

MEDAUSTRON

THE PARTICLE THERAPY FACILITY IN AUSTRIA

Mauro T. F. Pivi

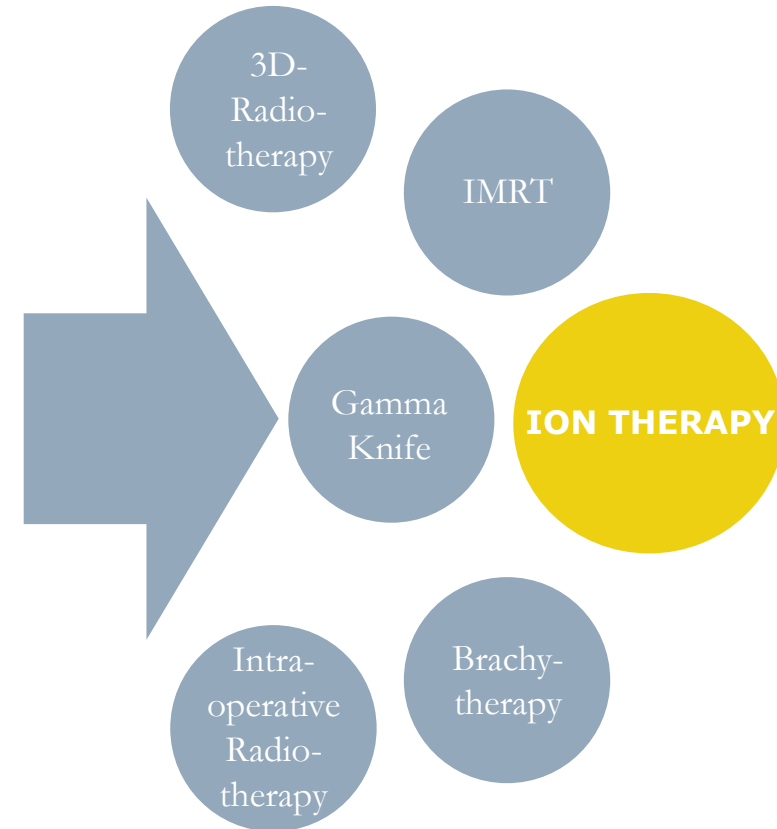
on behalf of the Accelerator Beam Physics group

Including slides/content provided by: Dale Prokopovich, Alexander Wastl, Laurids Adler, Florian Kühleubl, Fabio Farinon, Giulio Magrin, Alessio Elia, Claus Schmitzer, Thomas Schreiner, plus many others...

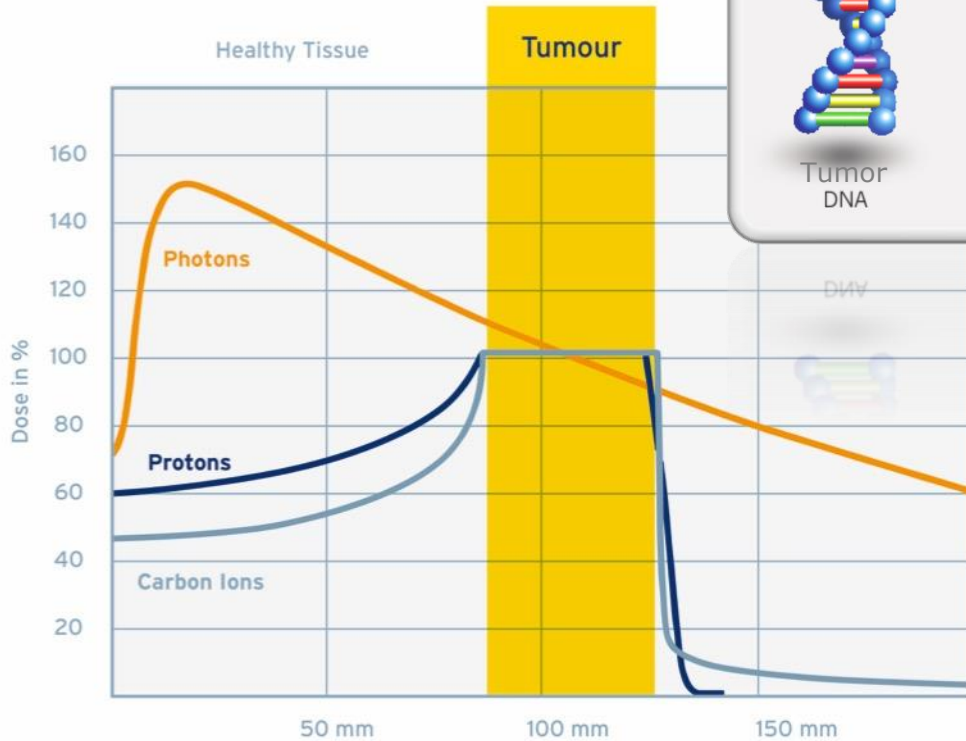
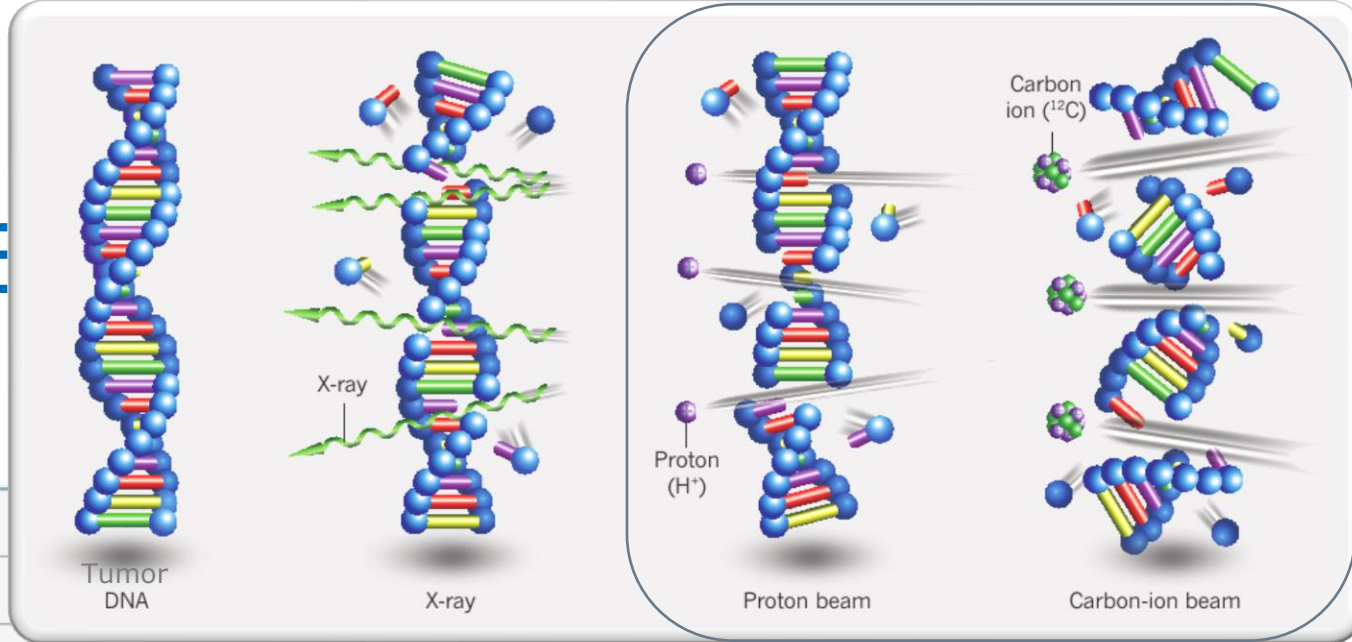
OVERVIEW

1. MedAustron Facility
2. Particle Therapy Technology
3. Research Overview
4. Recent developments
5. Future projects

TUMOR THERAPY



RADIATION: COMPARE PHOTONS TO PARTICLE



Lower exposure
to radiation of healthy tissue

Reduction
of side effects and long-term
damages

Photons:
„Conventional“
Radiation Therapy

**Protons,
Carbon Ions:**
Ion Beam Therapy

Carbon Ion Centers Worldwide: 13

(in operation by February 2020)

4

HIT Heidelberg
MIT Marburg
CNAO Pavia
MedAustron

Europe

9

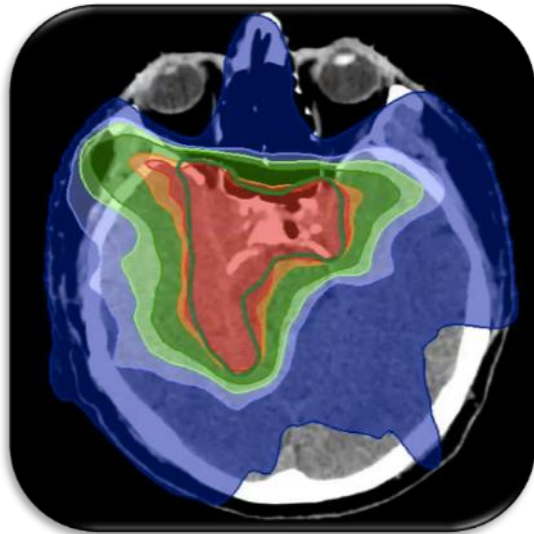
Asia

6 Protons & Carbons Ions (2 Asia, 4 Europe)

7 Carbon Ions

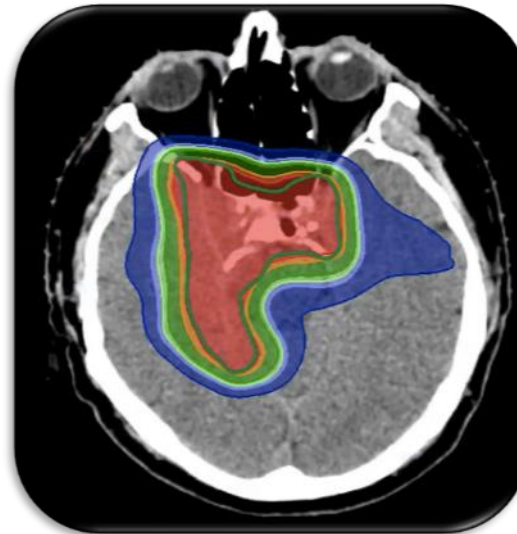
TREATMENT PLANNING - COMPARISON

PHOTONS
IMRT, VMAT, SBRT



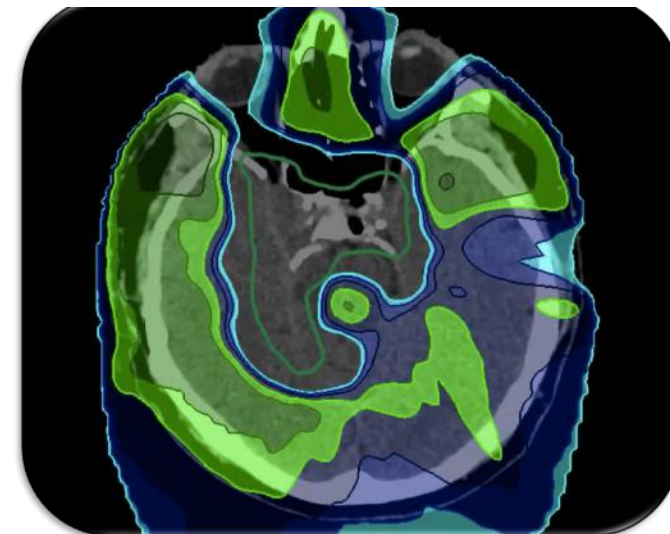
Several fields, entry and exit dose

PROTONS
IMPT

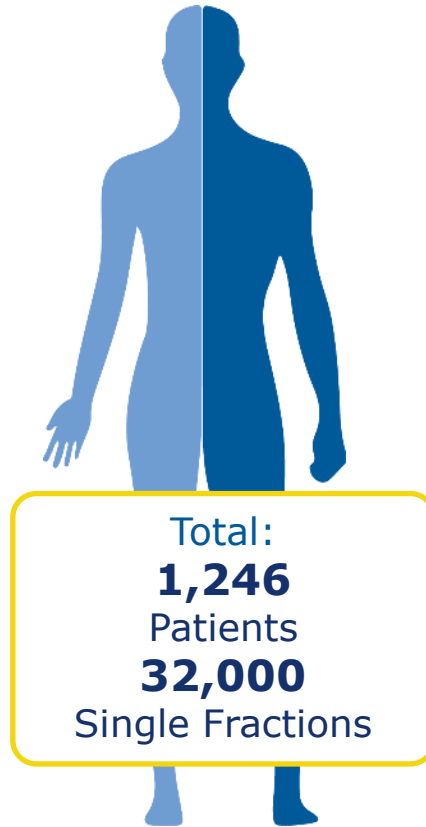


Fewer fields, reduced entry dose, no exit dose

DOSE DIFFERENTIAL
Photons minus Protons



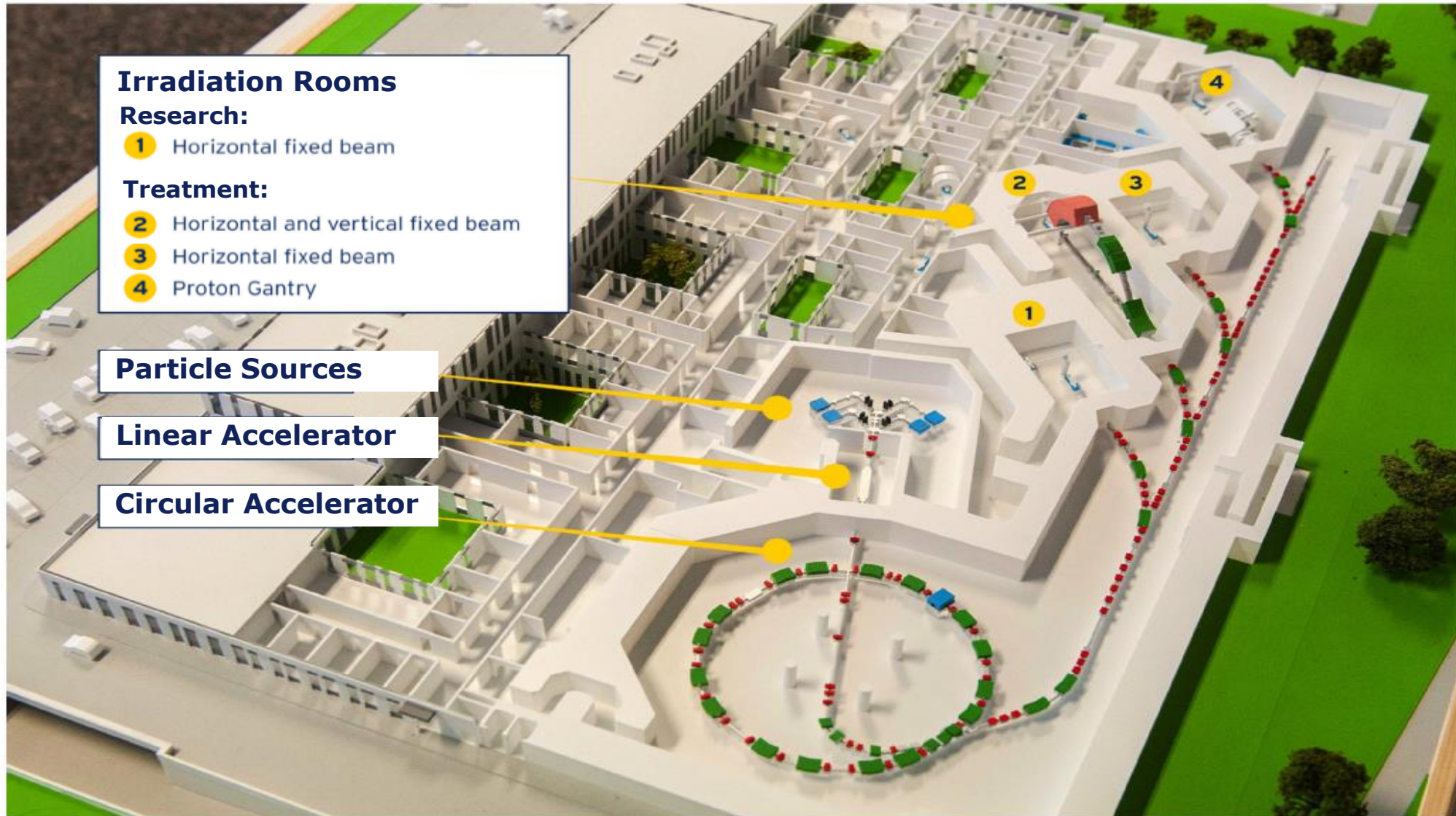
INDICATIONS TREATED AT MEDAUSTRON



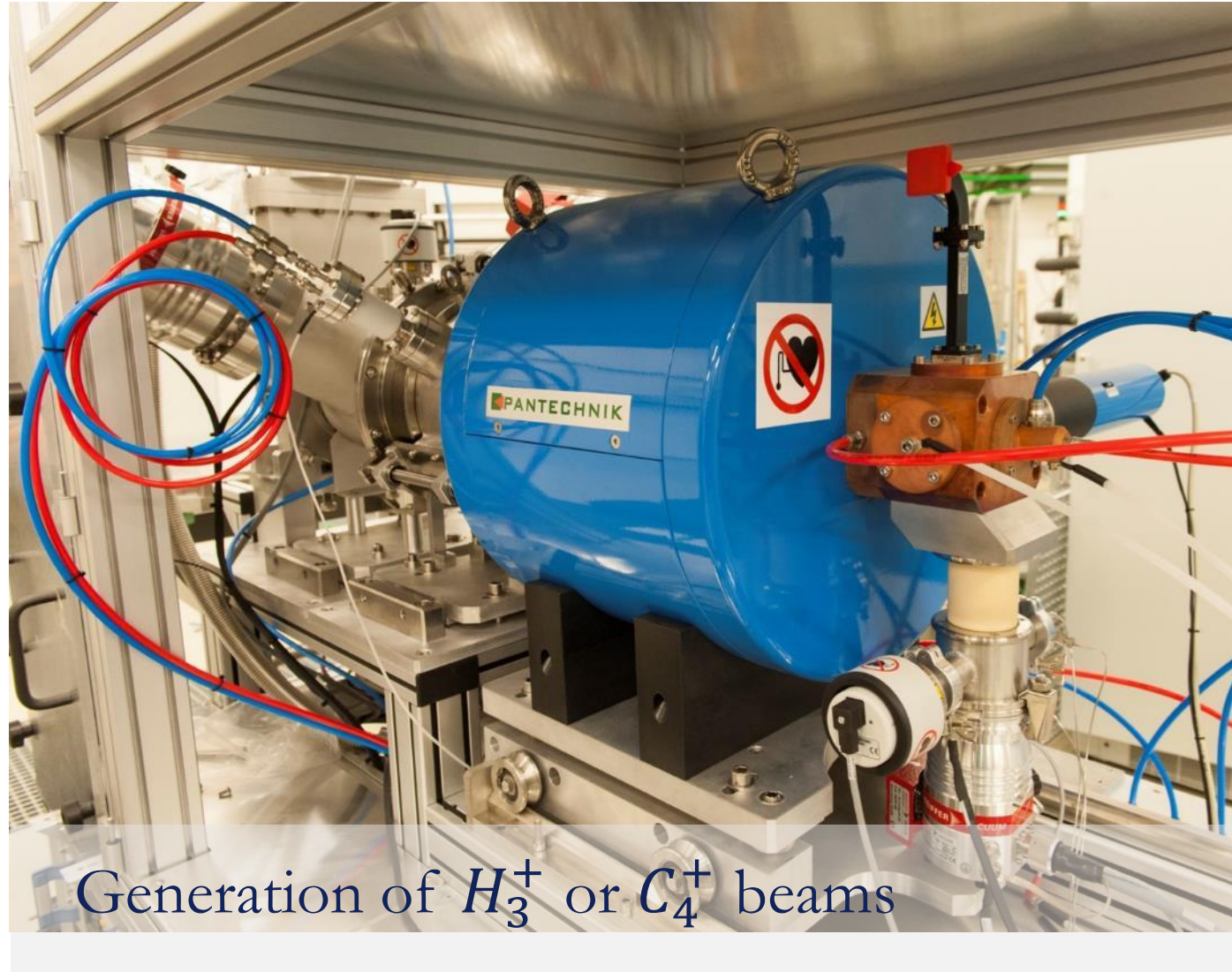
28%	Central Nervous System
20%	Head & Neck
15%	Pediatrics
15%	Re-Irradiation
10%	Sarcoma
6%	Skull Base
4%	Prostate
2%	Gastrointestinal (upper)
<1%	Gastrointestinal (lower)
<1%	Gynecological Tumors
<1%	Urogenital Tumors
<1%	Breast/Mamma-Ca

Values December 2021 • values rounded

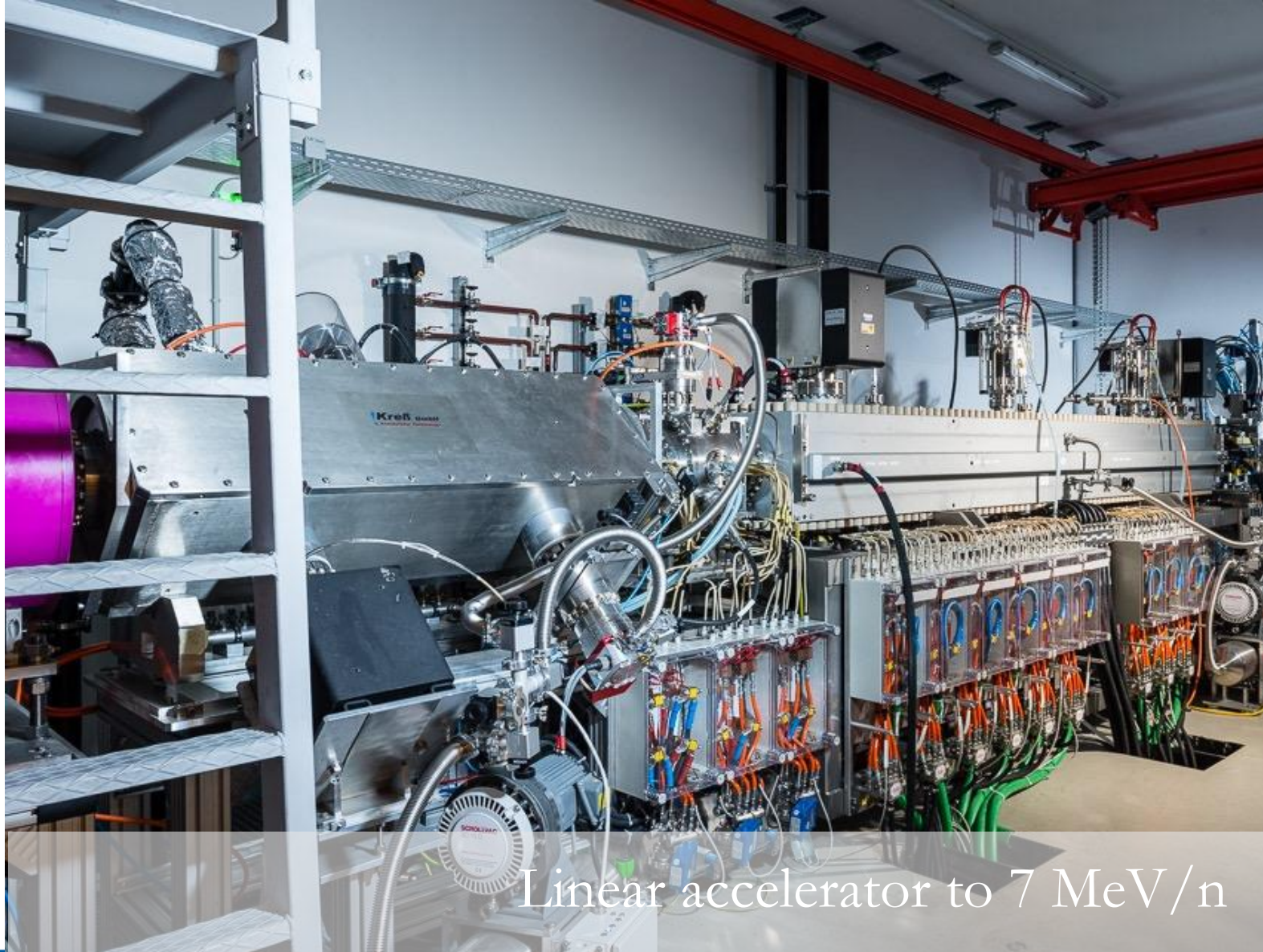
THE FACILITY



ION SOURCES

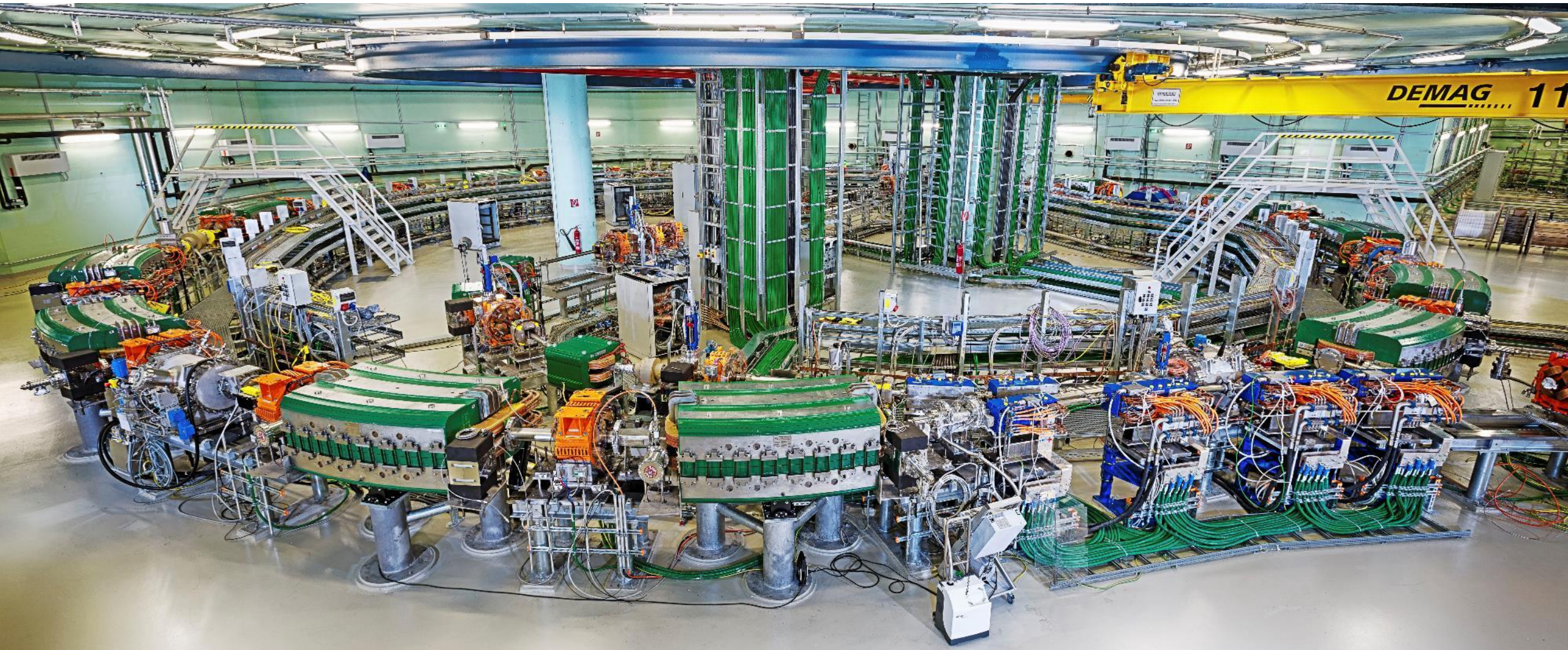


LINEAR ACCELERATOR



Linear accelerator to 7 MeV/n

MEDAUSTRON SYNCHROTRON



HEBT HIGH ENERGY TRANSFER LINE

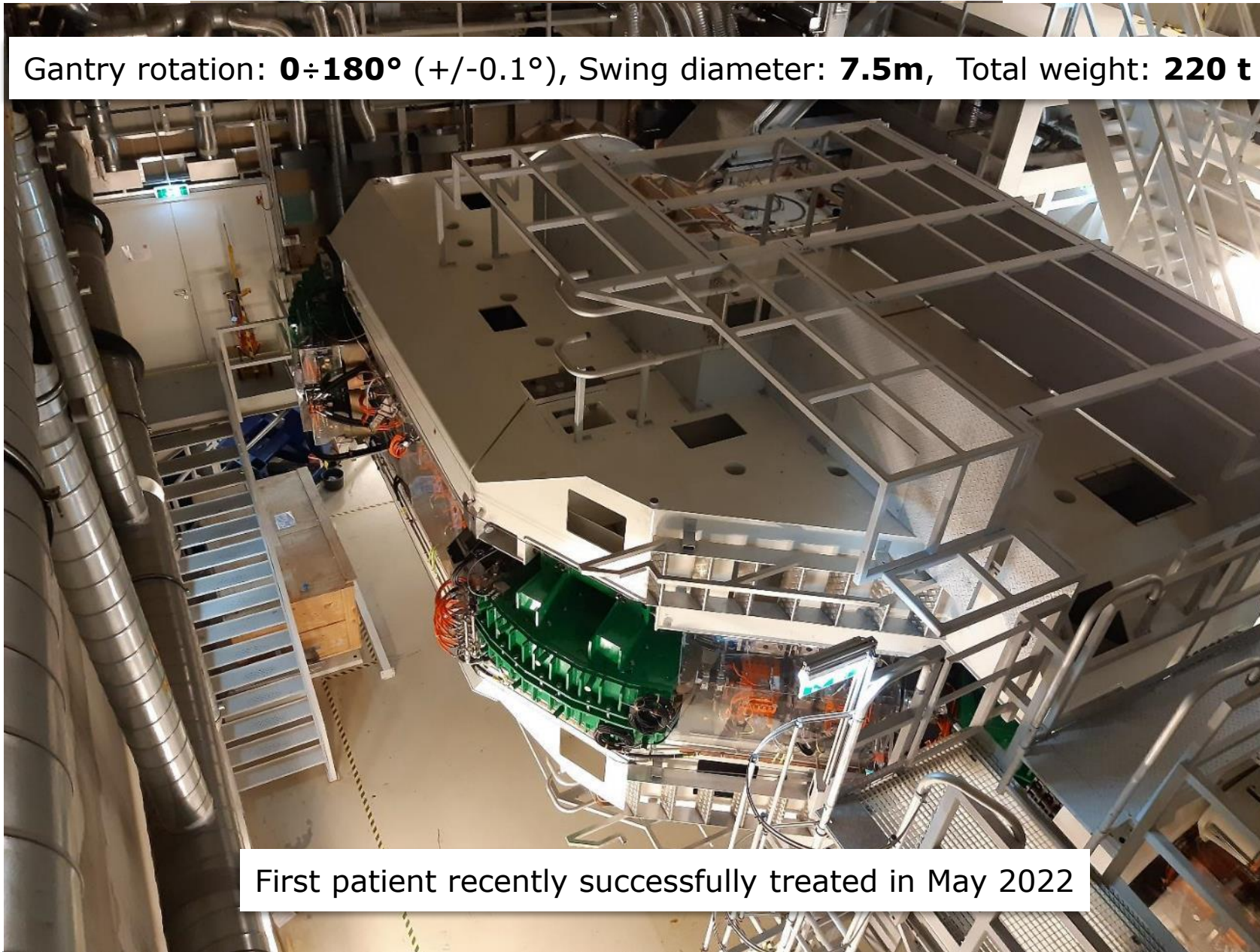


IRRADIATION ROOM AND PATIENT POSITIONING



PROTON GANTRY – A ROTATING BEAM LINE

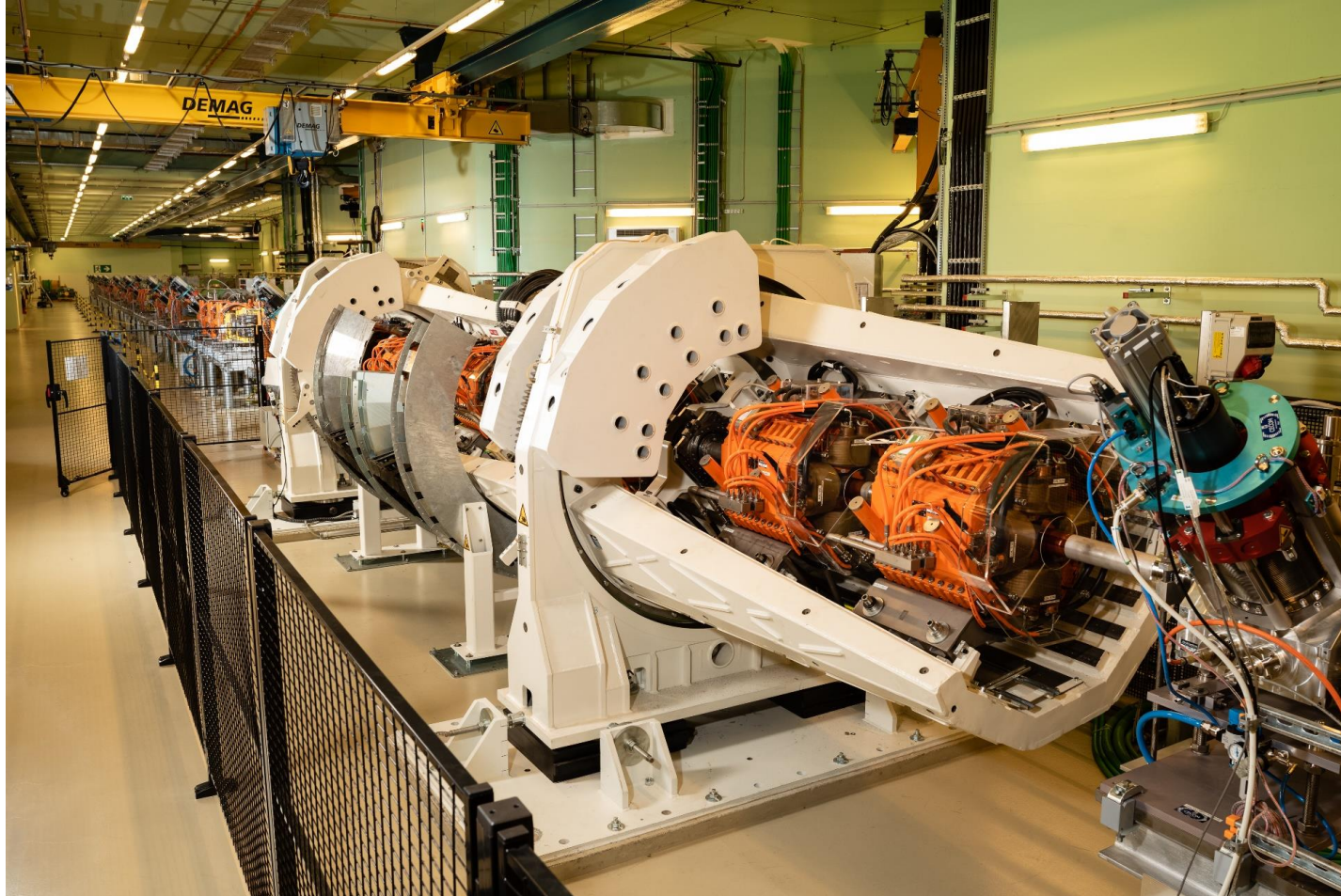
Gantry rotation: $0 \div 180^\circ$ ($\pm 0.1^\circ$), Swing diameter: **7.5m**, Total weight: **220 t**



GANTRY IN
HORIZONTAL
POSITION

First patient recently successfully treated in May 2022

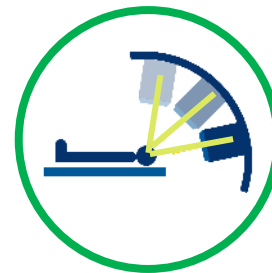
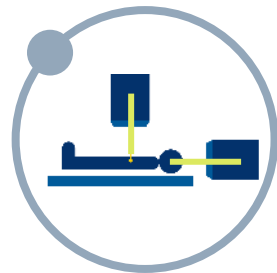
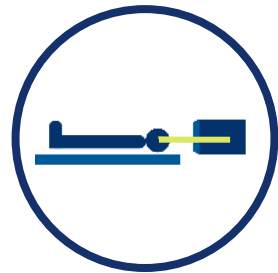
ROTATOR FOR GANTRY



The MedAustron **Gantry** is first world-wide with a **Rotator** beam line: so that the beam shape/profile at the patient is the same and independent from rotation direction

ALL 4 IRRADIATION ROOMS NOW OPERATIONAL ✓

What particles can be delivered **and from what directions?**



Clinical Rooms

Research

Fixed Beam

Fixed Beams

Gantry

Fixed Beam

Horizontal

Horizontal
and Vertical

Rotating

Horizontal

Protons
Carbon Ions

Protons
Carbon Ions

Protons

Protons
Carbon Ions

PERFORMANCE IMPROVEMENT – FASTER, MORE EFFICIENT, STREAMLINED TREATMENT

- Improvements to quality, beam intensity and speed of treatment delivery for patients through optimization and research
- The facility needs to be constantly improving to ensure that the best outcomes is available for patients
- Improvement projects
 - **Helium ions** being commissioned for research
 - **Eye treatment**
 - **Gating** (beam on-time follows organs movement)
 - 800 patients per-year goal project
- Future improvements for faster and better quality treatments
 - **Multi-energy per single-spill treatments**
 - New Diagnostics/Instrumentation + much more...
- Intl. Collaborations: HITRI+, SIGRUM, SEEIIST
 - **Carbon gantry and superconducting accelerator**



RESEARCH (NCR) AT MEDAUSTRON

○ Dedicated room for Research with:

- p and C beams as used for clinical treatment and more features
- Proton energies up to 800 MeV
- High and Low flux beams
- Large room with two focusing iso-centers
- Dedicated cell, chemical, biology, dosimetry and pre-clinical laboratories

○ Research areas are divided into programs 8 programs:

- P0 - Commissioning and Quality Assurance
- P1 - Intrafraction Adaptive Radiation Therapy
- P2 - Interfraction Adaptive Radiation Therapy
- P3 - Imaging with Ion Beams
- P4 - Magnetic Resonance Guided Particle Therapy
- P5 - Energy Transfer Mechanisms and Applications in Physics and Biology
- P6 - Pre-Clinical Animal Research
- P7 - Accelerator physics

NCR research in cooperation with:

The Medical Universities of Vienna and Graz

Technical University of Vienna

Institute for High Energy Physics (ÖAW)

University of Applied Sciences Wiener Neustadt (FH WN)



**“Slow Extraction Techniques”
CERN-MedAustron collaboration**

THANK YOU!

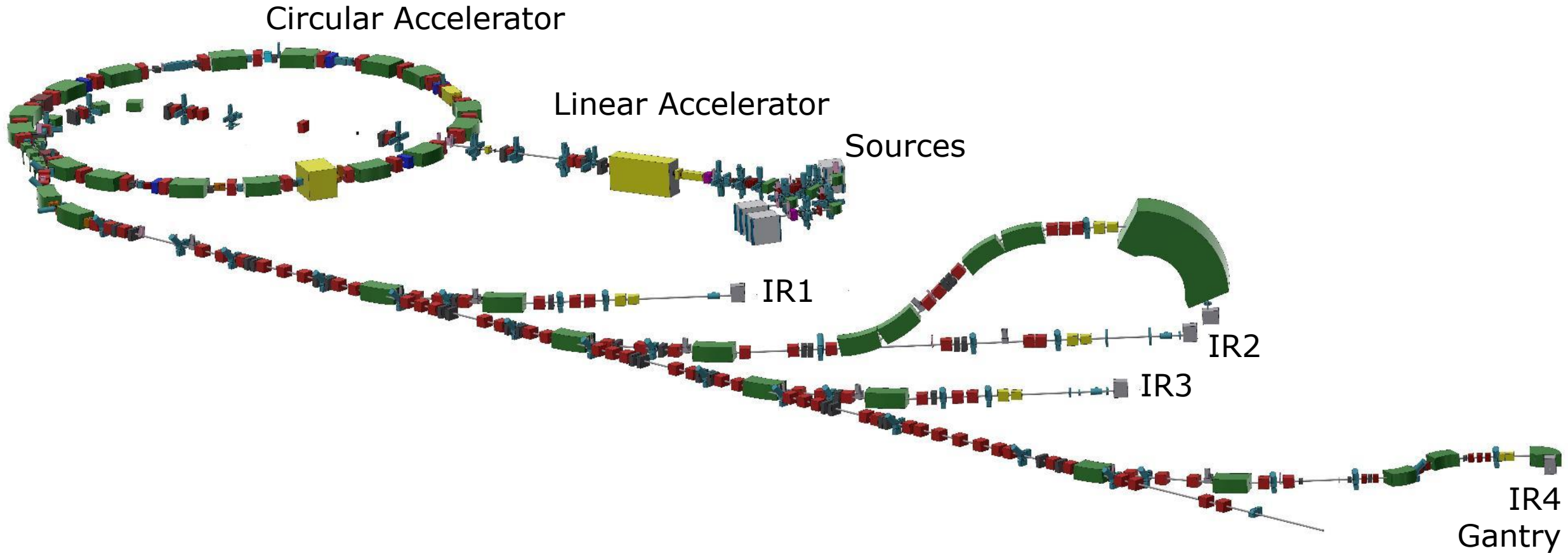
www.medastron.at

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- Claus Schmitzer
- Thomas Schreiner
- Ivan Strasik
- Alexander Wastl
- Markus Wolf

& all of the over 200+ people working at MedAustron working together to improve the treatment available to particle therapy patients

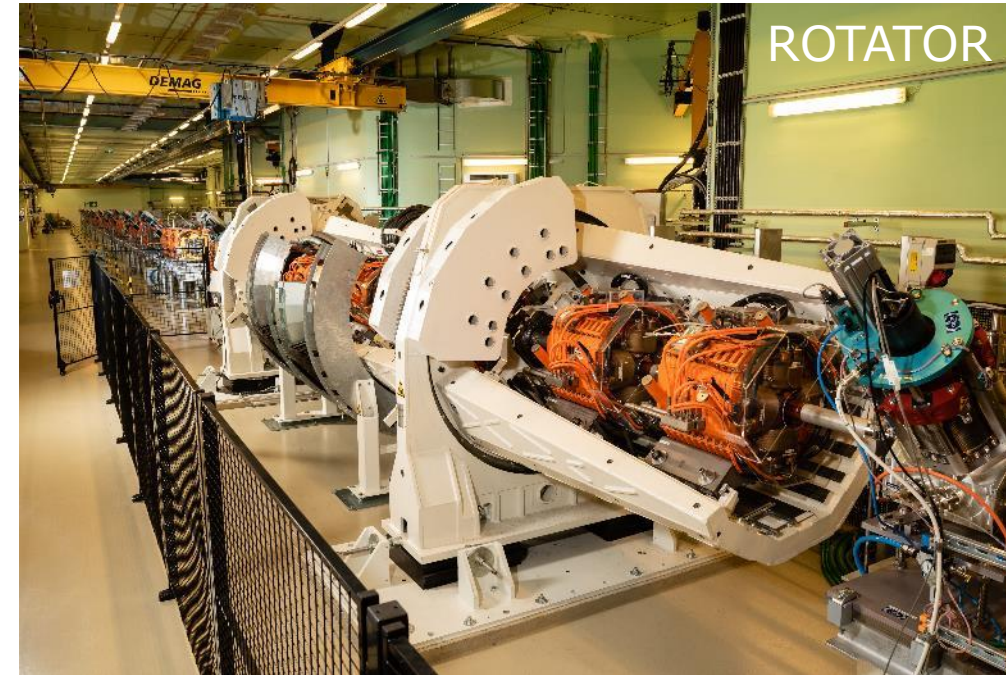
ACCELERATOR AND BEAM TRANSFER LINES



PROTON GANTRY



© Kaestenbauer/Ettl.



- The first world-wide gantry with a **Rotator** beam line: with a rotator the beam shape at the patient is independent from rotation direction
- Gantry rotation: **0 ÷ 180°** (+/-0.1°), Swing diameter: **7.5m**, Total weight: **220 t**
- First patient just successfully been treated: in May 2022