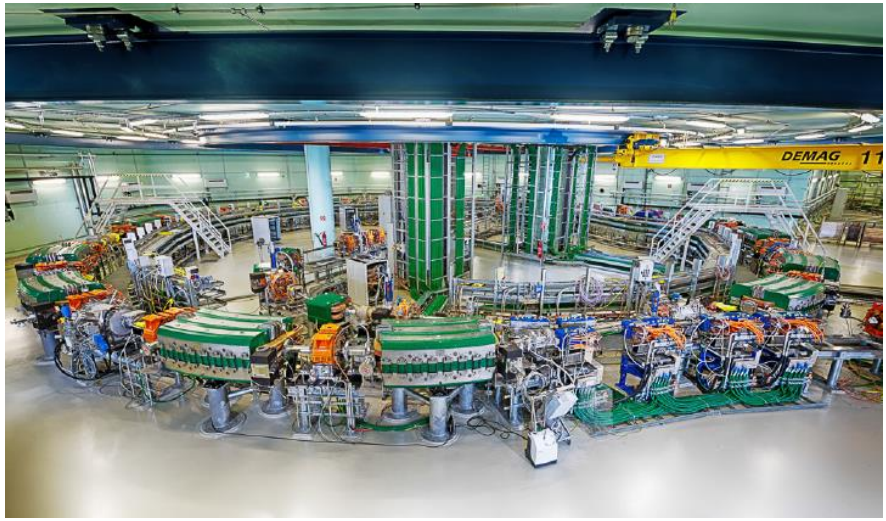
ADROTERAPIA A MEDAUSTRON

Antonio Carlino
Qualified Medical Physicist
EBG MedAustron GmbH, Wiener Neustadt, Austria

LNF Mini-Workshop: Stato e prospettive dell'Adroterapia in Europa, Frascati, Italia, 15-10-2014

Outline

- Introduction and milestones
- Building and construction
- Treatment beam lines and beam production
- Patient alignment system and Treatment Planning System (TPS)
- Patient workflow management
- Clinical Indications at MedAustron



Introduction

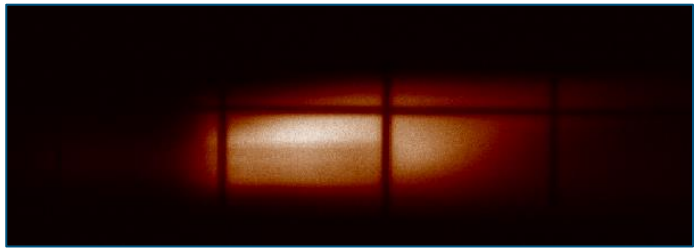
- EBG MedAustron GmbH, Wiener Neustadt (close to Vienna)
- Dual mode particle facility (protons and carbon ions)
- Synchrotron based, pencil beam scanning
- Investment of € 200 Mio.
- 160 employees in the full operational phase
- Co-operations:
  - CERN
  - CNAO, PSI, INFN
  - Austrian Universities and Hospitals

Medical staff	29
Technical staff	88
Administration	21
Total	**138**

Milestones

MedAustron

- Building: ground-breaking (February 2011), complete (October 2012)



- 1st turn in the synchrotron: April 2014

- Installation ring imaging system: September 2014
- The first extraction of a 65MeV proton beam: 14.10.2014

FUTURE MILESTONES:

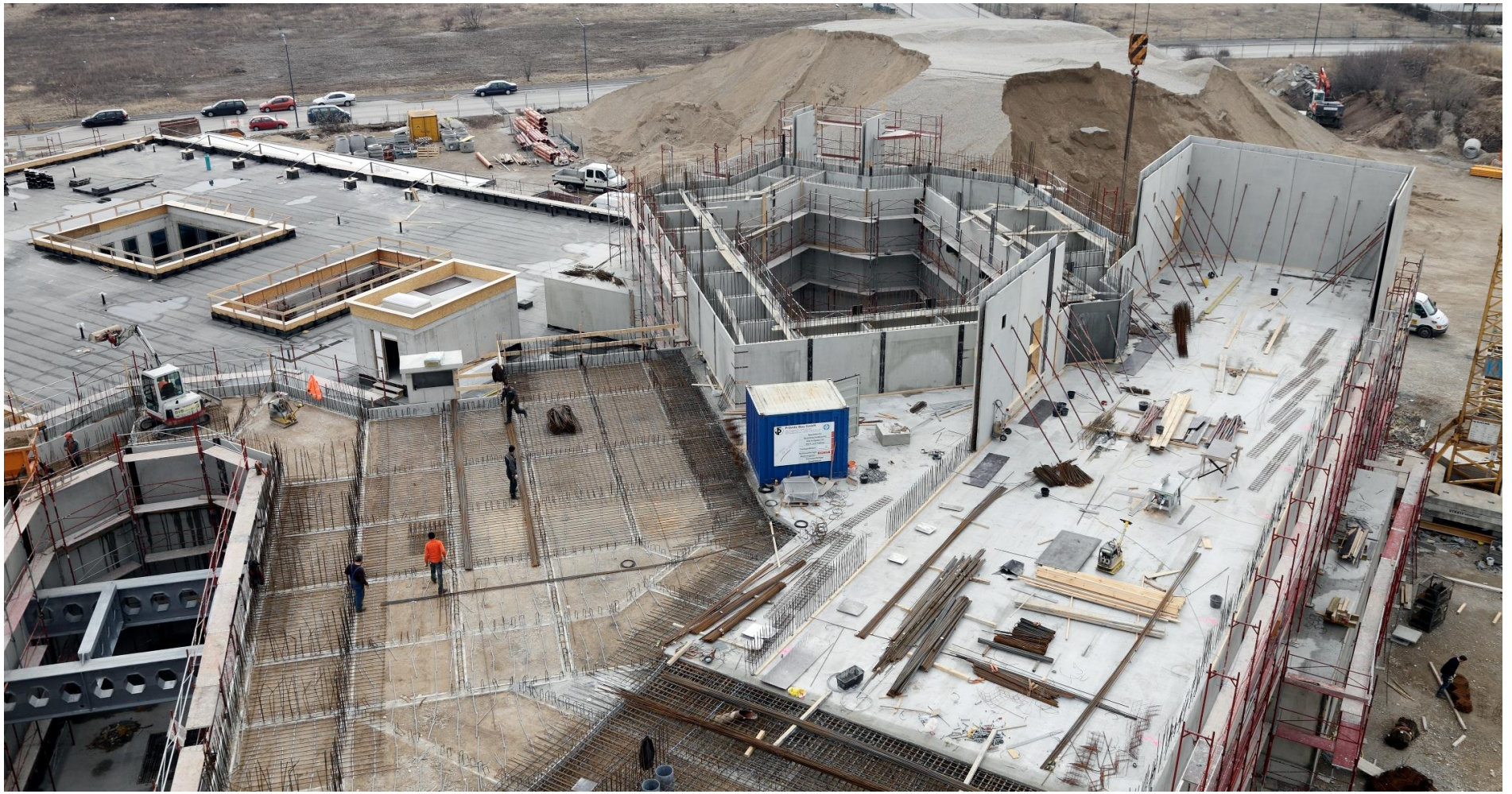
- First proton beam in HBL: November 2014
- Commissioning HBL for protons: 2015
- First patient protons: end of 2015
- First patient Carbon ions: end of 2016

Sandwich-Technology at MedAustron

- Excavation material used for radiation protection
- 25.000 m^3concrete saved
- 2.500 tons of steel saved
- 6 months construction time saved

Sandwich-Technology at MedAustron

Sandwich-Technology at MedAustron



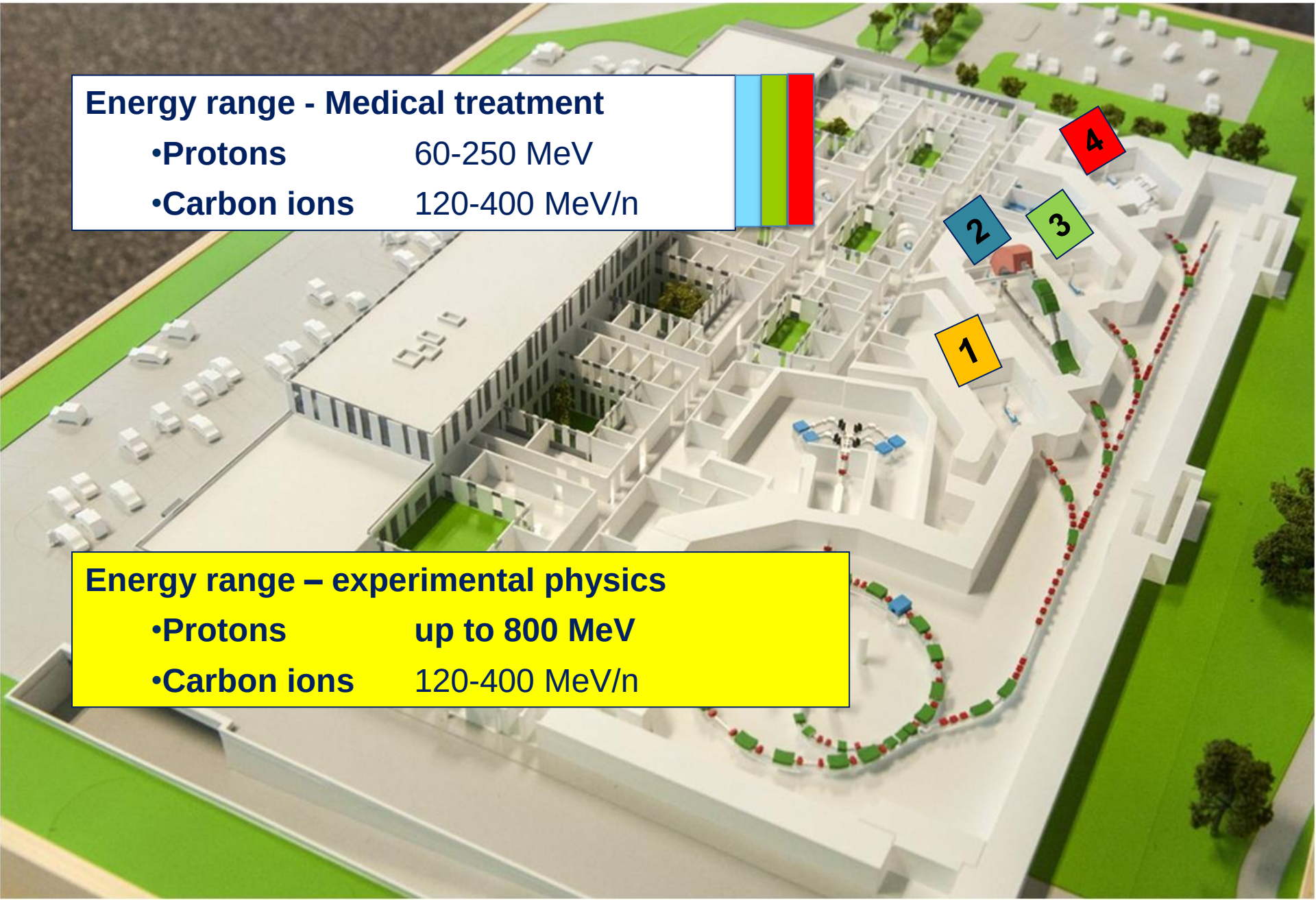
MedAustron treatment beams production:

Cooperation with CERN

MedAustron

Medical treatment/research:
- Proton-Gantry (IR 4)
- Horizontal beamline (IR 3)
- Horizontal and vertical beamline (IR 2)

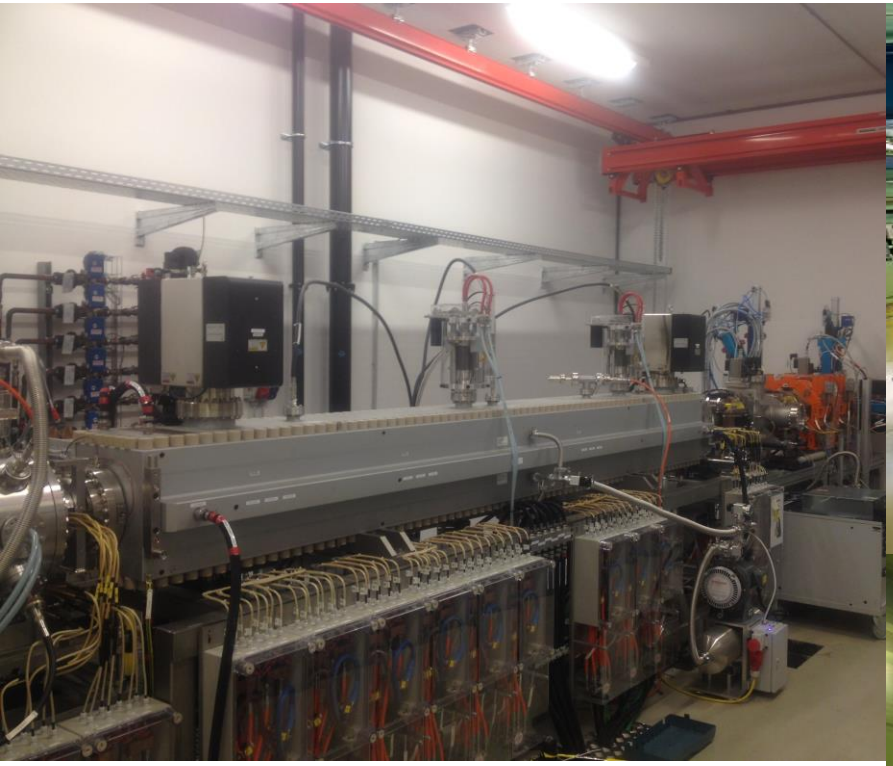
Non-clinical research:
- Horizontal beam line (IR 1)


Energy range - Medical treatment
•Protons 60-250 MeV
•Carbon ions 120-400 MeV/n
4
2
3
1
Energy range – experimental physics
•Protons up to 800 MeV
•Carbon ions 120-400 MeV/n

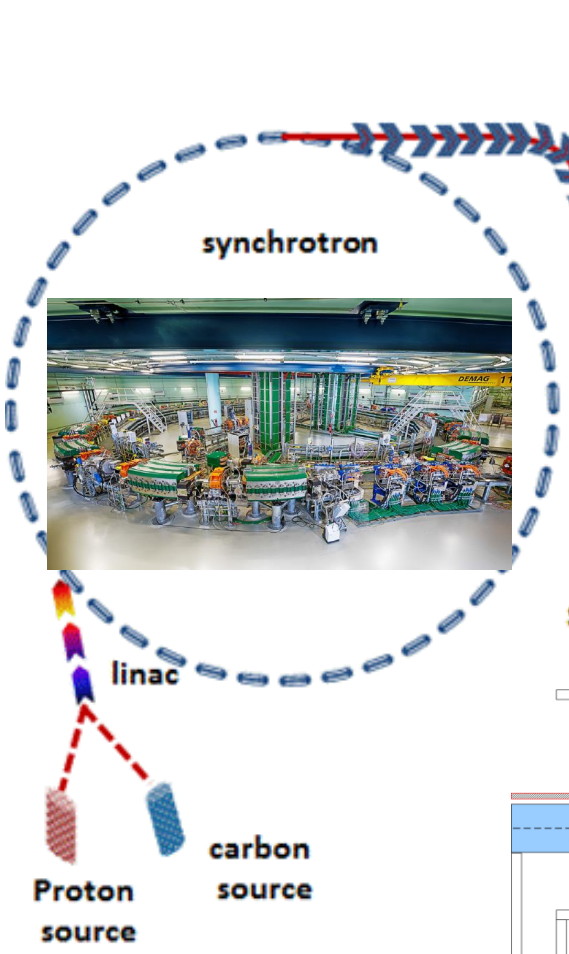
MedAustron treatment beams production:

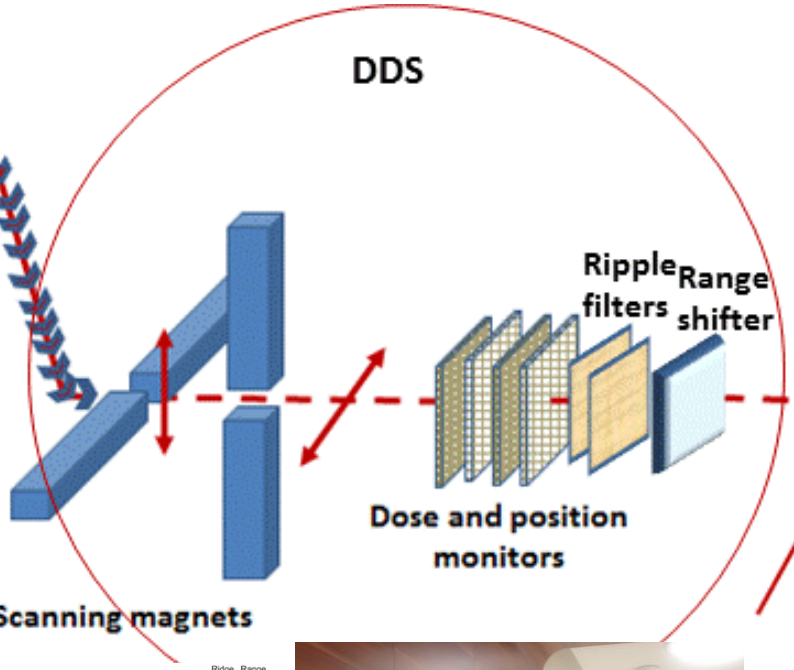
Cooperation with CERN

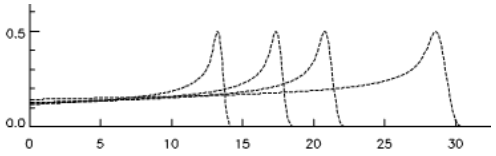
MedAustron

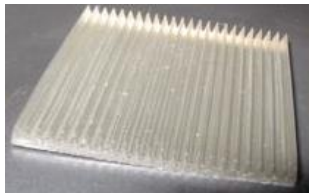


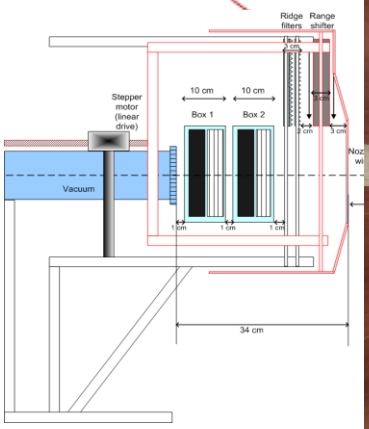
MedAustron treatment beams production: Cooperation with CNAO

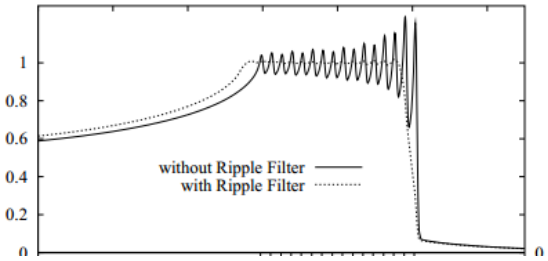




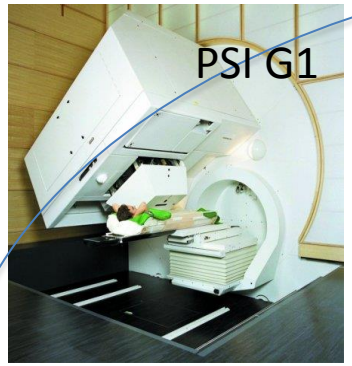


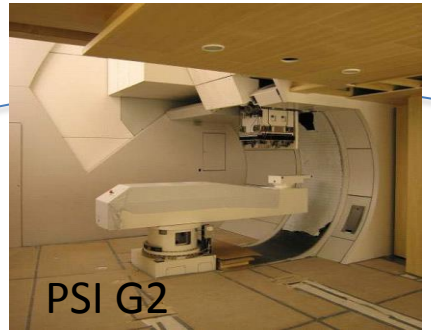


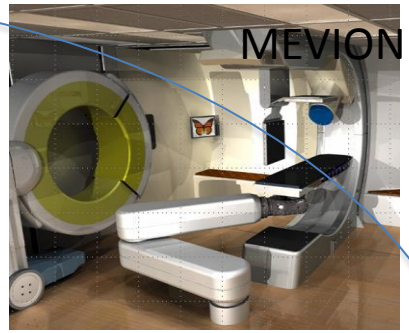




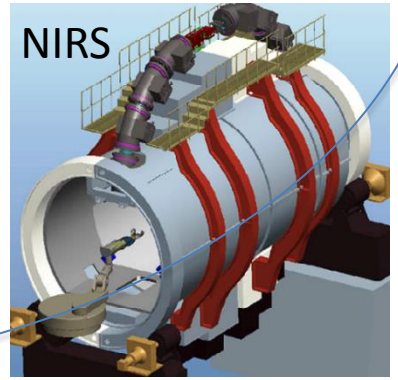
Evolution of ion beam gantry technology







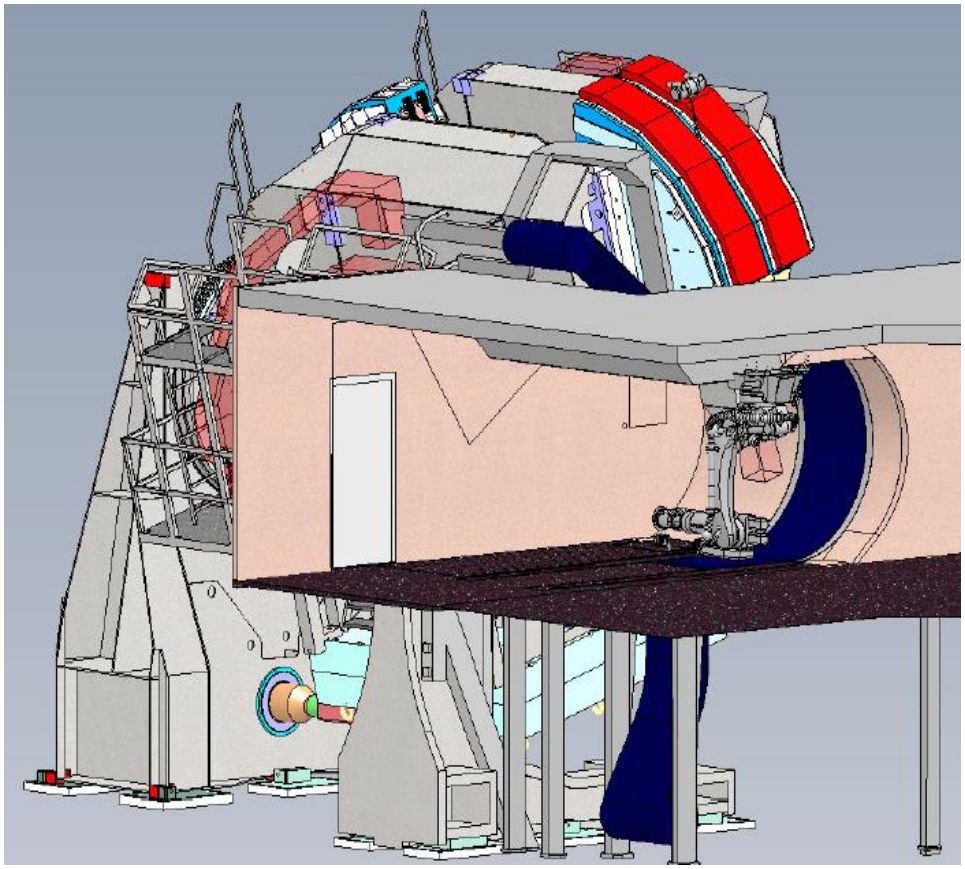
MEDAUSTRON?



MedAustron proton gantry:

cooperation with PAUL SCHERRER INSTITUT PSI

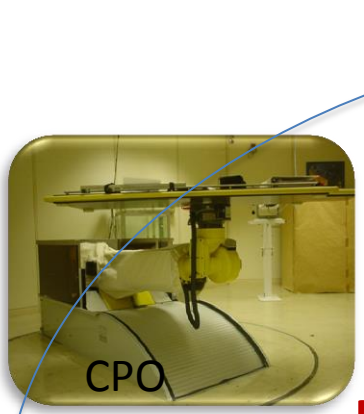
MedAustron



MedAustron proton Gantry

Weight 220 tons, only protons 60-250MeV, angles from -10° to 180 °

Evolution of Patient Alignment Systems in Ion Beam Therapy



Use Robotic Patient positioner with separate imaging system

MEDAUSTRON?

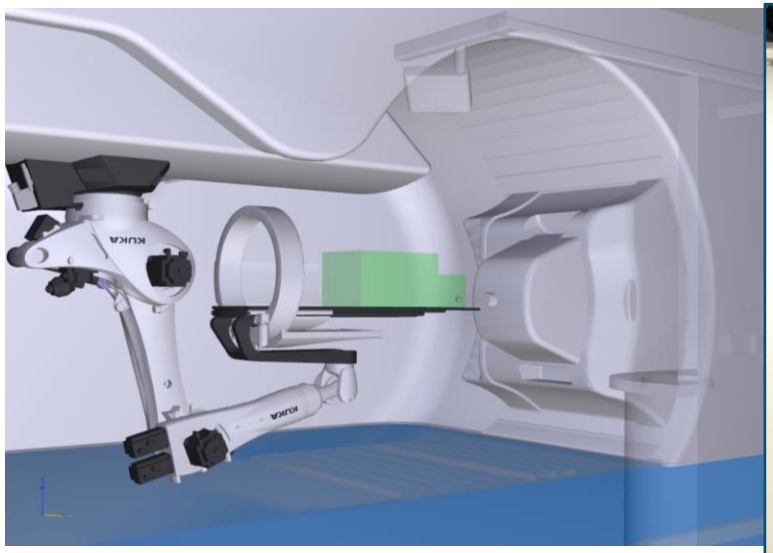
MedAustron patient alignment system: robotic positioner and imaging ring

Cooperation with MedPhoton and B-E-C

MedAustron

medPhoton

Buck Engineering & Consulting GmbH



MedAustron robotic positioner and imaging ring

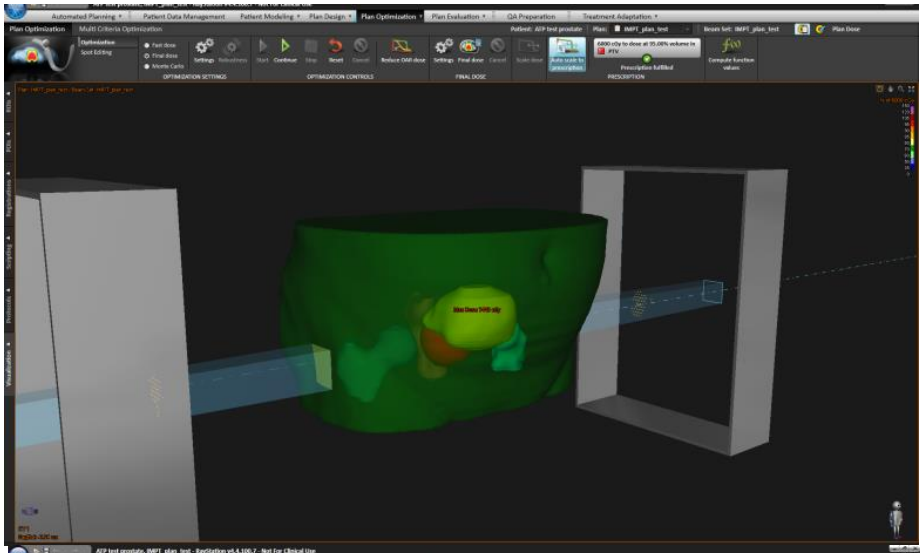
Cooperation with MedPhoton and B-E-C

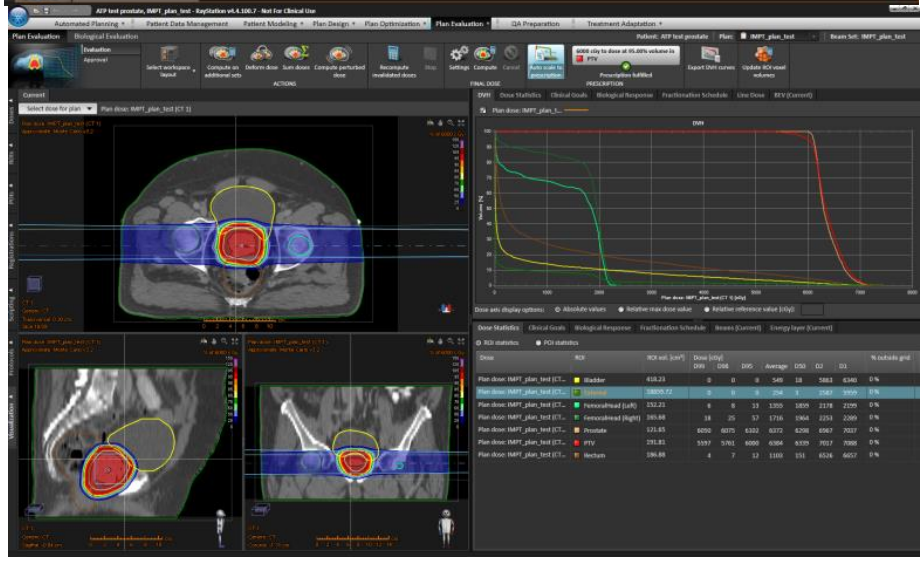
PAIR (Patient Alignment Imaging Ring)

- Ceiling mounted RP with 7 axes (additional linear rail)
- Sliding IR with independently rotating X-ray source and a flat panel detector
- Volumetric CBCT and 2D imaging
- 78 cm diameter with full resolution FOV of 60.5 cm
- Capability of dual energy X-ray imaging
- Optically tracking from the floor

MedAustron TPS RayStation:

Cooperation with RaySearch Laboratories





- Pencil beam algorithm (on GPU)
- Monte Carlo (on GPU)
- Robust optimization
- Biological optimization engine based on LEM model (LEM I and LEM IV)
- Scripting support (Python)
- Scan path optimization
- Support non-isocentric treatments
- Back up planning

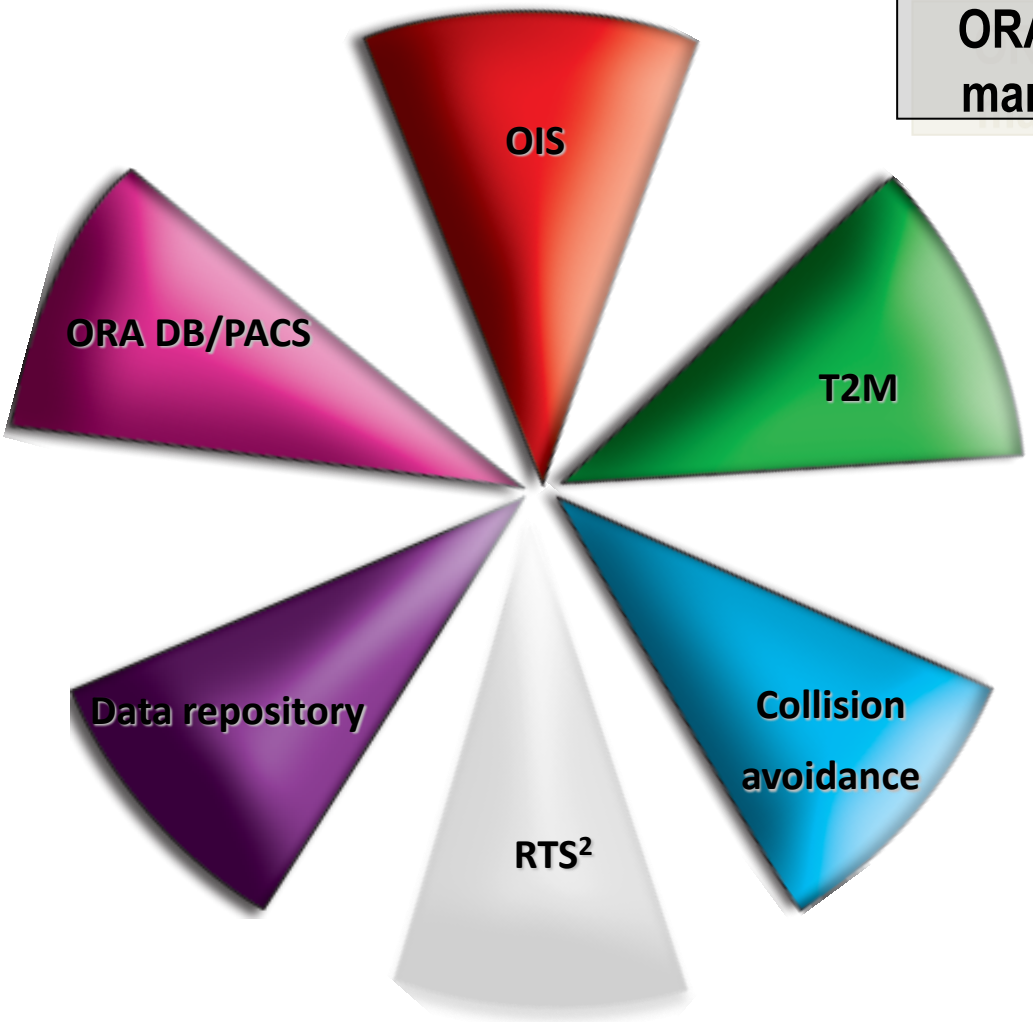
Patient workflow management

Cooperation with

PARACELSUS MEDIZINISCHE PRIVATUNIVERSITÄT

radART
Institute for Research and Development on Advanced

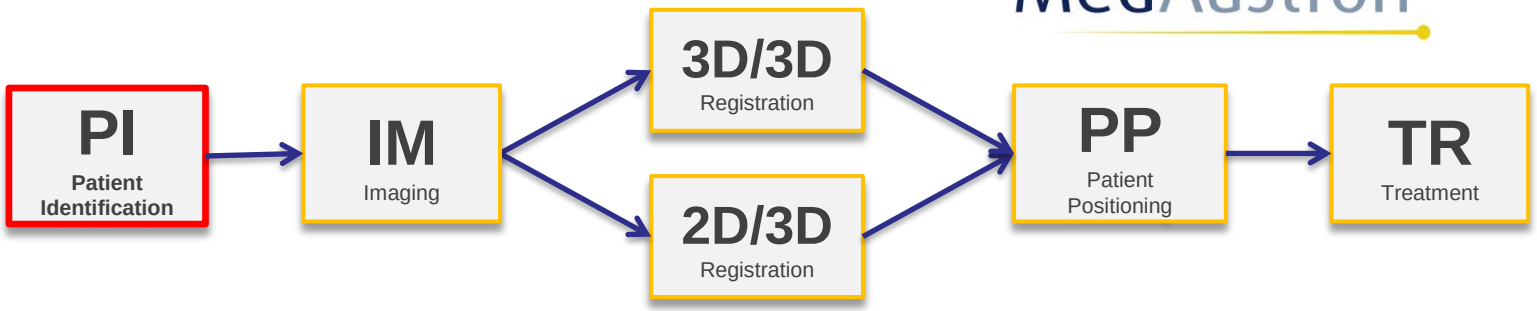
MedAustron



ORA_ion software is responsible for management of all data needed for:

- Workflow management
- Imaging
- Treatment
- Reporting
- Follow up

Treatment Workflow 1

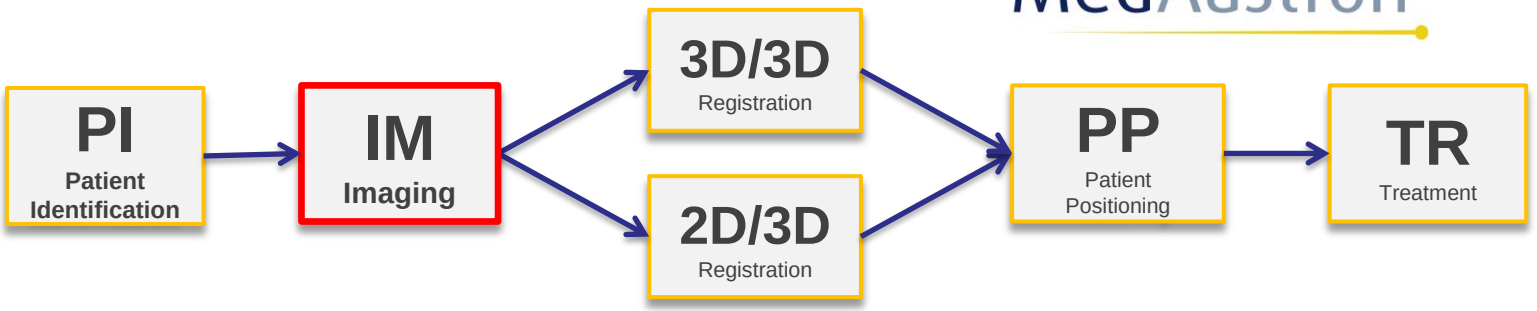


Barcode Scanner Plugin

- ensures right patient
- with right positioning aids

is treated

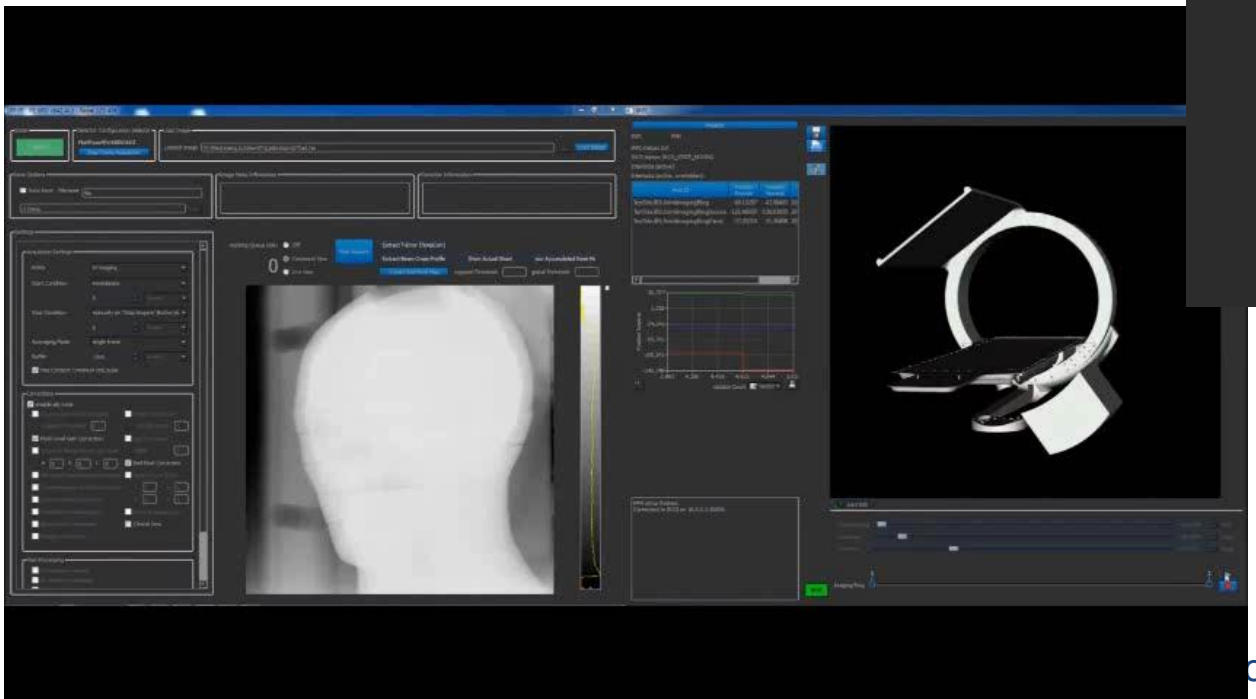
Treatment Workflow 2

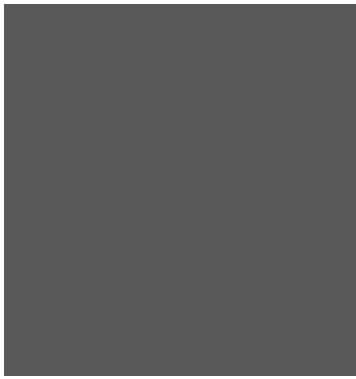


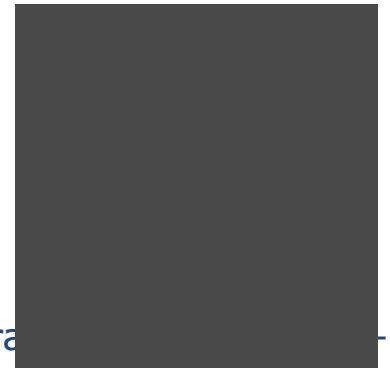
Online CBCT module

FPPI

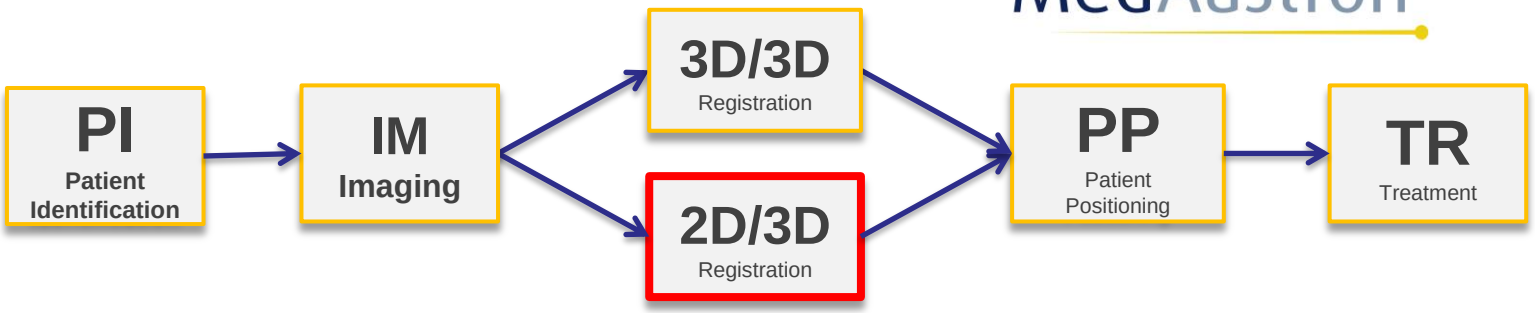
IRPI







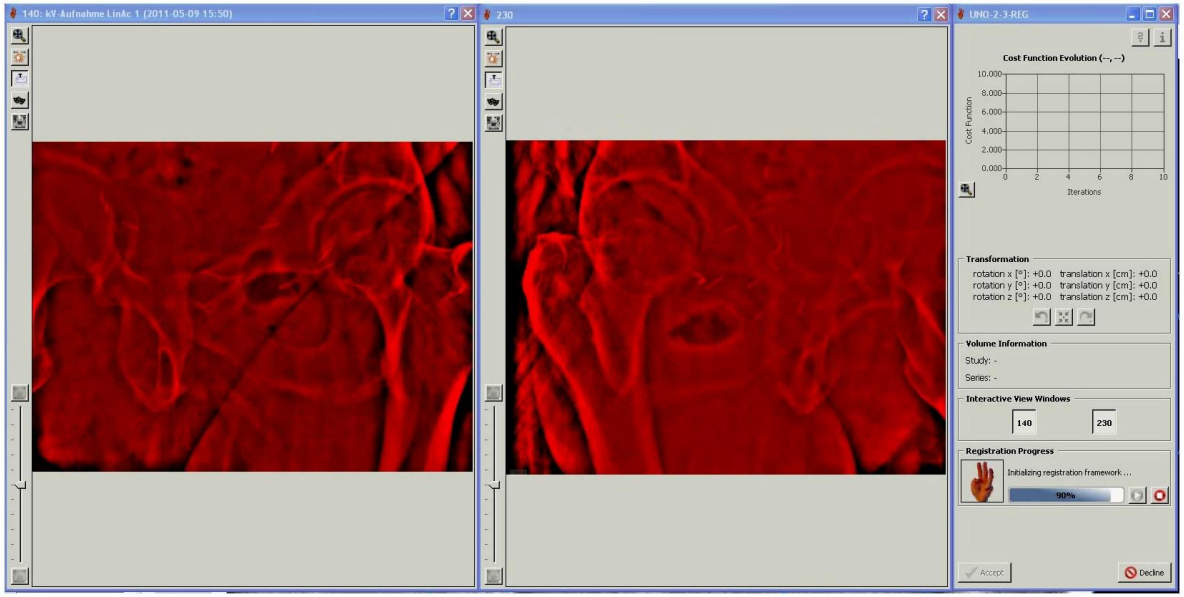
Treatment Workflow 3



ORA ion 2D/3D registration

Planning CT
(-> on-the-fly DRRs)

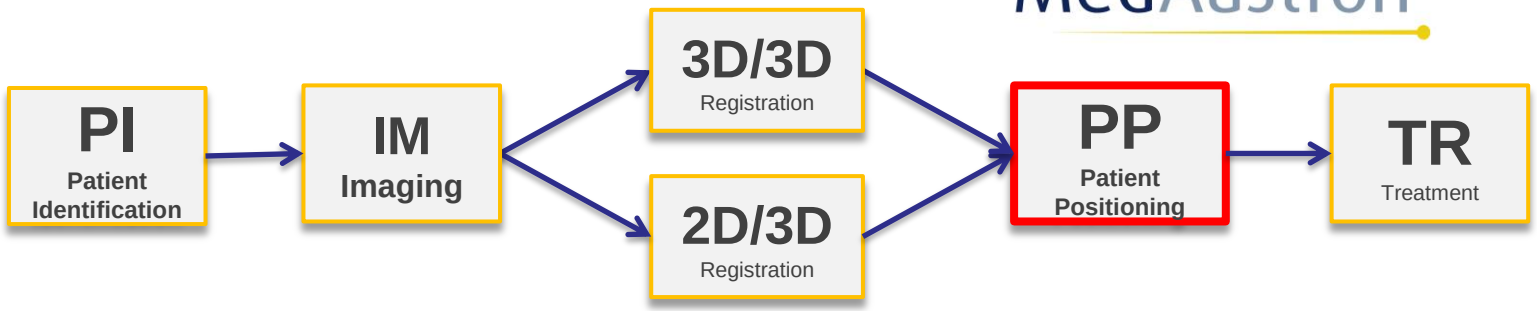
N planar x-ray Projection(s)



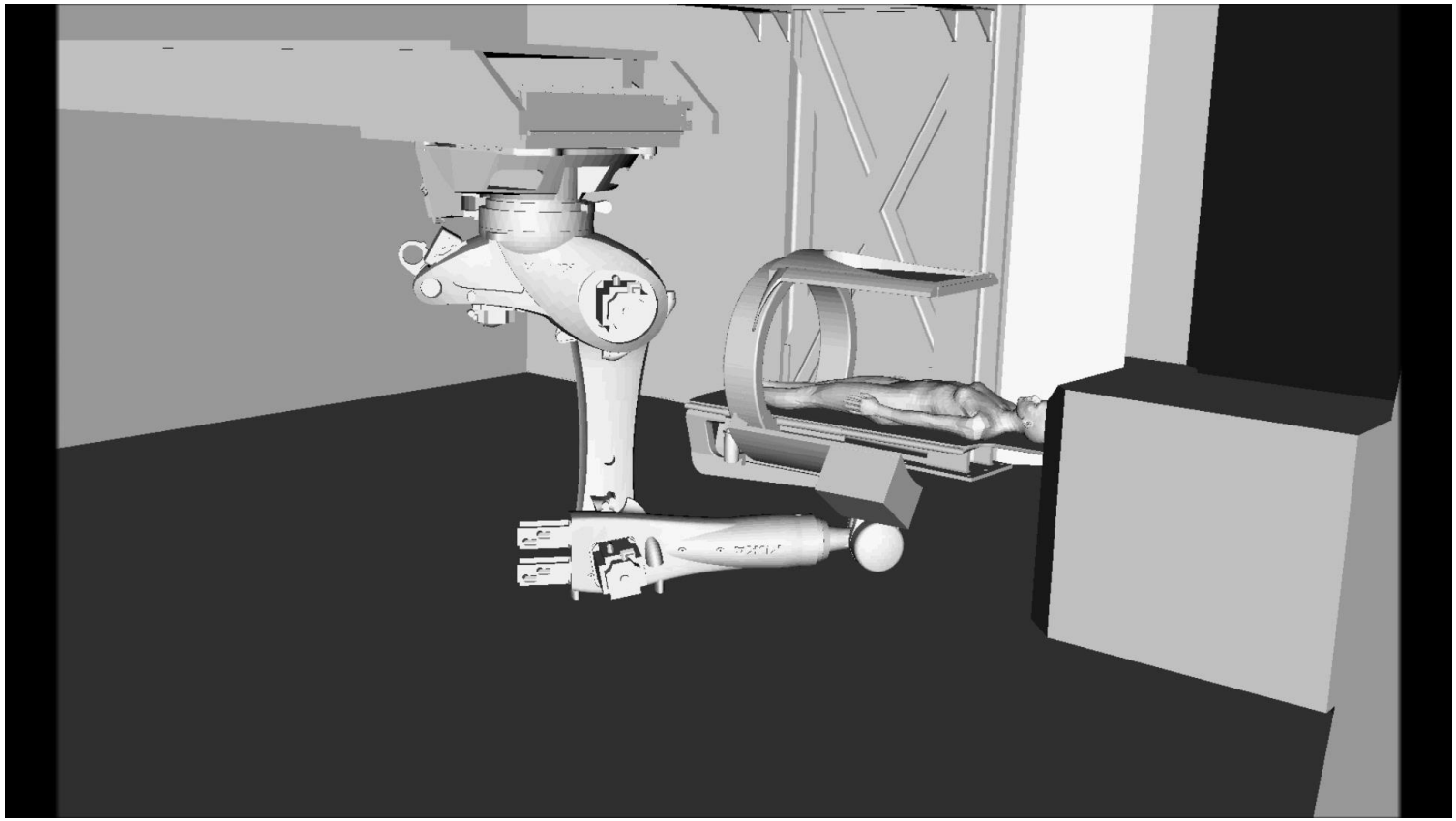
rigid registration:

T = (tx, ty, tz, rx, ry, rz)

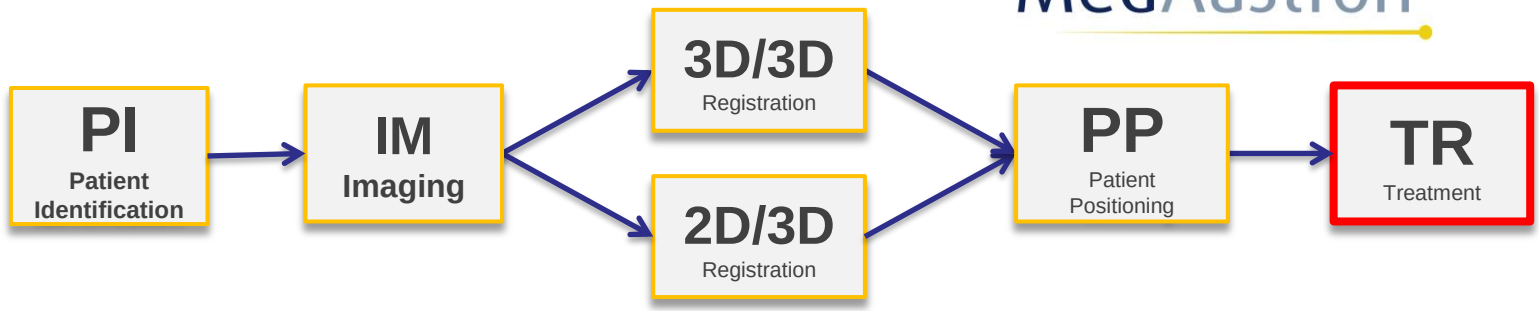
Treatment Workflow 4



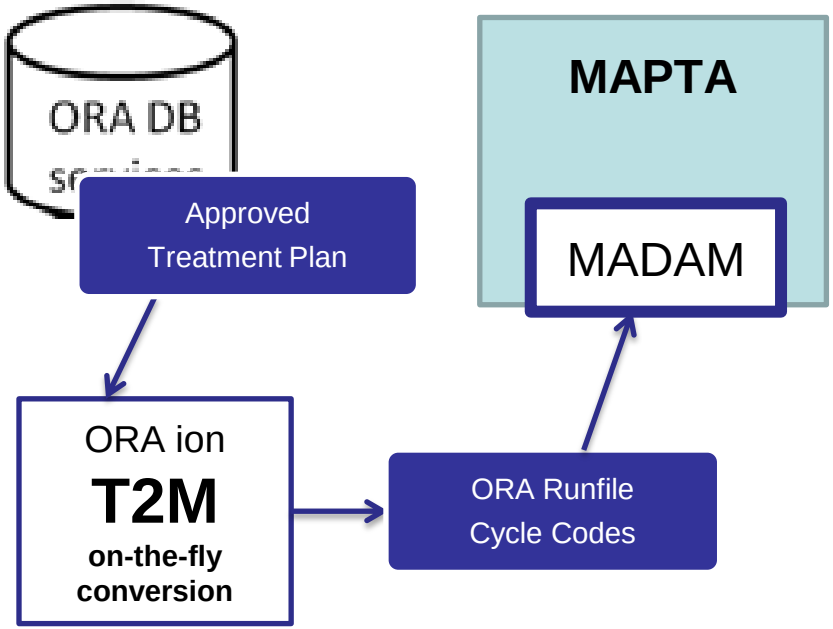
T



Treatment Workflow 5



RTS² (online record & verify)



Who will be treated with Ion Beam Therapy?

MedAustron

- In Austria approximately 36.000 patients per year develop cancer
- The existing radiation therapy institutes in Austria treat approximately 16 000 patients per year
- Out of this number about 10-15% would benefit from the Ion Beam Therapy
- In the full operational phase (since 2020) about 1200 pts can be treated at MedAustron

Clinical indications at MedAustron 1

- **Brain tumours:**
  - Glioma:
    - Low grade glioma in young patients

      Aim: reduction of late side effects in long time survivors

  - Complex Meningioma G1-G3

    Aim: reduction of side effects in long time survivors

    (G1-G2 meningioma)

    dose escalation (G2-G3 meningioma)

Clinical indications at MedAustron 2

- **Tumours of the skull base region**
  - Chordoma
  - Chondrosarcoma of intermediate/large size

  Long term aim: evaluation protons vs. carbon ions

- **Head and neck tumours**
  - Parotid carcinoma
  - Adenoid cystic carcinoma (carbon ions)
  - Nasopharyngeal carcinoma (IMRT + ion beam boost)
  - Carcinoma of the paranasal cavities (IMRT + ion beam boost)

Clinical indications at MedAustron 3

- **Prostate carcinoma**

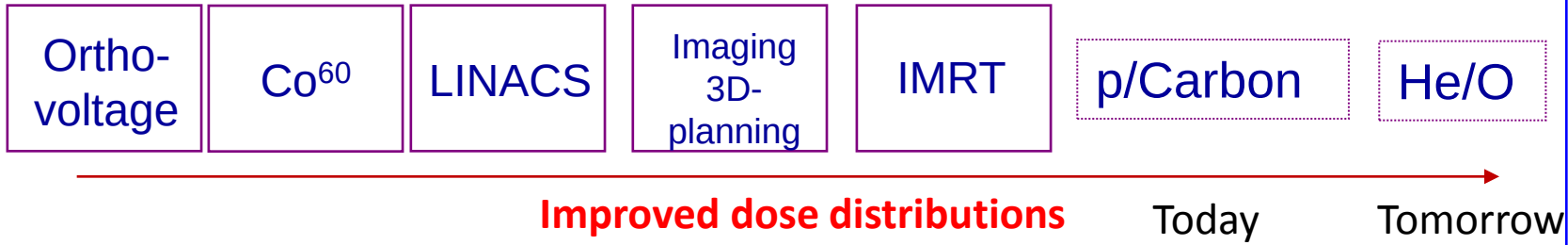
- **Sarcoma of the extremities**

Clinical indications at MedAustron: facility in full operation

- **Lung cancer (NSCLC)**
- **Pancreatic carcinoma**
- **Hepatocellular carcinoma** (because of moving targets no indication during the start-up phase)
- **Pediatric malignancies**

The future of ion beam therapy

MedAustron



Protons and ions can simply be considered to be the next logical step in the advancement of radiotherapy

However, light ions are NOT necessarily competitive to conventional radiotherapy ,

they could simply provide an additional treatment modality for those cases that can't be satisfactorily treated using other techniques.

MedAustron

Grazie per l’attenzione