



CNAO ion cancer therapy centre

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Perspectives for cancer tumour research and therapy with ions
Greece, April 6th, 2022

CNAO
Centro Nazionale di Adroterapia Oncologica

CNAO = National Centre for Oncological Hadrontherapy

Not-for-profit private Foundation

Created by the Italian Ministry of Health in 2001

with the purpose to build and run a hadrontherapy Centre



Organization Accredited
by Joint Commission International



HITRIplus PARTNERS

Project start: April 2021- Duration: 4 years



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

WP6: Transnational Access

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.

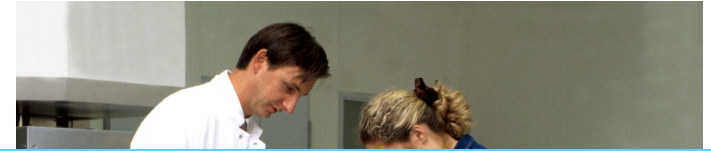


The **Research Access** will attract universities, research centres, and hospitals, which will connect all the groups to perform research activities with carbon ion beams. Industrial partners are also encouraged to take part in the research programme, to be involved in the development of new clinical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

**62 hours of Research
Access used !**



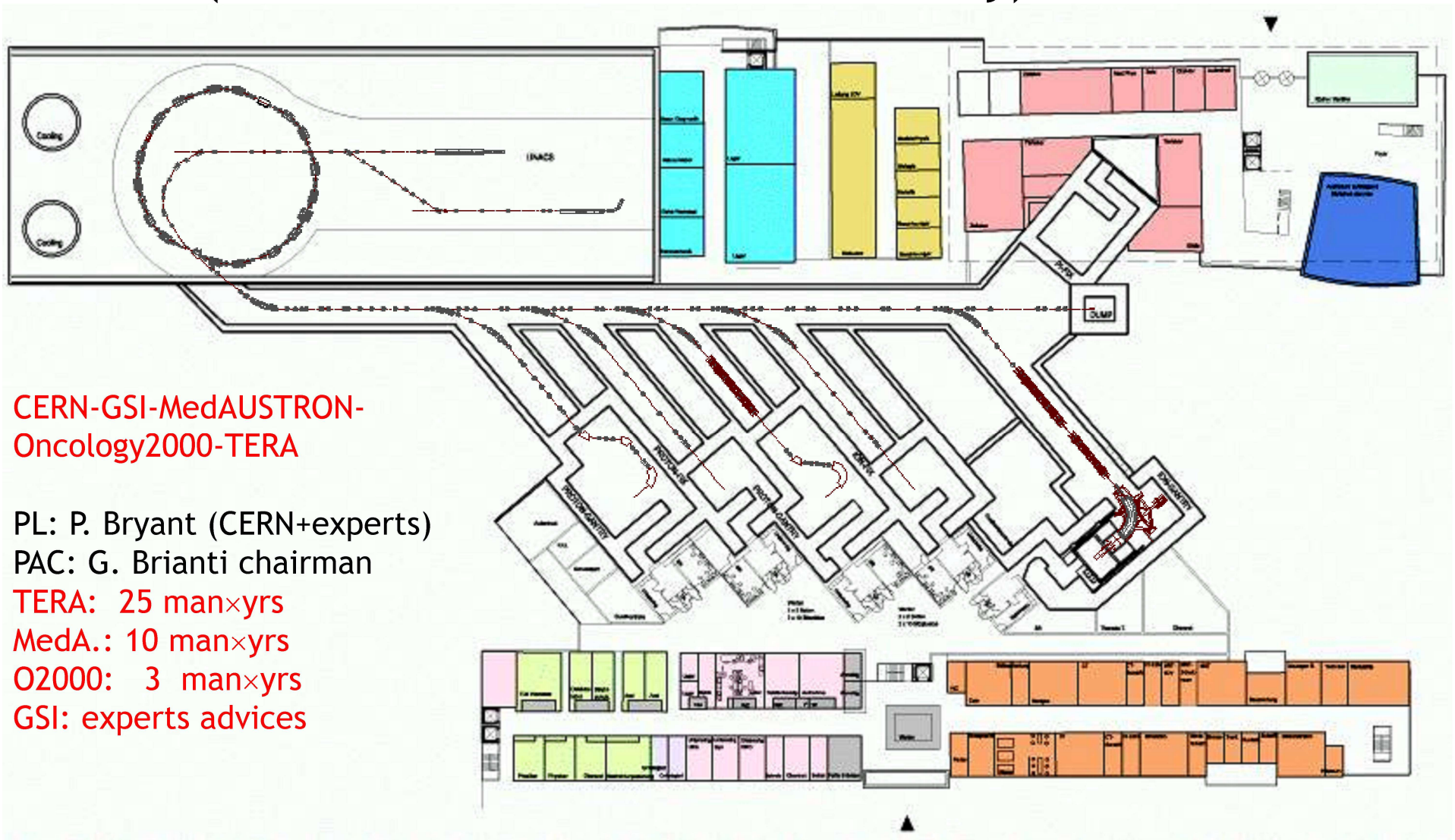
**Available and effective
Capacity Building
in SEE Countries
for Clinicians and Researchers**

www.hitriplus.eu

Big opportunity for SEEIST Members!!!

From 1996 to 1999 at CERN

PIMMS (Proton-Ions Medical Machine Study)



CERN-GSI-MedAUSTRON-
Oncology2000-TERA

PL: P. Bryant (CERN+experts)

PAC: G. Brianti chairman

TERA: 25 man×yrs

MedA.: 10 man×yrs

O2000: 3 man×yrs

GSI: experts advices

Objective: define the optimal hadrontherapy centre without constraints



Collaboration agreements: fundamental contracts for construction and presently for technology R&D

NATIONAL

TERA Foundation: final design and high tech specifications

INFN: technical issues, radiobiology, research, formation

University of Milan: medical coordination and formation

University of Pavia: technical issues, radiobiology, formation

Polytechnic of Milan: patient positioning, radioprotection, authorisations

INTERNATIONAL

CERN (Geneva): technical tasks, PIMMS

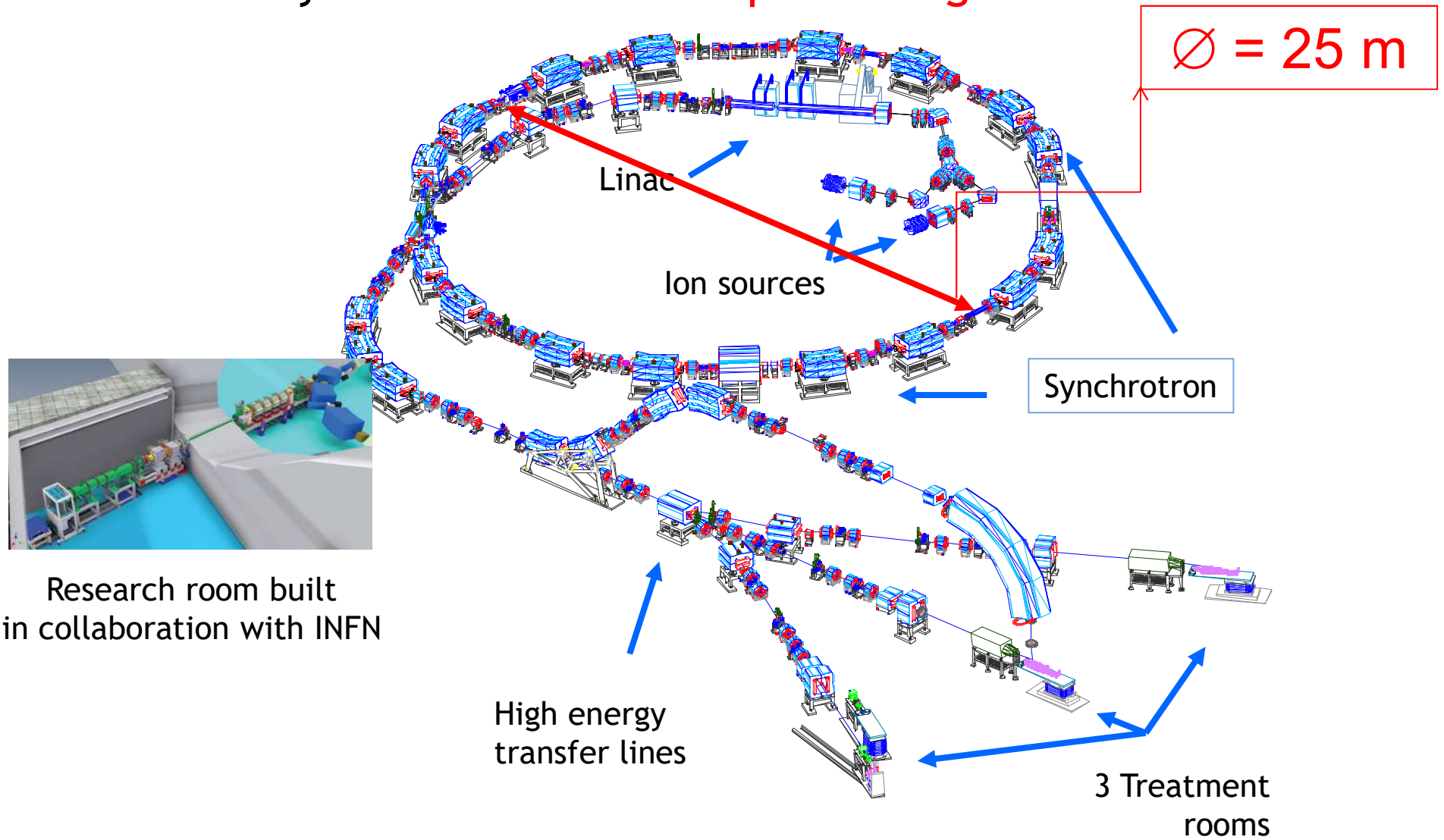
GSI (Darmstadt): linac and special components

LPSC (Grenoble): technical tasks

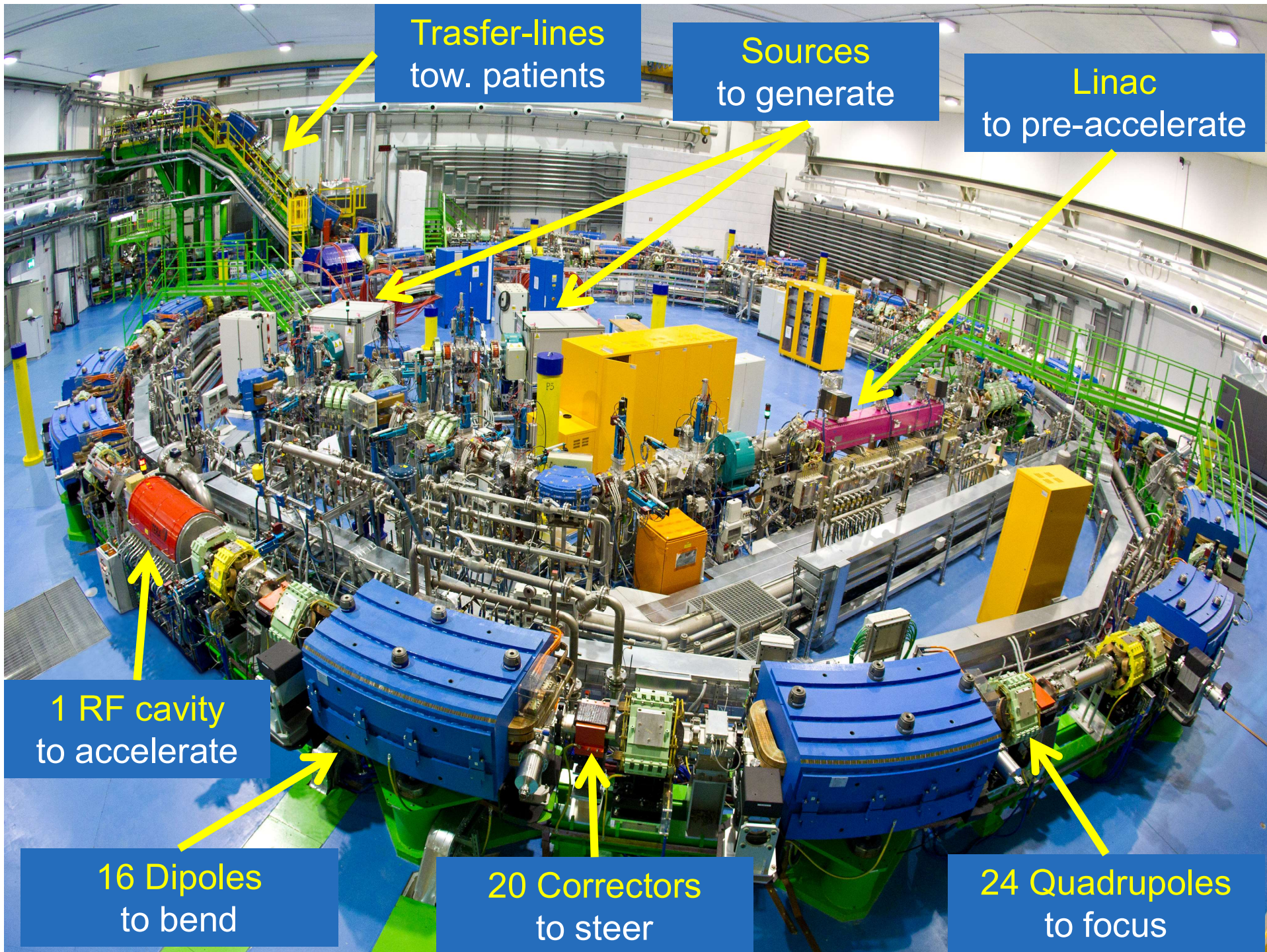
NIRS (Chiba): medical activities, radiobiology, formation

Accelerator for hadrons are circular

The CNAO synchrotron has a **compact design**



Intellectual property shared by CNAO - INFN - CERN



Trasfer-lines
tow. patients

Sources
to generate

Linac
to pre-accelerate

1 RF cavity
to accelerate

16 Dipoles
to bend

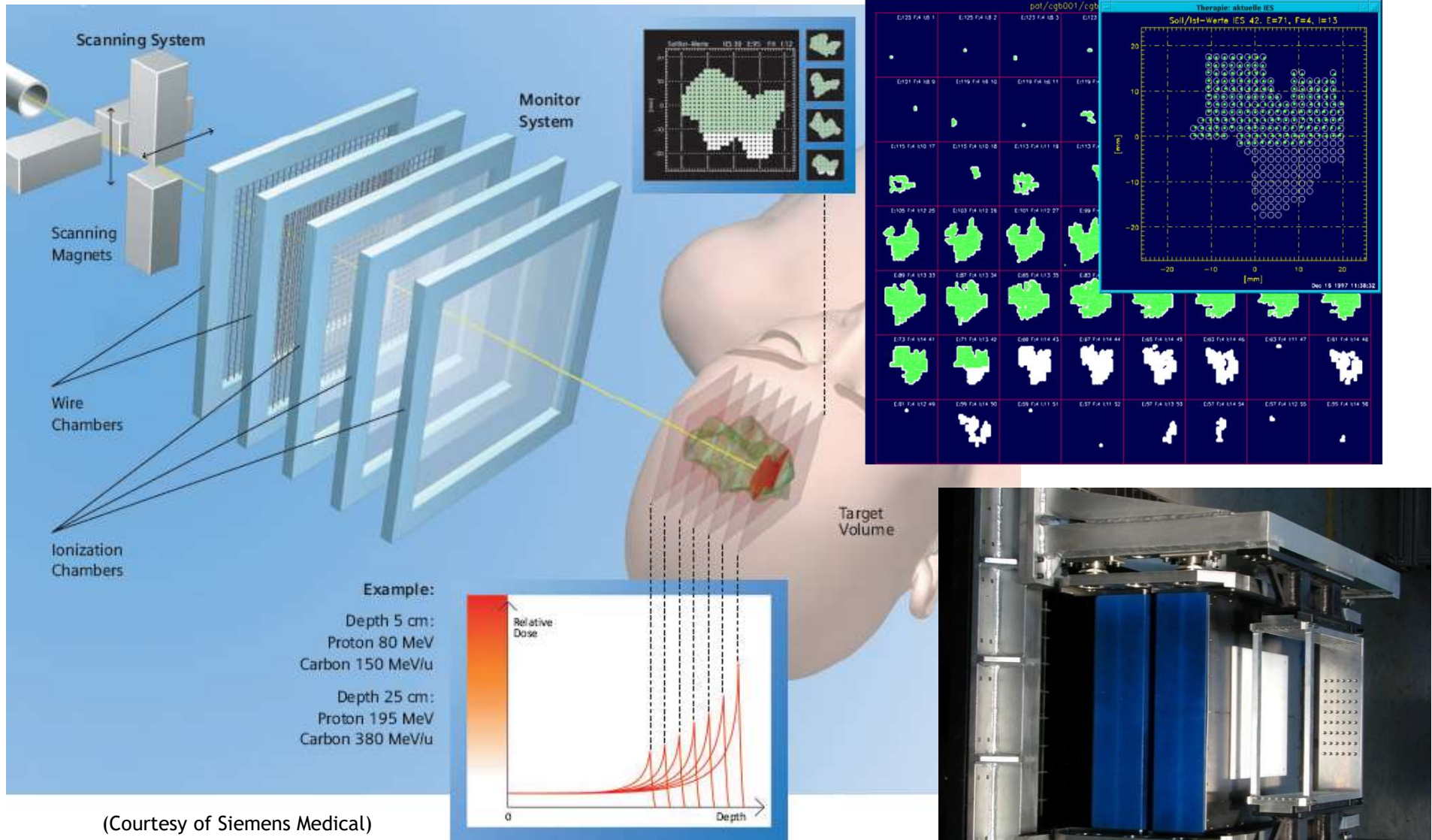
20 Correctors
to steer

24 Quadrupoles
to focus

Positioning and verification systems



Synchrotron is the best machine for hadrontherapy



CNAO is a Medical Device Producer

Synchrotron is the best machine for hadrontherapy

4 Magic words in Hospital Setting:

Safety

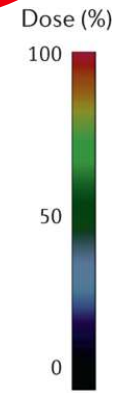
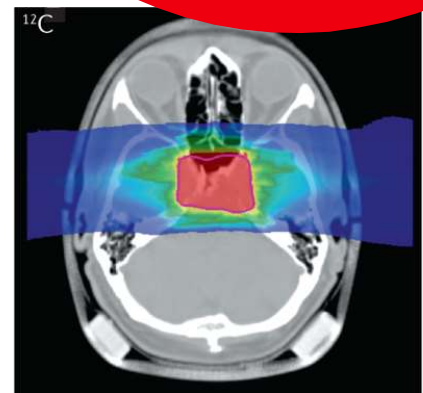
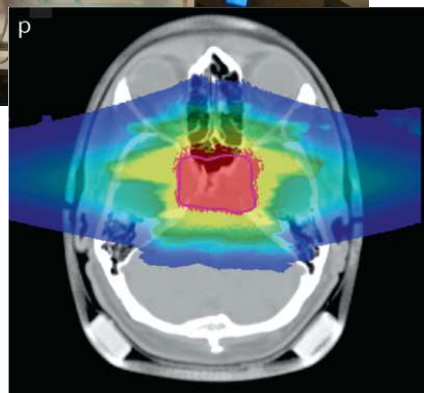
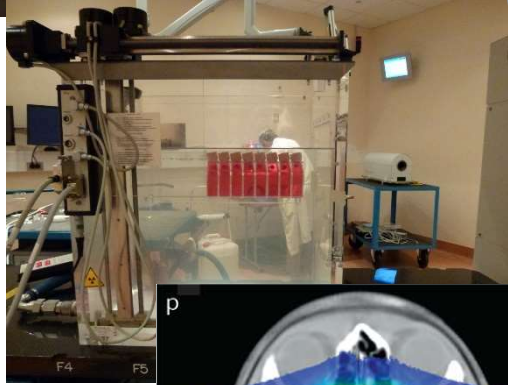
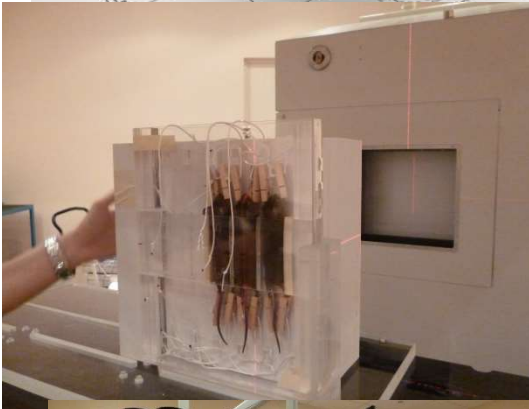
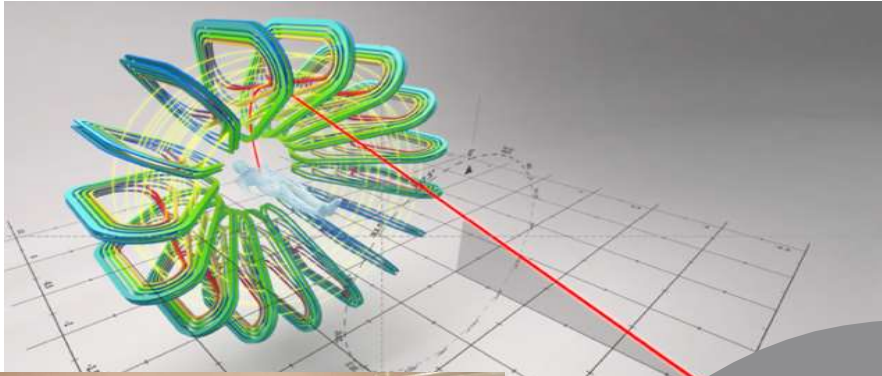
Efficiency

Maintainability

Reliability

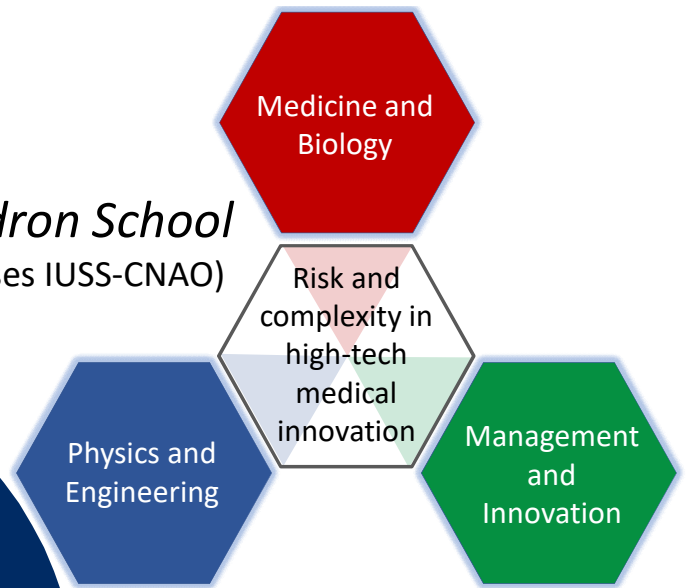
CNAO System Reliability 2021:

98% !!!

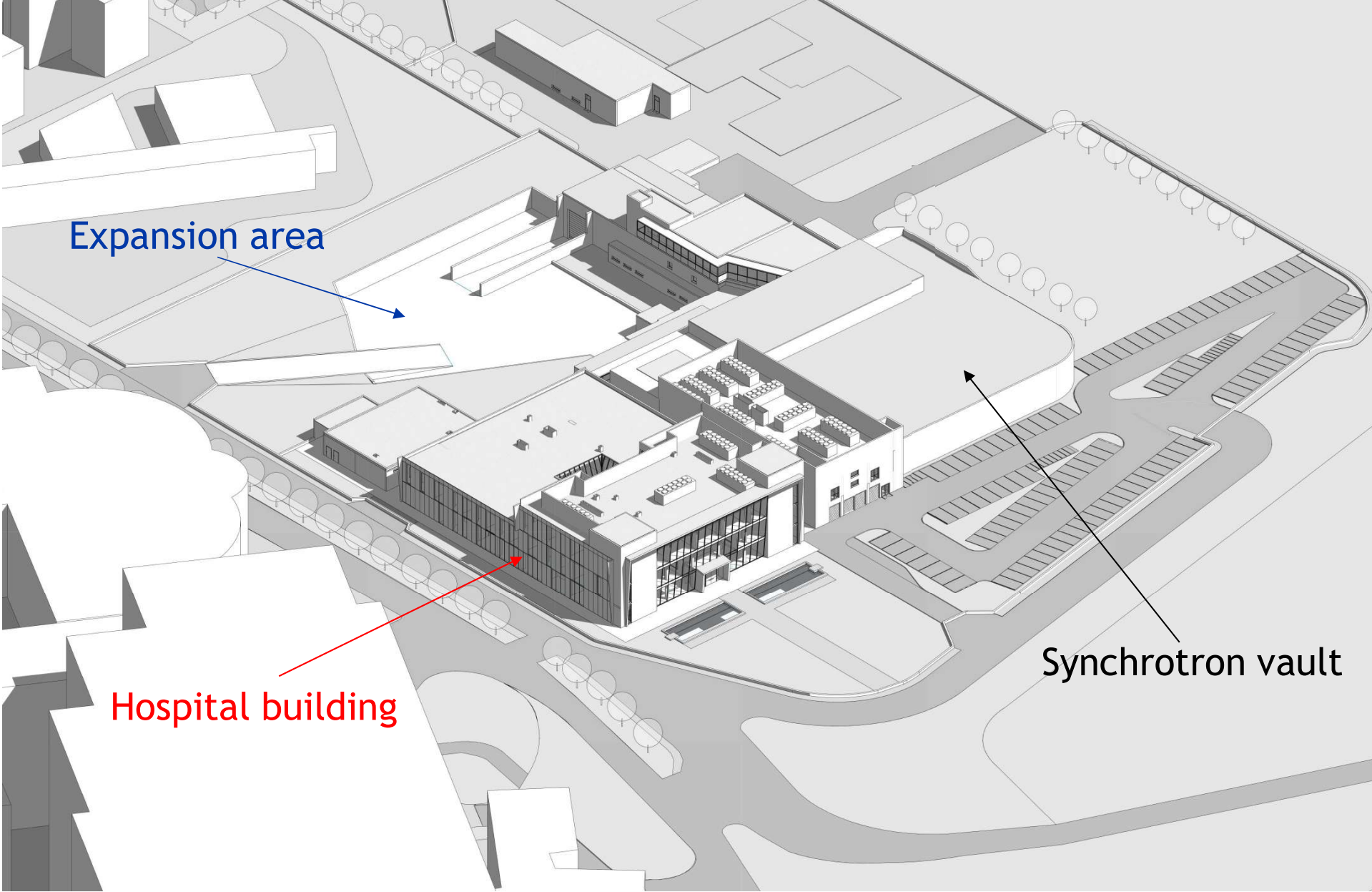


The Hadron School

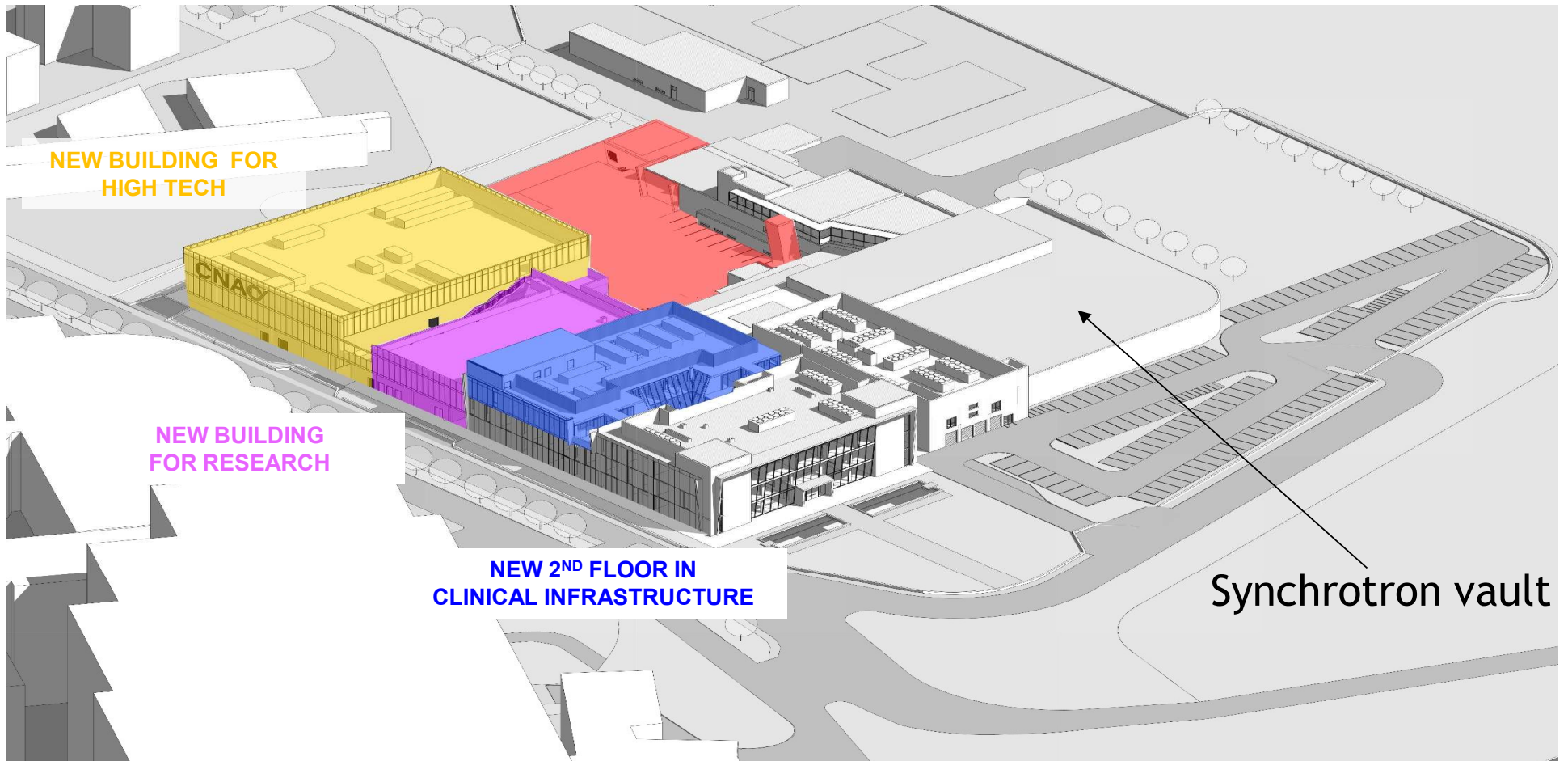
(PhD Courses IUSS-CNAO)



Present layout



CNAO 2.0



Layout end 2023

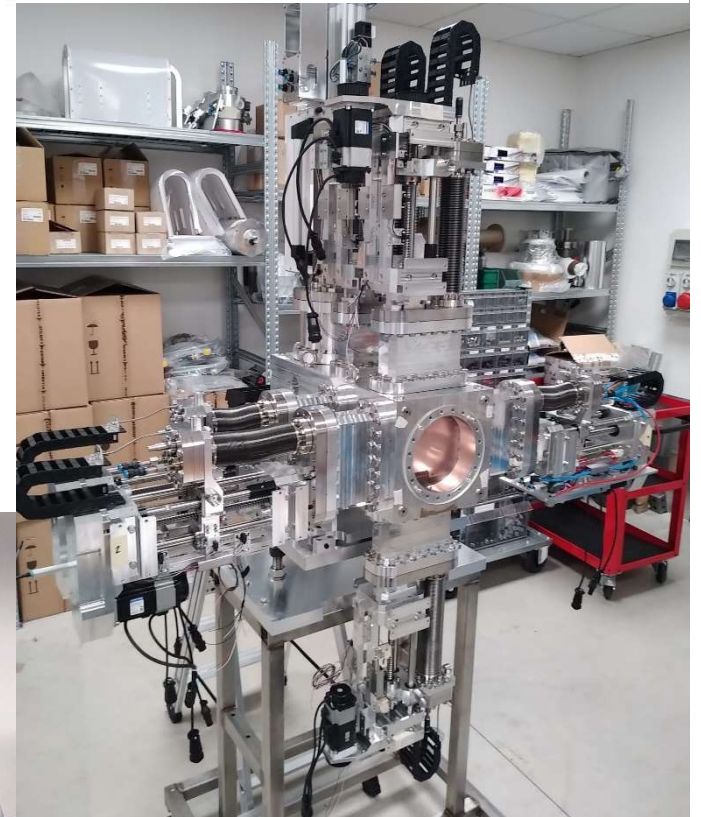
INSpIRIT: new Ion Species

Collaboration CNAO-INFN-HiFuture



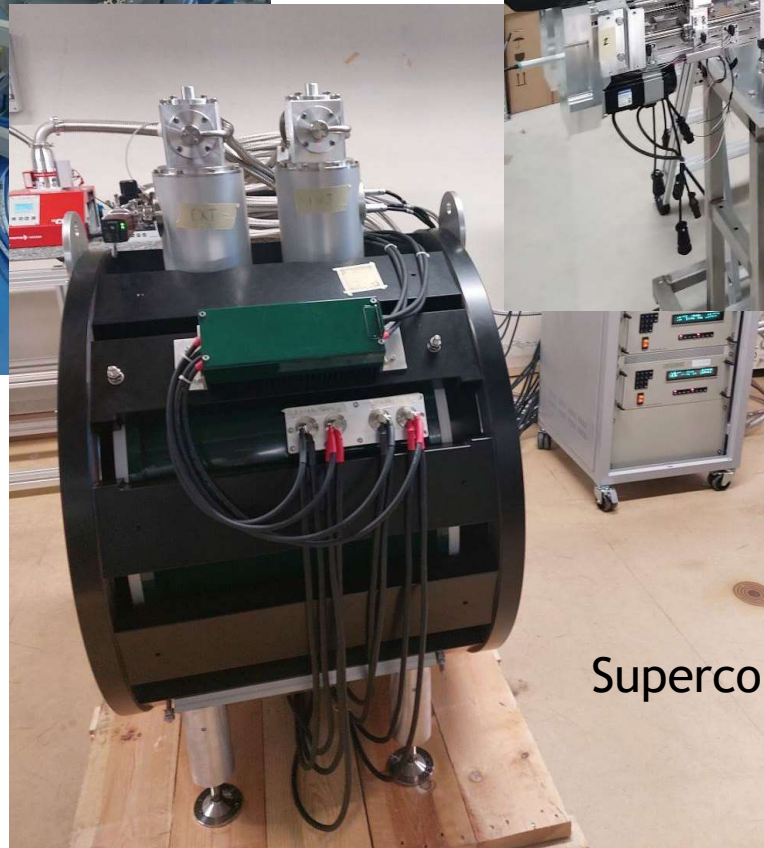
Mechanics in synchrotron room

Beam diagnostics

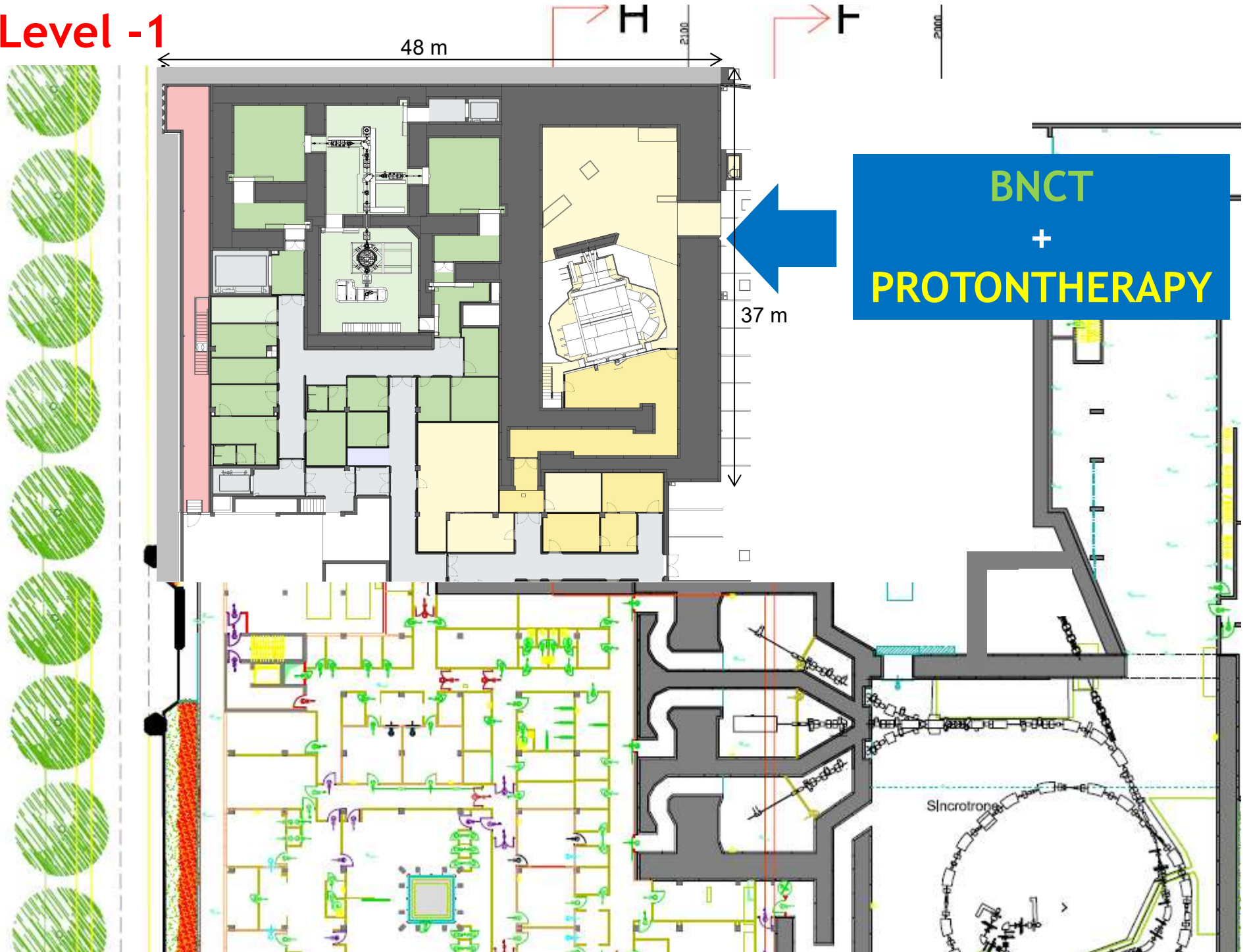


Superconducting magnet

Status: on-time
Deadline: end 2022



Level -1



HITACHI single room facility

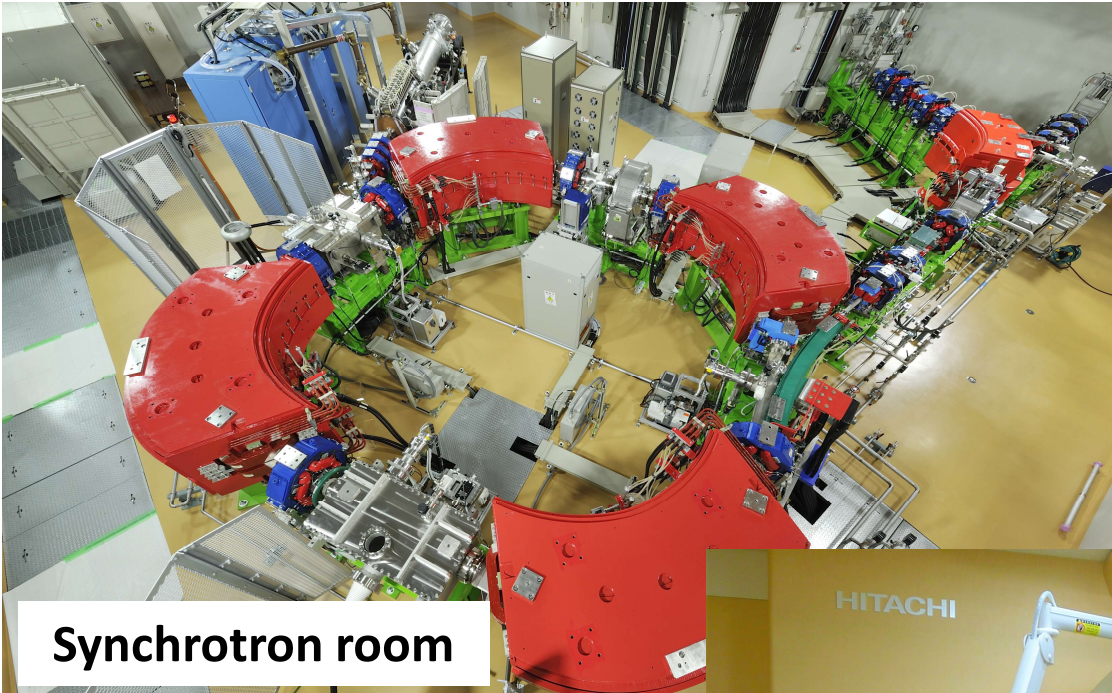
Main features:

- synchrotron, 5.7 m diameter;
- 70-230 MeV energy range;
- active pencil beam scanning;
- organ motion management functionality;
- large irradiation field (30 x 40) cm²; for paediatric patients, to ease cranio-spinal irradiations reducing to a minimum the required field patching;
- 360 deg rotating gantry, 6 dof robotic couch;
- possibilities of treatments in anaesthesia.



Hitachi PT systems have been used by 32 centres worldwide to treat more than 80,000 cancer patients

New single-room for protons



Synchrotron room

Contract signed with Hitachi:
December 5th, 2019

Start installation end 2023



360° isocentric gantry



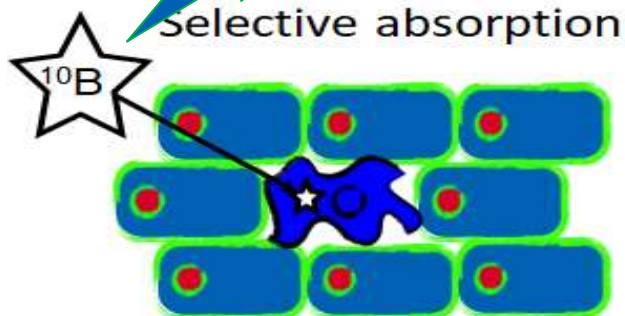
Treatment room

BNCT: Boron Neutron Capture Therapy

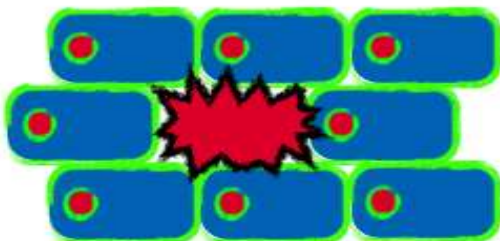
2-steps research approach for metastasized tumours

Boronated drug that selectively reaches the tumour cells and avoids the healthy tissues

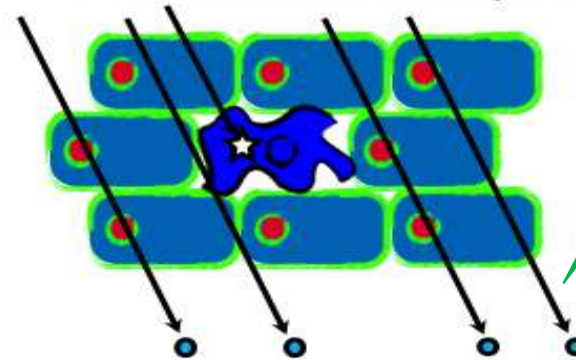
Accelerator driven neutron production



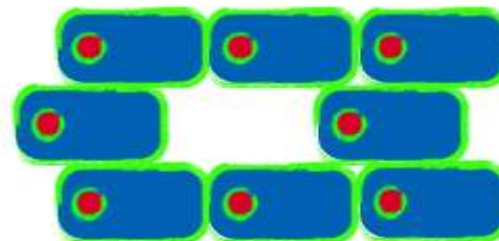
Local energy deposition



$^{10}\text{B}(n,\alpha)^7\text{Li}$
Boron neutron capture



Sparing healthy tissues



BNCT: proton tandem accelerator

Collaboration agreement with TLS
signed November 2020

Start installation end 2023



Proton energy 2.5 MeV
Intensity 10-15 mA
p-Li reaction

alpha α beam™

tae LIFE SCIENCES

CNAO is ready and willing to continue sharing and collaborating with **SEEIIST** and the **Greek clinical and research communities**

THANK YOU!

STAY TUNED

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