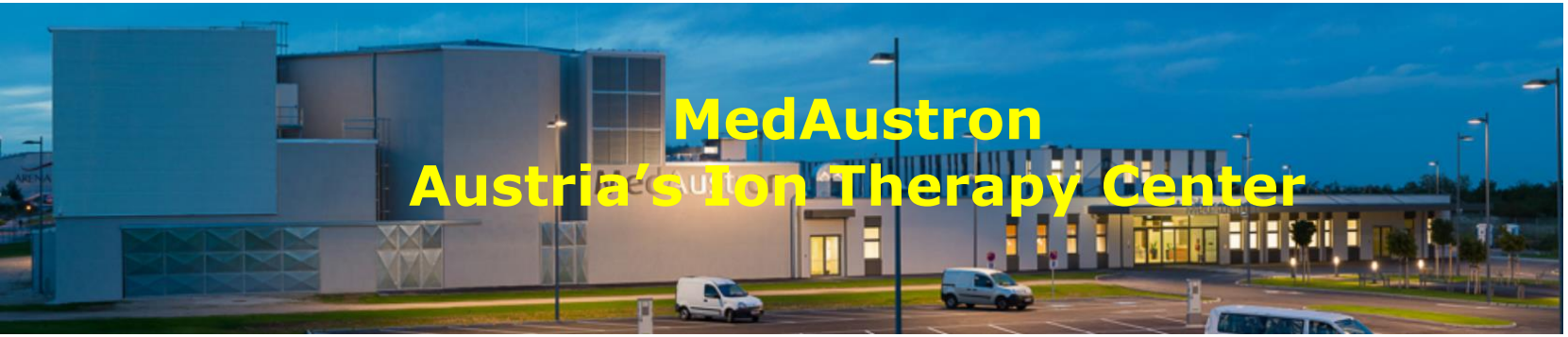
MedAustron



MedAustron
Austria's Ion Therapy Center

Eugen Hug,
Ulrike Mock, Johanna Salinger

MedAustron
Ion Therapy Center

Wiener Neustadt, Austria

MedAustron

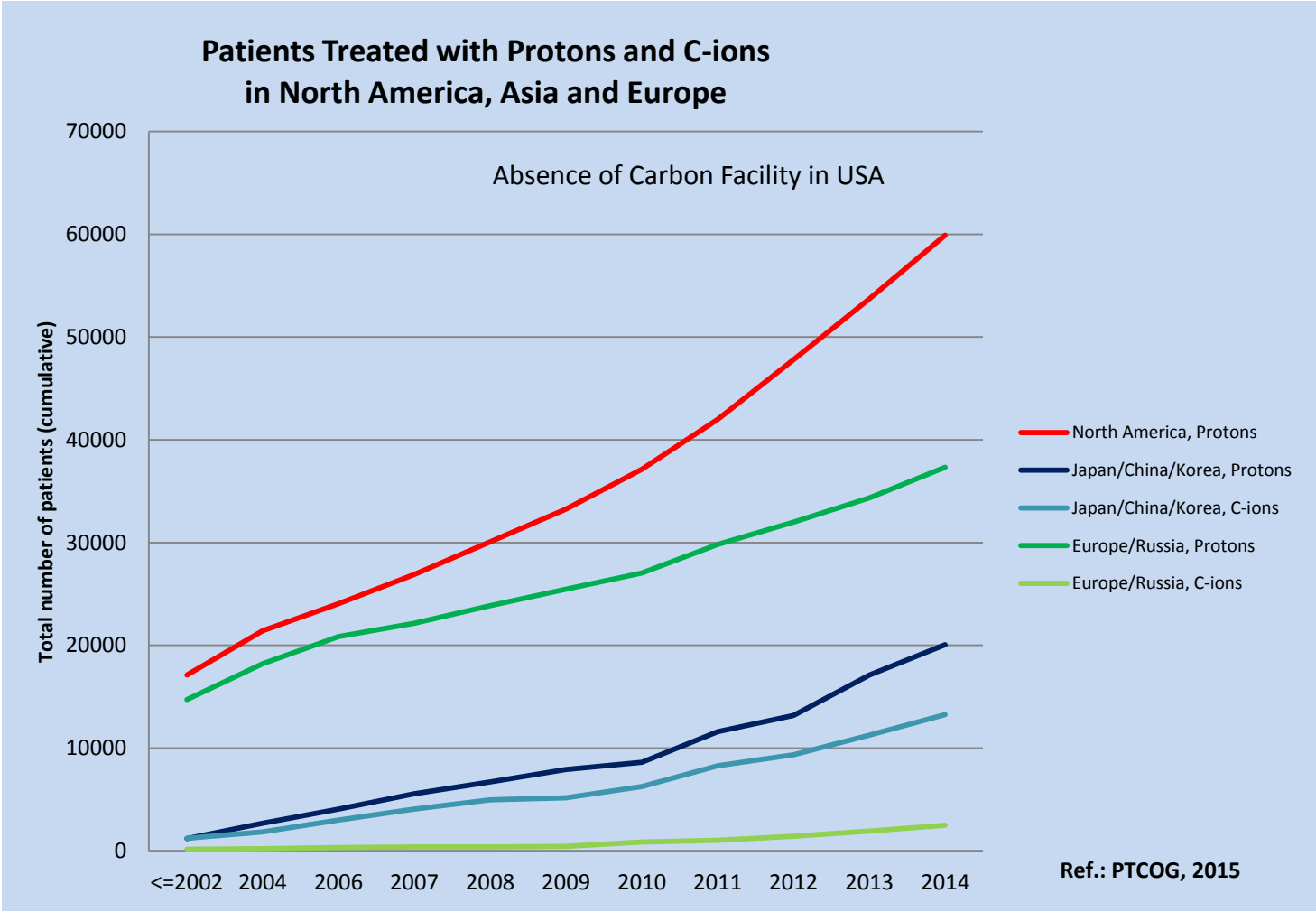
Particle Therapy Worldwide – 2014 Survey by PTCOG
Presented at PTCOG-54, San Diego, 2015 – E. Hug, M. Jermann

Number of Patients treated with Particle Therapy* worldwide as of End 2014:

49 Centers operational

Total of all facilities (in and out of operation):	**He**	**2054**	1957-1992
	Pions	**1100**	1974-1994
P : C = 9:1	**C-ions**	**15736**	1994 -
	Other ions	**433**	1975-1992
	Protons	**118181**	1954 -
	Grand Total	**133931**	

** Data collection = voluntary reporting by particle centers*



From: M. Jermann, Annual PTCOG Survey 2014

MedAustron

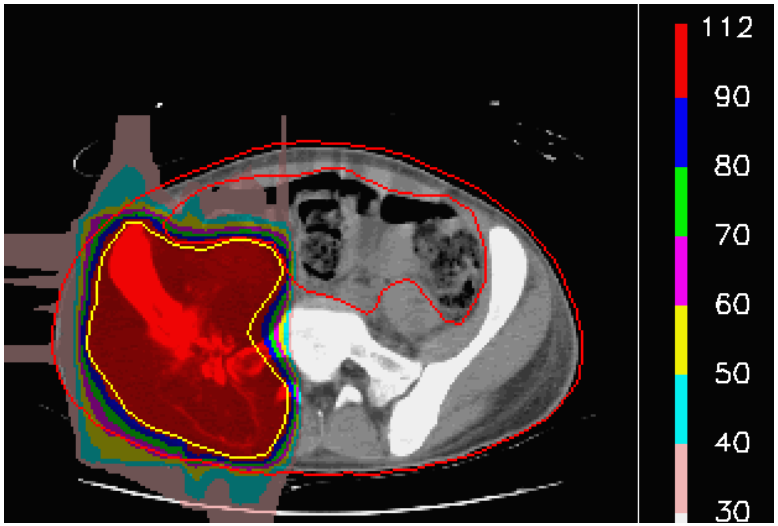
Particle Therapy –

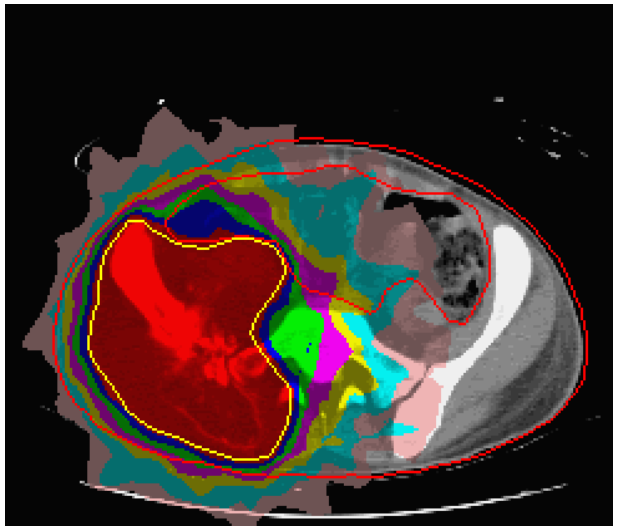
The Quest for the Clinically Meaningful Benefit

↑ Dose to tumor

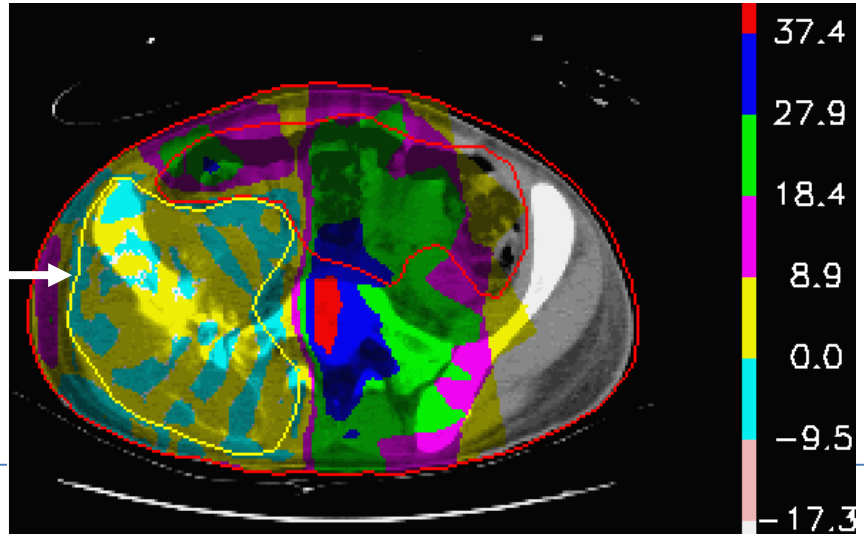
↓ Dose to healthy tissue

IMPT vs. IMXT : Ewing's Sarcoma



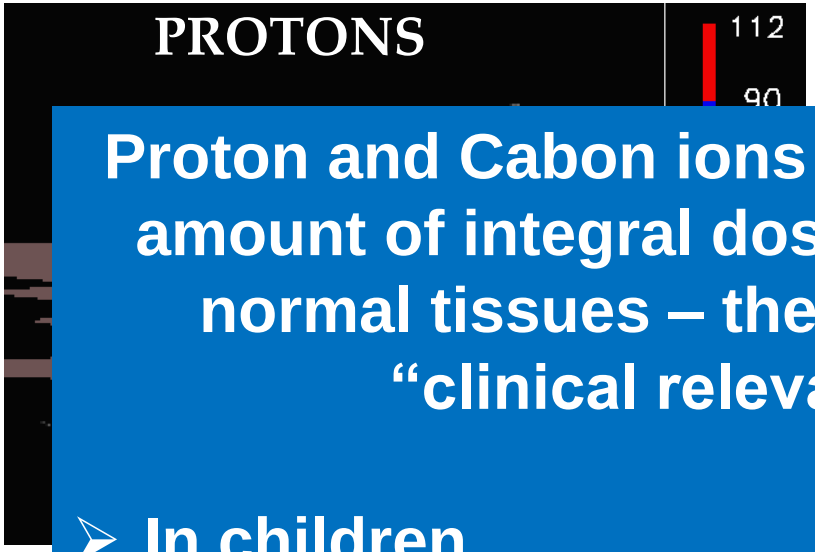


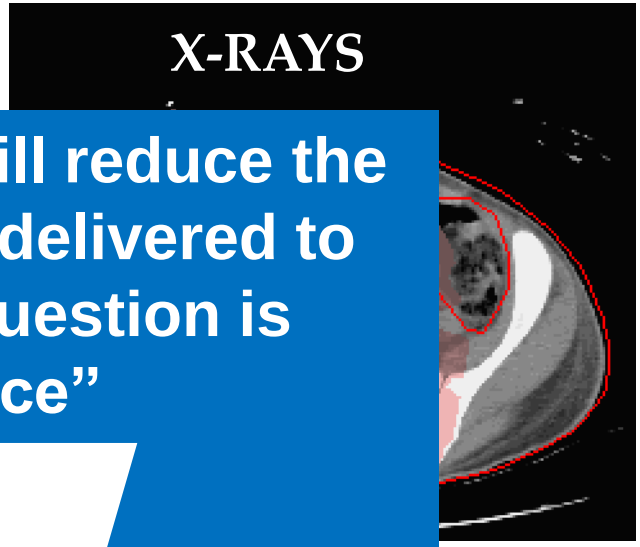
Difference
(IMXT – IMPT)



Courtesy T. Lomax, PSI

IMPT vs. IMXT : Ewing's Sarcoma

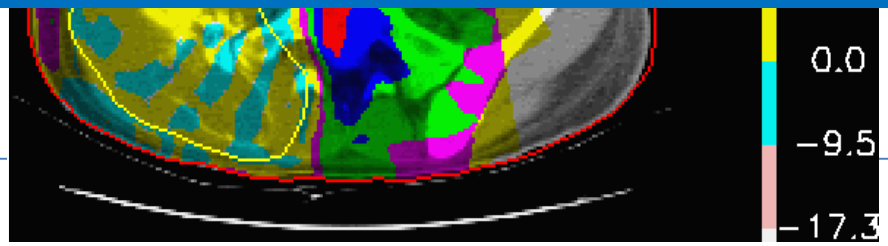




Proton and Cabon ions will reduce the amount of integral dose delivered to normal tissues – the question is "clinical relevance"

- **In children**
- **In young adults**
- **Adults**
- **Aging adults**

Difference (IMXT – IMPT)



Courtesy T. Lomax, PSI

Proton Indications: Large Target, High Complexity, Combined Modality Therapy

Ewing's Sarcoma

Isodose lines

42 %

76 %

90 %

95 %

98 %

100 %

105 %

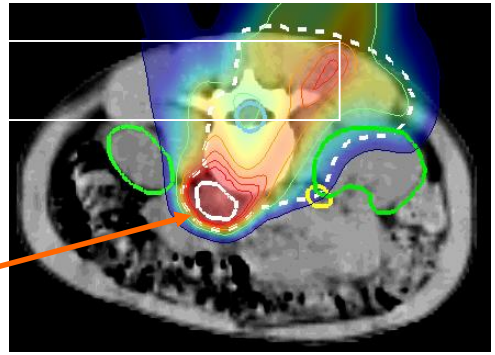
Max 108%

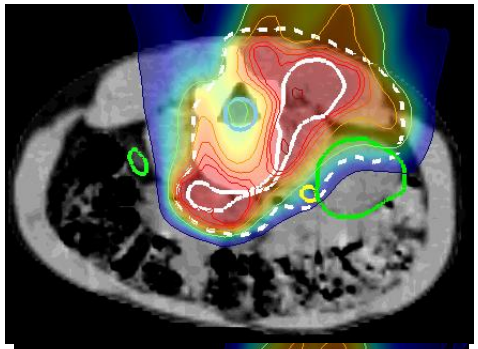
100 % (59.4Gy, PTV3)

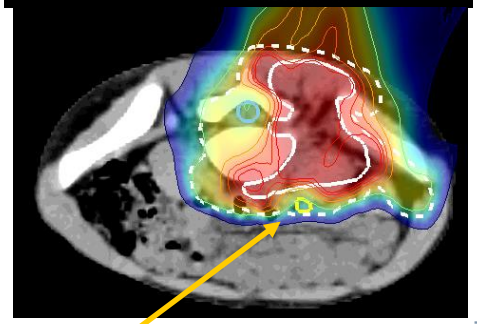
76% (45Gy, PTV2)

42% (25.2Gy, PTV1)

GTV: Tumor thrombus in Vena Cava







left Ureter

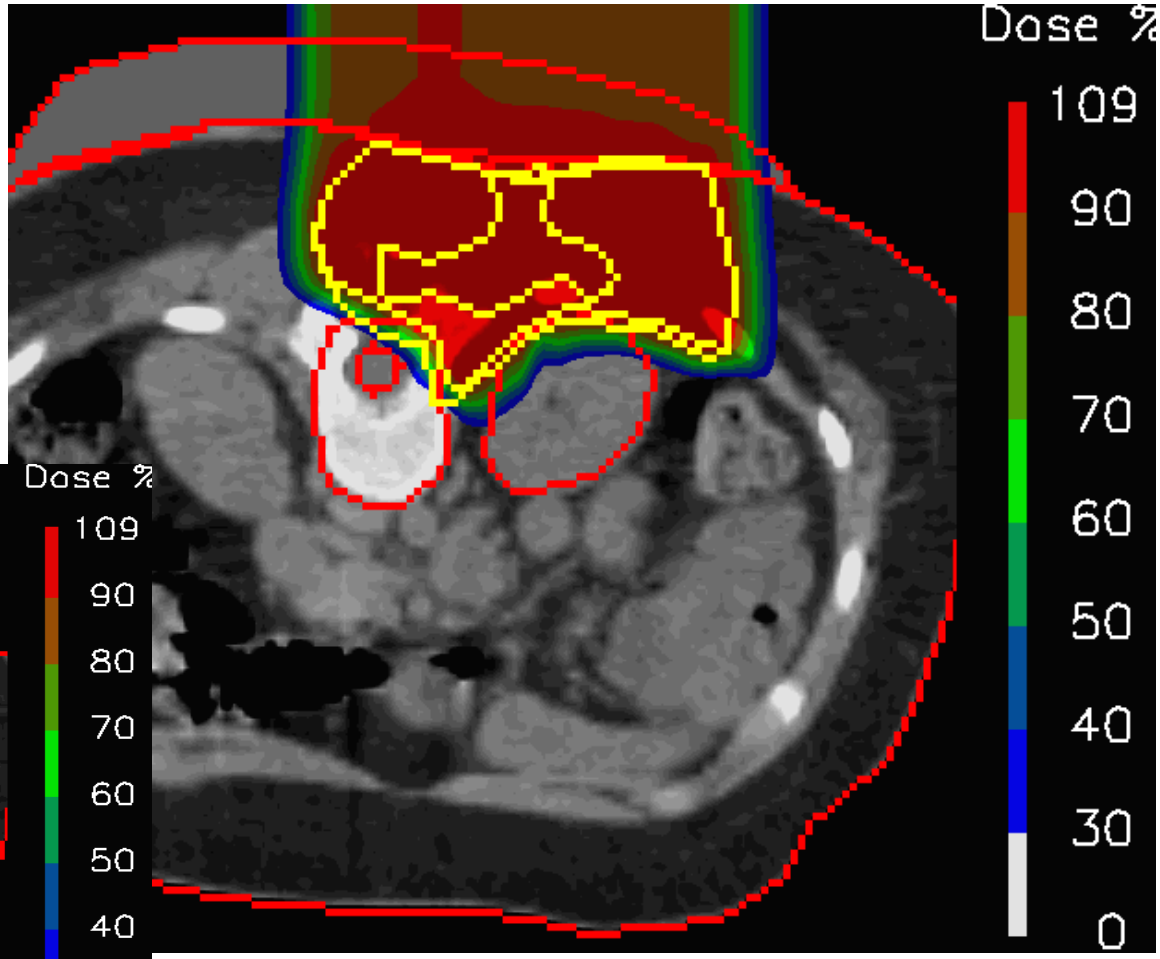
Note: Organ sparing in immediate proximity to the target

MedAustron

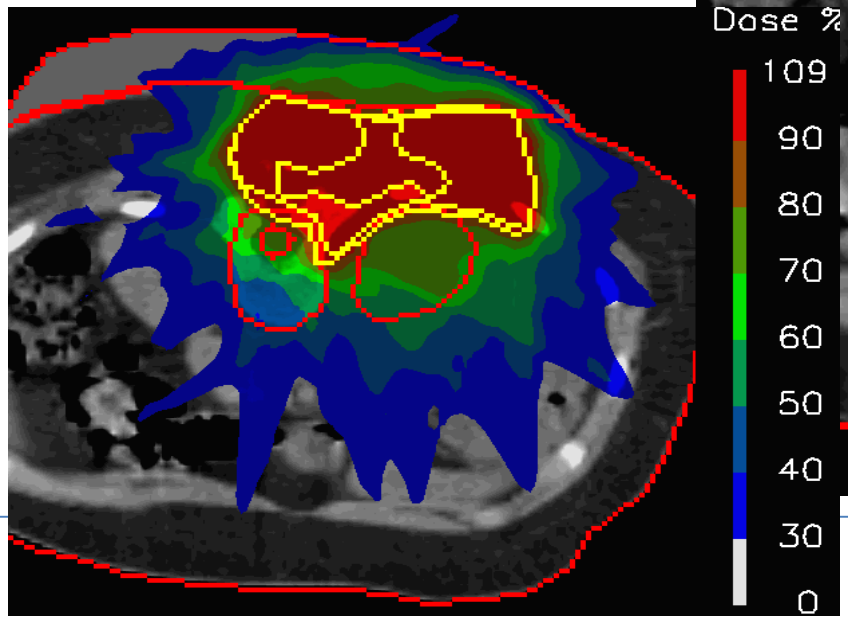
Protons

Dx: Rec. Desmoid, Boy, 2 yrs.

Dose:
50.0 Gy + 10.0 Gy



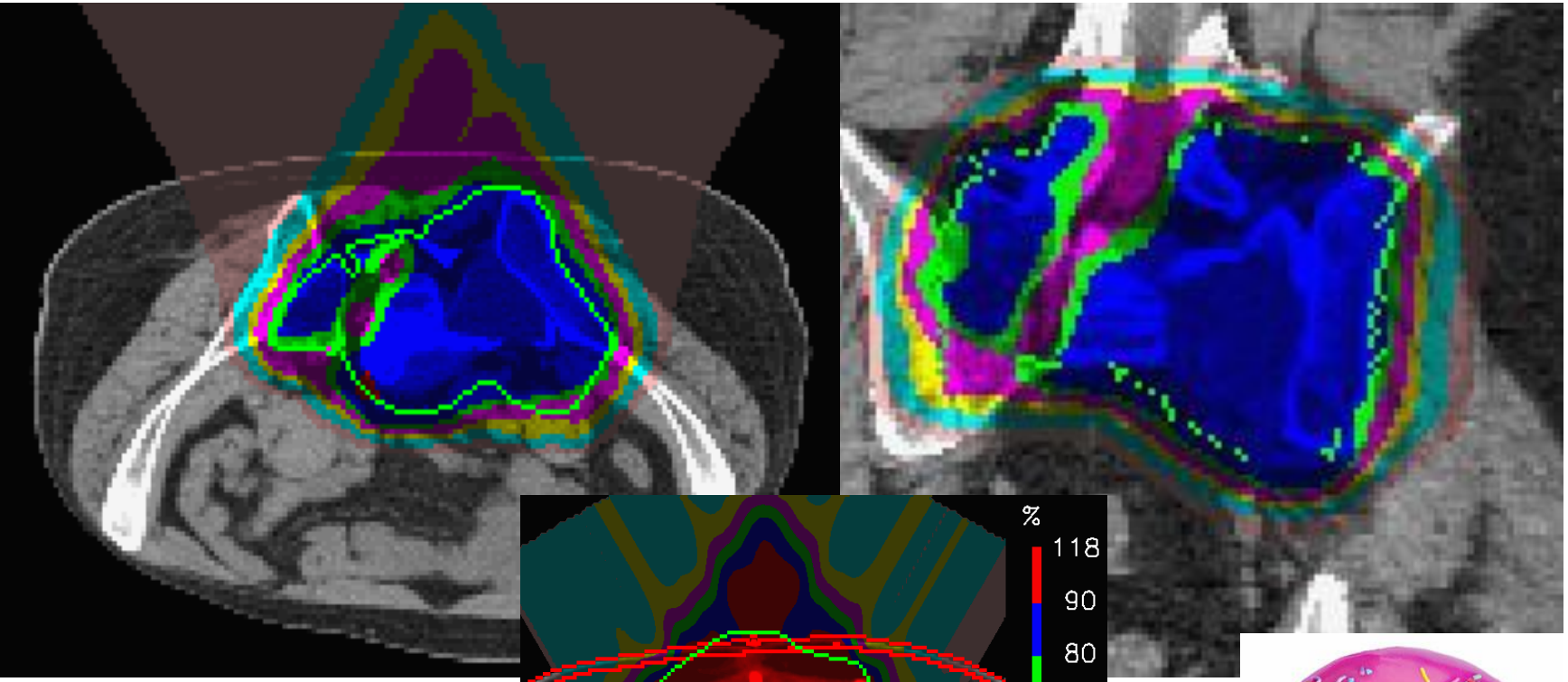
IMRT- Photons

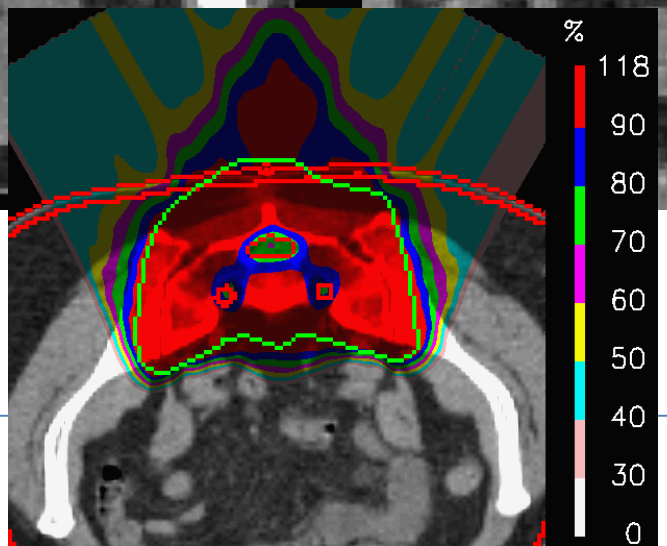


MedAustron

Active scanning: “sculpting” the dose:
Creating differential dose distributions within targets with relative ease – hot (SIB) or cold regions (OAR)

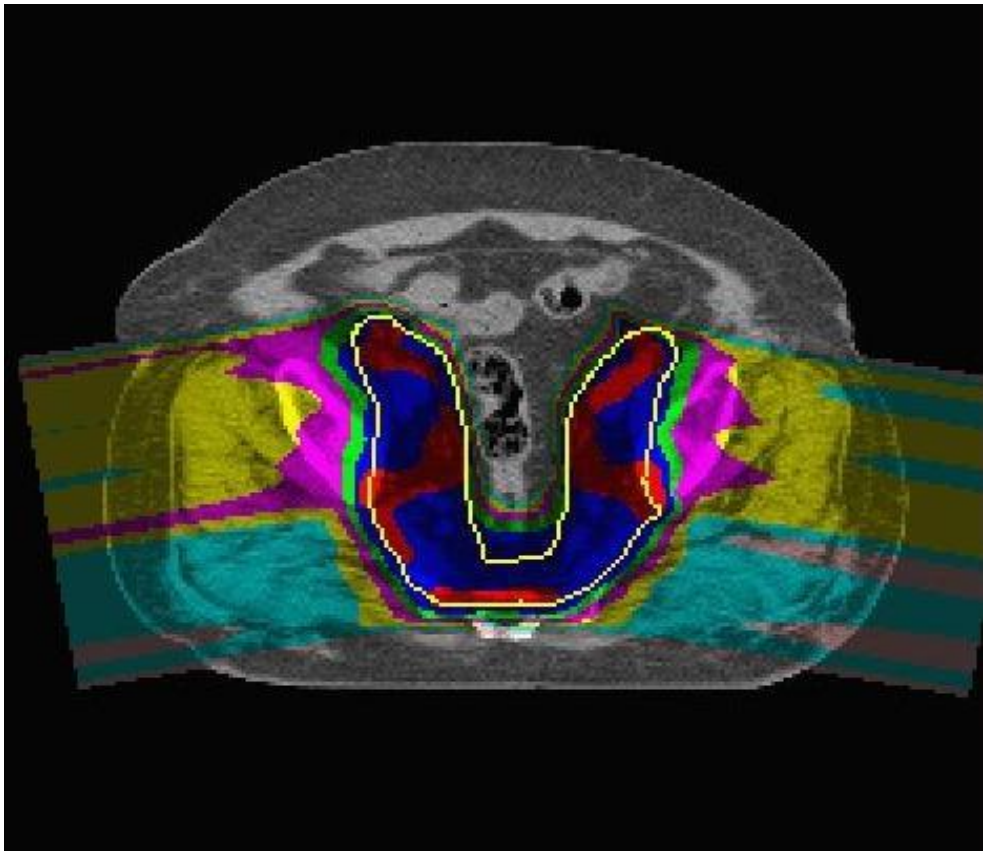
Example: sparing of selective nerve roots / cauda equina





Geometric advantages of proton therapy

Irradiation of Pelvic Lymph nodes with IMPT including selective boost.

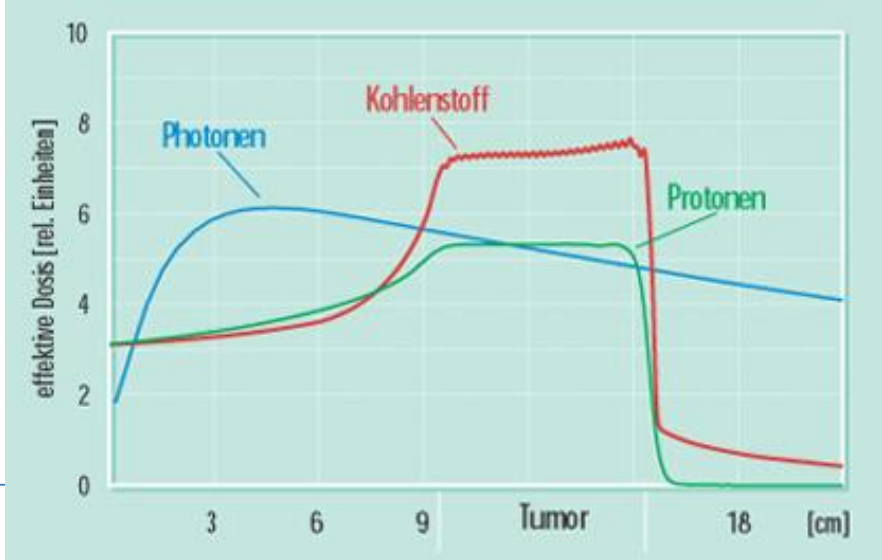


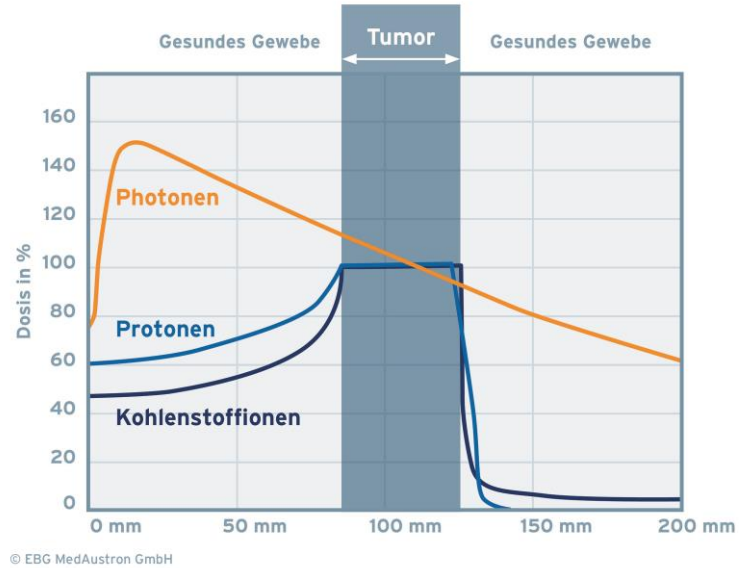
Particle Therapy -
The Quest for the Clinically Meaningful Benefit

Particle Community needs to focus <u>disease-subpopulation-specific</u> on realization of Proton's physical advantages and Carbon Ion's physical and radiobiological advantages

i.e.

to identify the subpopulation of patients most likely to maximally benefit from use of particle therapy.





From Construction to 1st Patient Treatment

MedAustron

- Center for ion beam therapy and research
- Synchotron allows protons and carbon ions
- „EBG MedAustron GmbH" was founded in 2007
  - indirect ownership of the federal state of Lower Austria

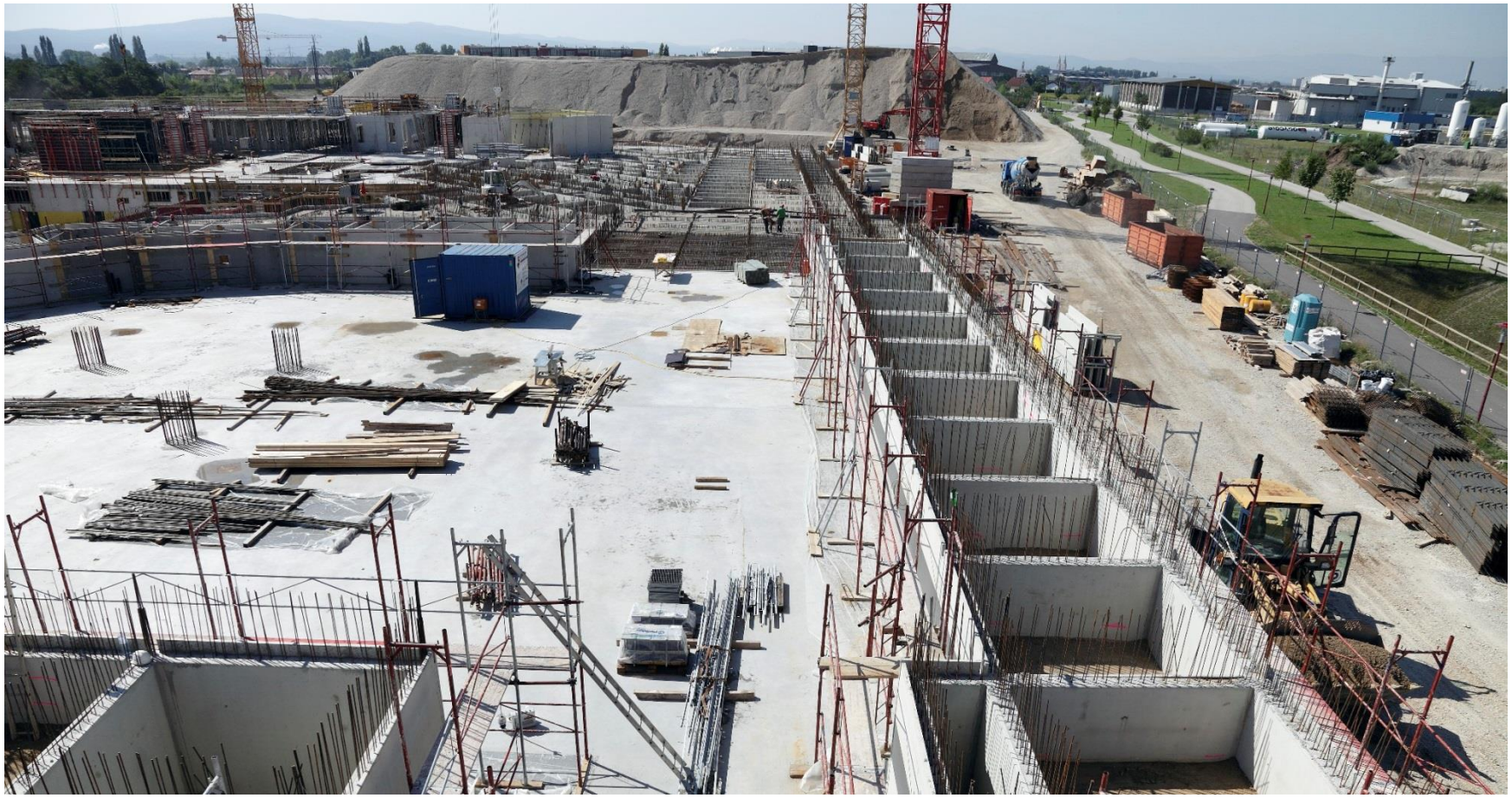
Investment

- Investment volume: € 200 million
  - 40% Accelerator
  - 30% Building
  - 10% Development & CE Certification
  - 10% Medical Infrastructure
  - 10% Others

Financing

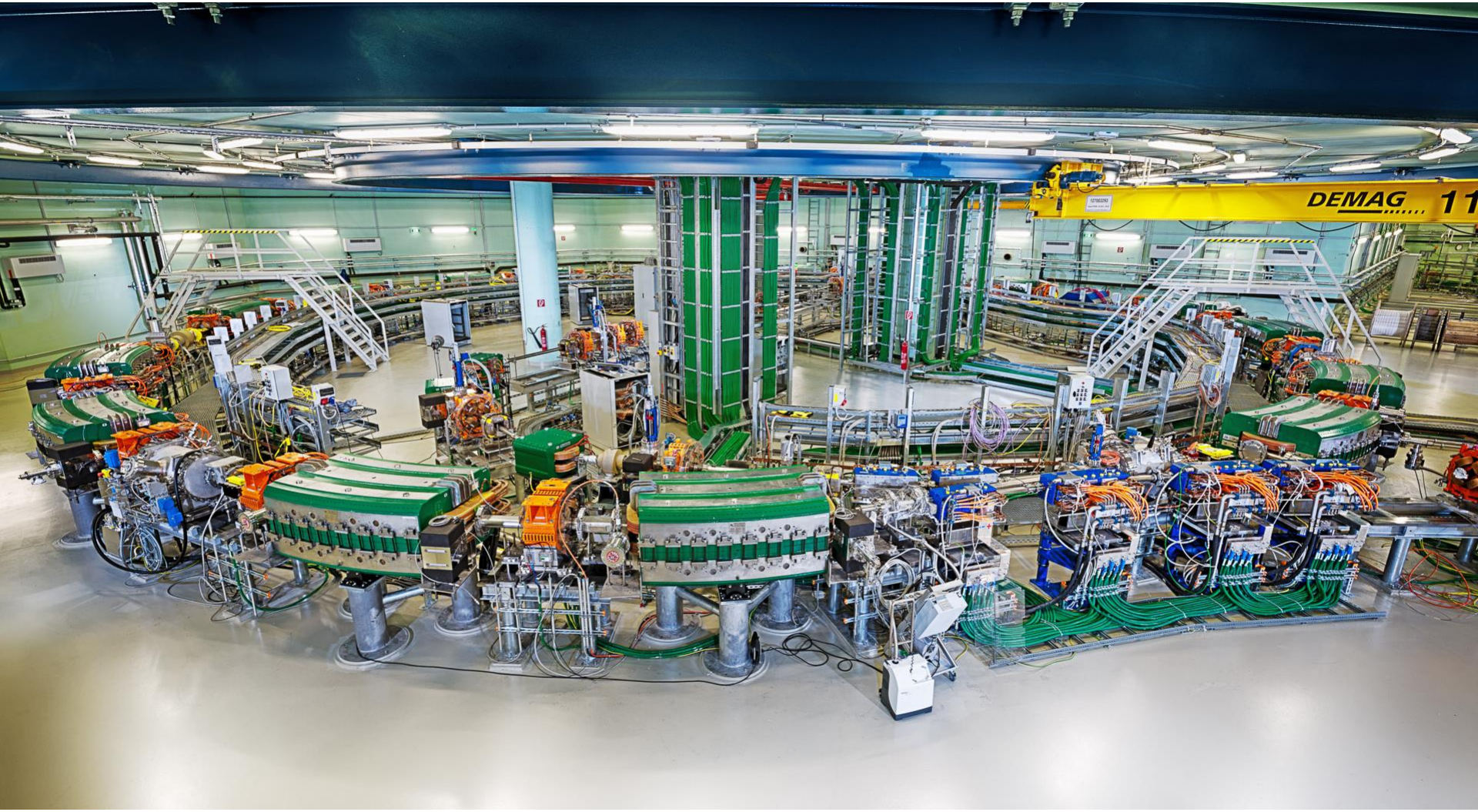
- Public sponsoring for „non clinical research“:
  - Republic of Austria
  - Federal State of Lower Austria
  - City of Wiener Neustadt
- Private financing of „clinic“
  - Bank loans
  - Equity/ guarantee from Federal State of Lower Austria

Construction 2011- 2012



March 2011: Construction Start

MedAustron


DEMAG


Irradiation Rooms
Treatment / Clinical Research:
4 Proton Gantry
3 Horizontal fixed beam
2 Horizontal and vertical fixed beam
Non-clinical Research:
1 Horizontal fixed beam
Ion Sources
Linear Accelerator
Synchrotron
4
2
3
1

MedAustron

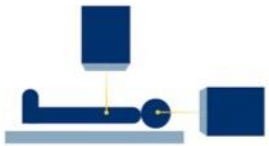
Irradiation Rooms

Horizontal Fixed Beam

p c

Protons &
Carbon Ions

Patient Treatment



Horizontal and
Vertical Fixed Beam

p c

Protons &
Carbon Ions

Patient Treatment

Gantry

p

Protons

Patient Treatment

Horizontal Fixed Beam

p c

Protons &
Carbon Ions

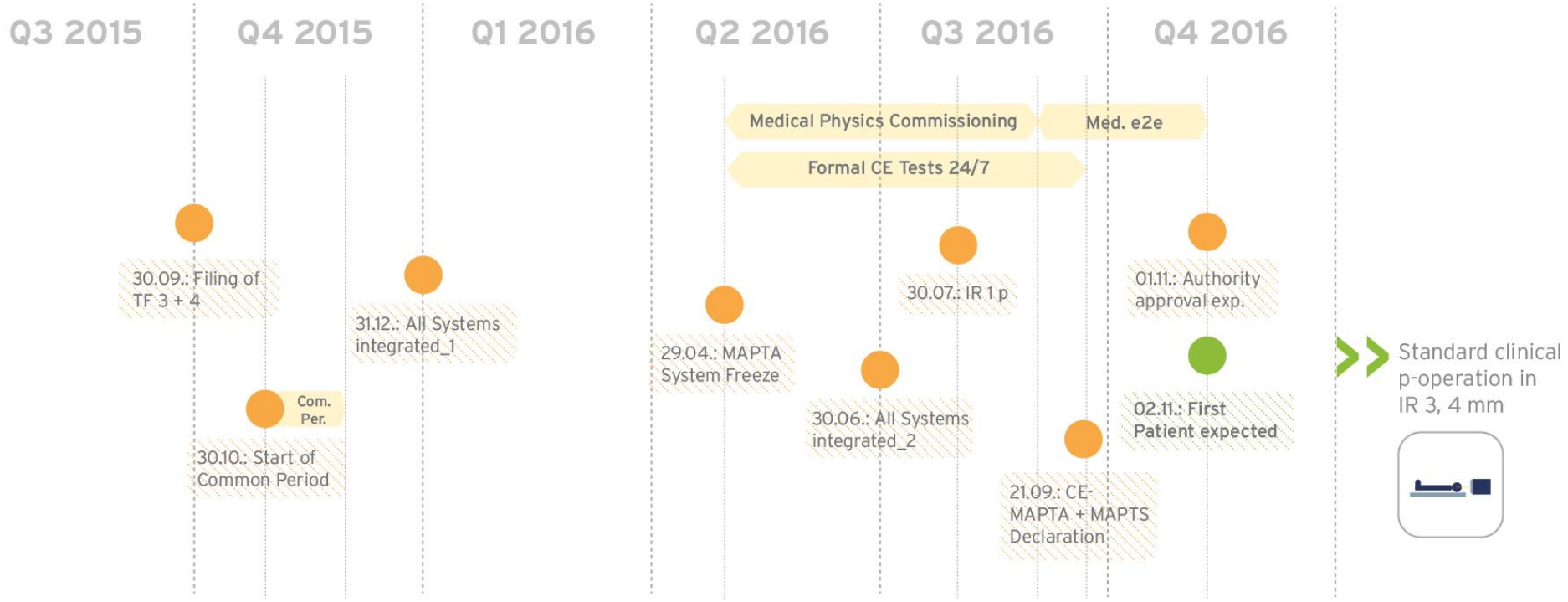
Non-clinical Research

MedAustron

Unique System for Patient Positioning

MedAustron

Timeline Short



MedAustron

"Adapted" Ramp Up / Road Map

	2016	2017	2018	2019	2020	2021
Modalities	p H	p H+V	p H+V c H+V	p H+V+Gantry* c H+V	p H+V+Gantry c H+V	p H+V+Gantry c H+V
Rooms	1	2	2	3	3	3
Med. Shifts	1	1	1	2	2	2

* Gantry cardinal angles in Q3/2019

Start of patient treatments in 2016

- Start in one treatment room =

  Horizontal fix beam line with protons
- Parallel commissioning of the other treatment rooms
- Increasing functionality by adding vertical beam line to horizontal beam line
- Carbon ion treatment will be starting in 2018
- The gantry will be available by 2019/2020
- Continuous increase of patient numbers

Research at MedAustron

- **Clinical Research**
- **Non-clinical research**
  - Radiobiology
  - Medical Translational Physics Research
  - Experimental Physics

MedAustron:
Clinical Perspectives and Indications

MedAustron

"Adapted" Ramp Up / Road Map

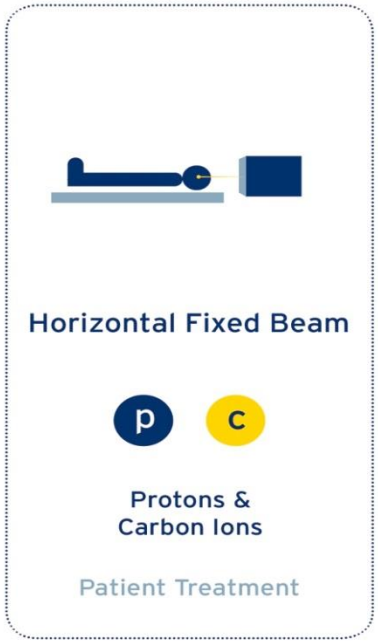
	2016	2017	2018	2019	2020	2021
Modalities	p H	p H+V	p H+V c H+V	p H+V+Gantry* c H+V	p H+V+Gantry c H+V	p H+V+Gantry c H+V
Rooms	1	2	[illegible]	3	3	3
Med. Shifts	1	[illegible]	[illegible]	[illegible]	2	2

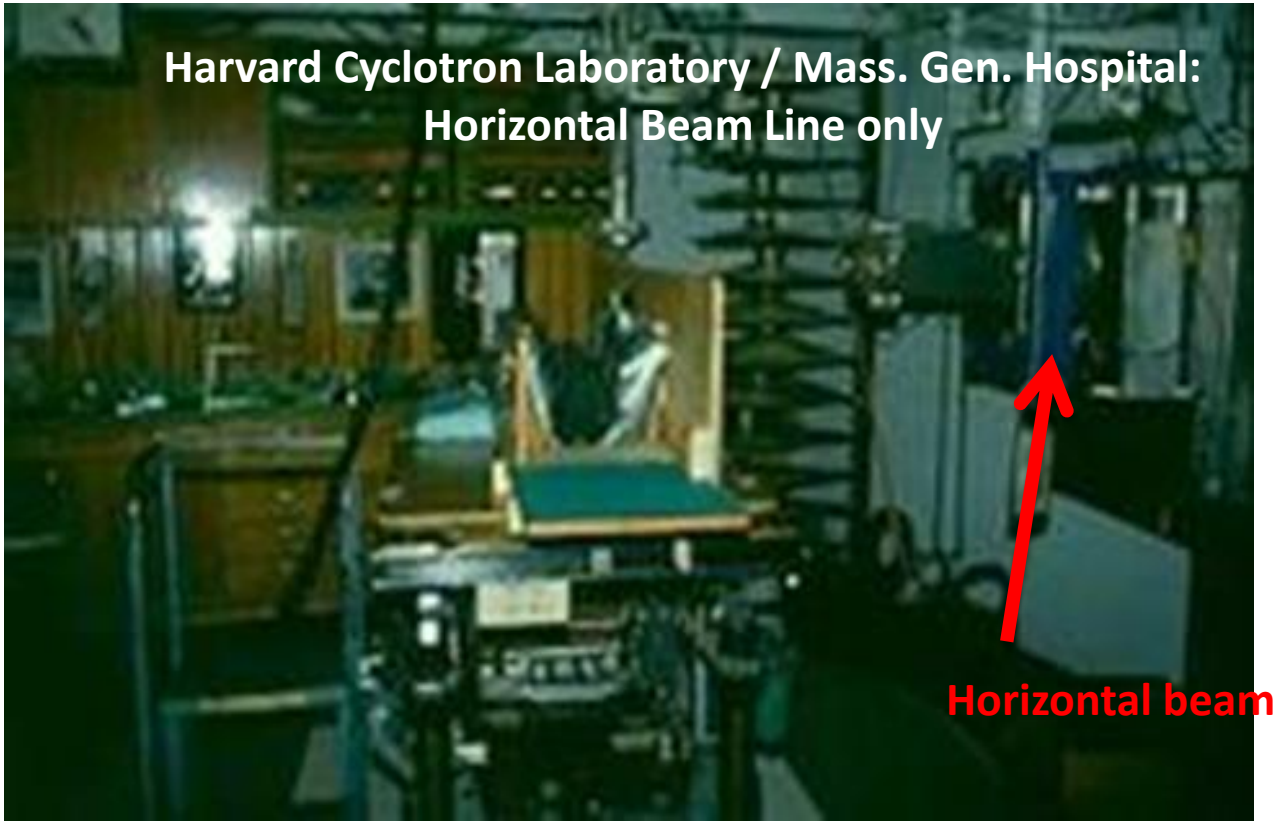
Clinical Implications

* Gantry cardinal angles in Q3/2019

Opportunities and Limitations of a Horizontal Beam Line:

MedAustron





- **Many long term data of "established indications" are based on treatments performed using horizontal beam line (chordomas, chondrosarcomas, skull base, paraspinal, prostate, pediatrics) at HCL**
- **Scanning technology increases capabilities to deliver treatment in horizontal planes**
- **We expect that approx. 30% of particle-eligible initial indications will require added field entries (CSI a.o.)**

MedAustron

MedAustron – Indications 2017/18

(Note: Majority „established" indications)

Skull Base (Chordomas, Chondrosarcomas)	RE-Irradiation
Pediatric Tumors (CNS, Sarcomas, other solid tumors)	Prostate
Head and Neck (Adenoid-Cystic, Paranasal Sinus)	
Sarcomas (Paraspinal, H&N, Truncal, Extremities)	
CNS (Meningiomas, Gliomas)	
Liver	

….. If suitable for horizontal and/or horizontal and vertical beam line

MedAustron – Indications 2020

(Note: already presently treated internationally and under study evaluation)

Skull Base	RE-Irradiation
Pediatric Tumors	**Thoracic Malignancies** Non-small-cell Lung Cancer (central, Stage III) Lymphomas Thymomas, Mesotheliomas
Head and Neck (Adenoid cystic, Paranasal sinus) **Parotid, Oropharynx, Re-irradiation with larynx preservation**	**Breast-Ca** left-sided, complex lymphatic RT, unusal anatomy
Sarcomas	**Gastrointestinal (upper)** Esophagus, Pancreas
CNS **(high grade gliomas??)**	**Gastrointenstinal (lower)** Anus, Rectum
Prostate	
Liver	

Patient treatments at MedAustron will be embedded in clinical studies

MedAustron

Clinical Study Opportunities and Concepts

- **“Registry-Study” = prospective data evaluation with 90% - 100% recruitment of patients treated at MedAustron**
- **Disease-specific Clinical Studies implemented at MedAustron and developed in collaboration with Austrian Oncology Groups**
- **Multicenter Trial participation with international Proton Centers**
- **Multicenter Trial participation with international Carbon-Ion Centers (HIT, CNAO NIRS)**

Registry Study

- an „umbrella" study to prospectively capture data on all patients treated at the center
- Data capture:

  Tumor-specific data (local control, disease progression)

  Patient Status (disease-specific survival, overall survival etc.)

  Acute and Late Side-Effects

  Optional: Quality of Life
- Status: Conditional approval by Ethics-Committee

MedAustron

Disease-specific Study Protocols at MedAustron developed collaboratively with Austrian Rad Onc Centers (A-IONTREB)
(P. Georg, Study Protocol Office)

- Chordomas, Chondrosarcomas (Skull Base, Paraspinal, Sacrum)
- Soft Tissue Sarcomas (pre- and postoperative)
- Meningiomas (Grade I-III)
- Gliomas (low- and high-grade (III))
- Prostate Ca (definitive and postoperative)

Potential International Collaborative Partners for clinical trials' participation

- NRG – formerly RTOG (Radiation Therapy Oncology Group) / USA
- COG (Children's Oncology Group) / USA and SIOP / Europe
- PCG: Proton Collaborative Group / USA;
- "single Institution-initiated" proton studies (MGH, MD Anderson, Univ. Florida, Univ. Penn., a.o.)
- Emerging European Initiatives: EORTC, IPACS
- Carbon Ion Studies: HIT (Heidelberg), CNAO (Pavia), NIRS (Japan)

Challenges of Clinical Particle Therapy

- Protons:
  - Paradigm: Particle Therapy has to demonstrate a significant clinical benefit over photon RT
  - Define most suitable tumor entities and patient subpopulations = clinical studies
  - Emerging Technology = further improvements on beam delivery, planning aspects, imaging etc.
  - Refinement / revision of universal concept of proton RBE = 1.1

Challenges of Clinical Particle Therapy

- Carbon-Ions:
  - Will Carbon Ions add a significant advantage over protons?
  - For which tumor entities and patient subgroups?
  - Will specific radiobiological advantages in vitro/in silico /in vivo translate into clinical results?
  - Will the international Carbon Ion Community be able to repeat single-institution resulsts?
  - Further refinements of RBE for tumors and normal tissues and therefore further refinements of biologically equivalent dose determination in treatment plans

Present, Radiobiologic Challenges of Clinical Particle Therapy

- Protons:
  - RBE optimization at end-of-range; revision/refinement of the universal RBE Concept of „1.1"
  - Incorporation of optimized RBE into treatment planning system
- Carbon-Ions:
  - RBE refinement of tumors and normal tissues
  - Increase RBE optimization and therefore dose precision of Local Effects Model, i.e. Treatment Planning System

MedAustron is a stand-alone Ion Therapy Facility within Austria

MedAustron will be integrated in the Radiation Oncology Community Austrias and the Particle Therapy Community within Europe and worldwide based on Clinical, Translational and Basic Science Research Collaborations.