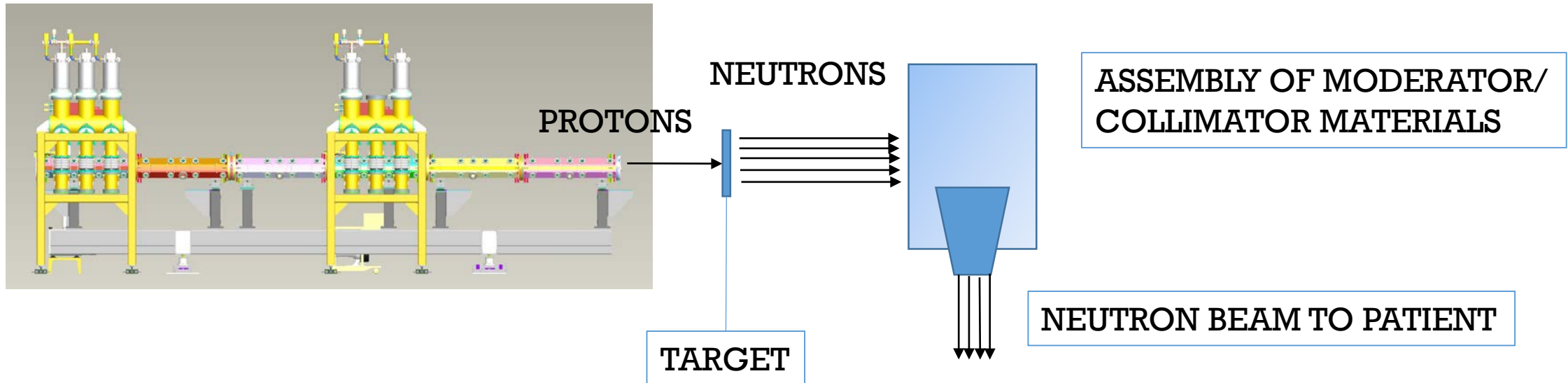
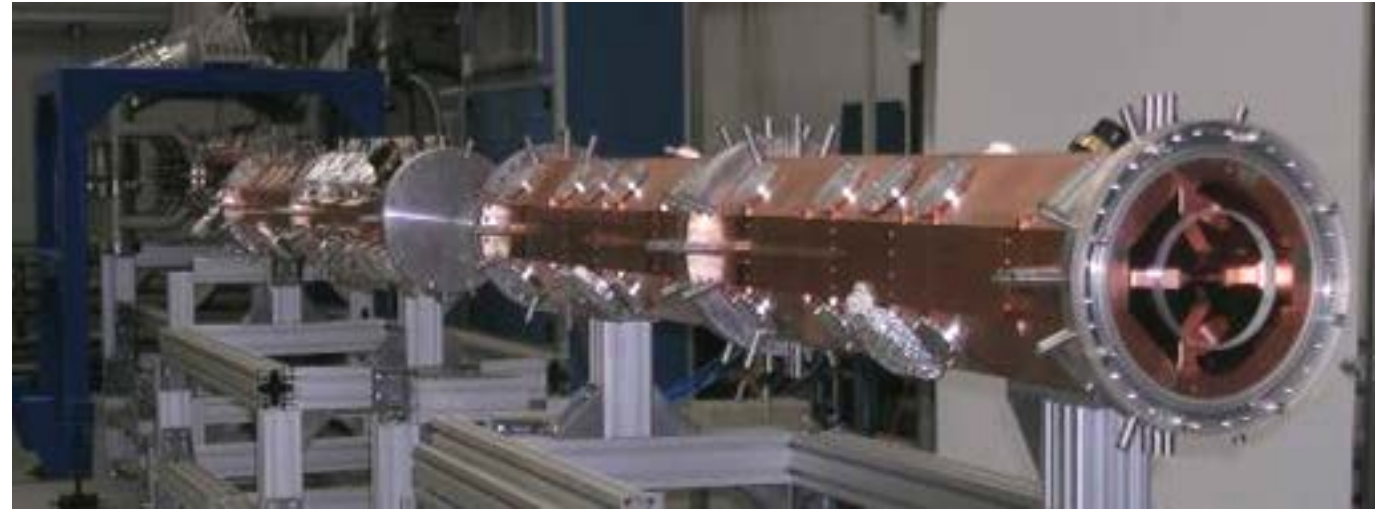
Another form of hadrontherapy

- CNS5 funds fundamental research and clinical application (explanted liver, TAOrMINA project) in the past years and currently (BEAT_PRO, 3CATS for example)
- Coordinates TT activities (external contracts, partnership with companies and industrialization/patenting processes)
- Built RFQ and target for the development of a clinical neutron source based on high intensity proton beam.

Neutrons from Proton Accelerators



RFQ technology developed in Legnaro National Labs allows irradiation times between 0.5 and 1 hour. One, max 2 irradiation sessions per patient



Summary and Conclusions

- INFN has a significant activity devoted to medical applications. Already existing in its history since many years.
- The interdisciplinary aspects of medical applications requires mandatorily the establishment of relationships with the medical community and with Universities and other Research Institutions
- R&D and Technology Transfer activities are strongly correlated in this field
- INFN international partnership are in its DNA. Enlarging and strengthening collaborations also in medical physics is the future.