

The Austrian Synergies between Universities and MedAustron



Thomas Schreiner
PEG MedAustron
November 3, 2016

Centre for Ion-Beam Therapy and Research

▶ radiation therapy and clinical research

- ▶ protons and carbon ions
- ▶ 24 000 single fractions per year
corresponds to about 100 patients/day
corresponds to about 1200 patients/year
- ▶ three medical irradiation rooms
- ▶ two shift operation from Monday to Friday

▶ non-clinical research

- ▶ protons and light ions
- ▶ one irradiation room dedicated for non-clinical research
- ▶ labs for non-clinical purposes



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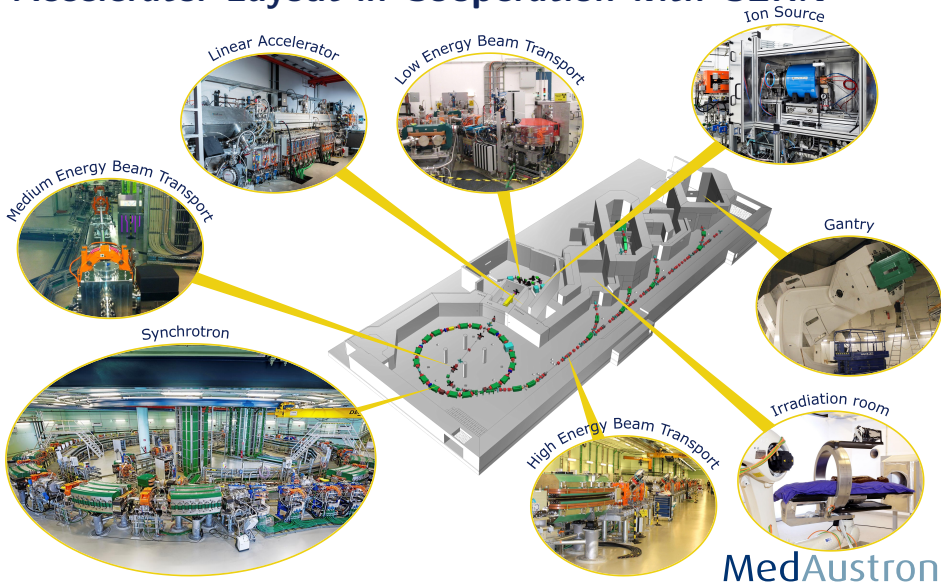


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Beam Parameters for Non-Clinical Research

particles:	protons	carbon ions
	later additional ions like He or O	
beam intensity particles per pulse:	$\leq 10^{10}$	$\leq 4 \times 10^8$
beam energy min – max:	60–800 MeV	120–400 MeV/A
magnetic rigidity min – max:	1.14–4.88 Tm	3.25–6.35 Tm
extraction duration min – max:	0.1–10 s	0.1–10 s
beam delivery active scanning	horizontal-vertical fast scanning magnets energy variation with synchrotron	

Accelerator Layout in Cooperation with CERN



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Irradiation Rooms

treatment & clinical research:

horizontal fixed beam (IR 3)

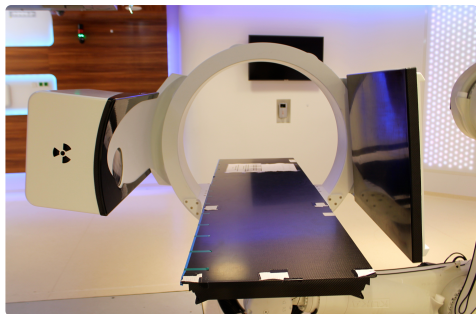
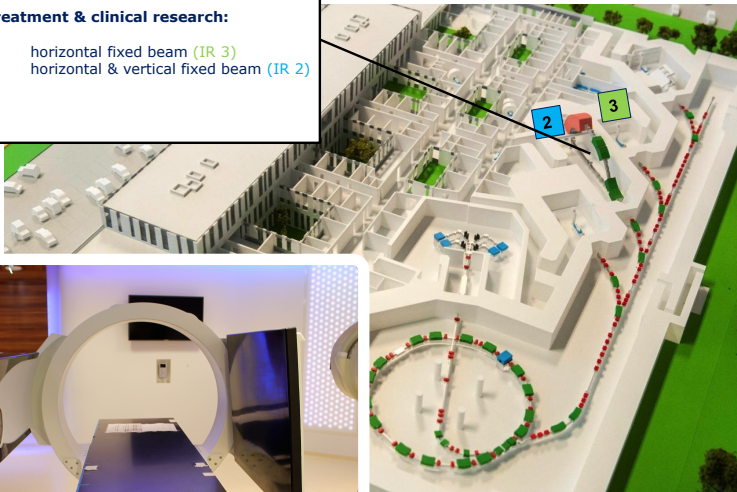


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Irradiation Rooms

treatment & clinical research:

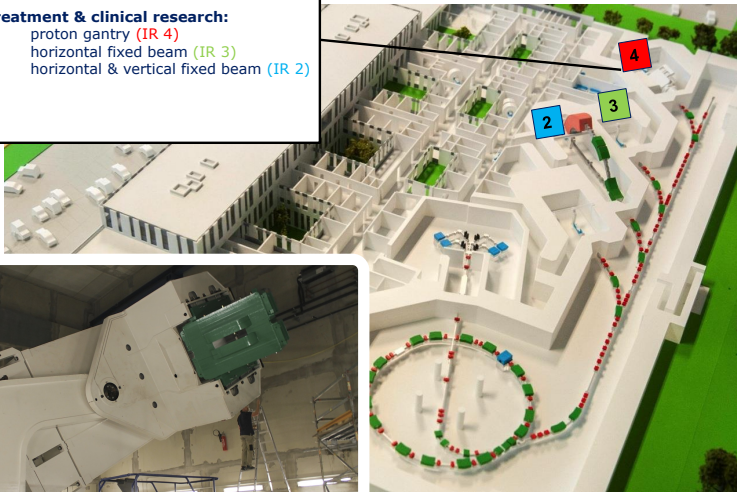
- horizontal fixed beam (IR 3)
- horizontal & vertical fixed beam (IR 2)



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Irradiation Rooms

treatment & clinical research:
proton gantry (IR 4)
horizontal fixed beam (IR 3)
horizontal & vertical fixed beam (IR 2)

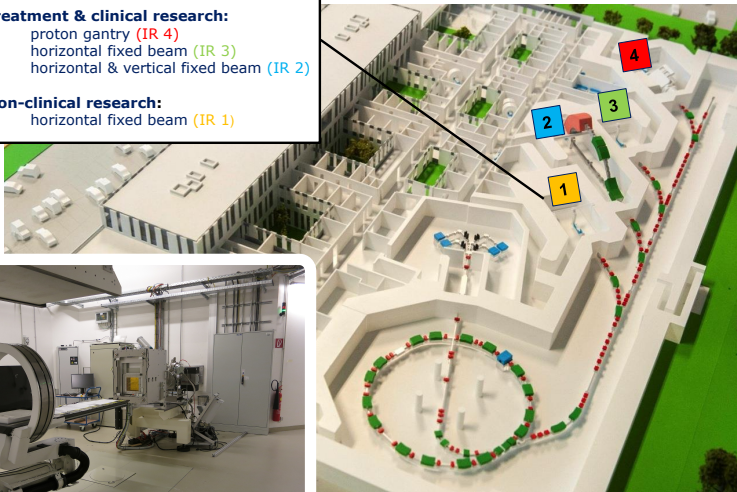


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Irradiation Rooms

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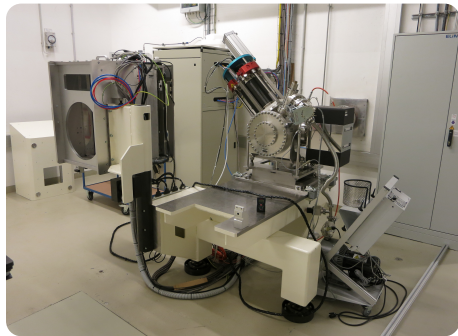
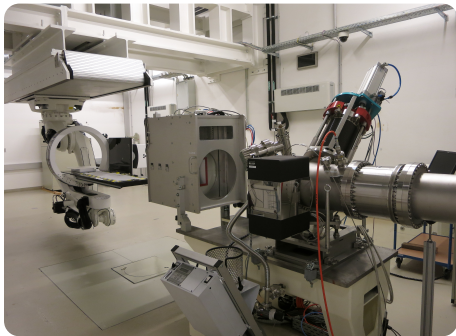
non-clinical research:
horizontal fixed beam (IR 1)



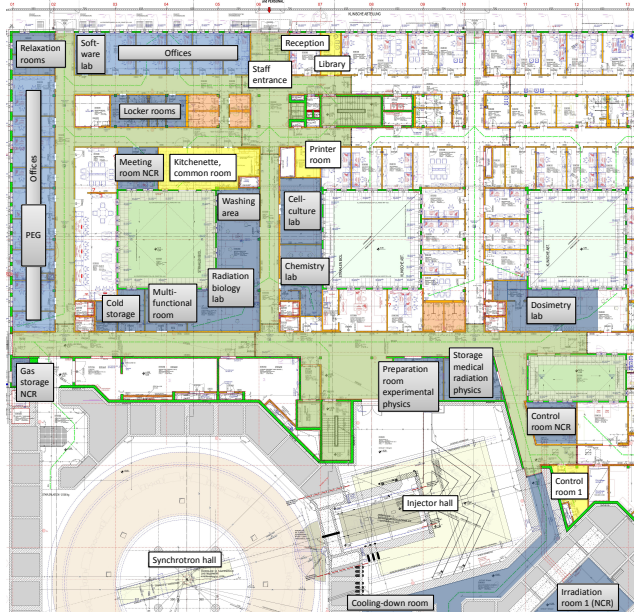
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Non-Clinical Irradiation Room – IR 1

- ▶ dedicated irradiation room with 8 m × 12 m, i. e. 96 m²
- ▶ up to 800 MeV protons
- ▶ cooling-down room for storage of activated material
- ▶ same positioning and verification system as in the medical rooms



Non-Clinical Research Infrastructure



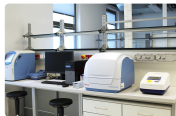
area on the
ground floor

- ▶ offices
- ▶ labs
- ▶ storage
- ▶ IR1

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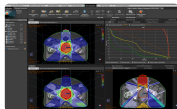
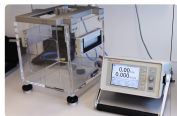
Dedicated Laboratories and Equipment

- ▶ cell culture laboratory
incubators, laminar flows, microscopes
- ▶ chemical laboratory
digestor, safety storage cabinets, acid and lye liquids
- ▶ main laboratory radiation biology
histology equipment, cell counter, X-ray reference
radiation source, washing room, freezer, cooling cell

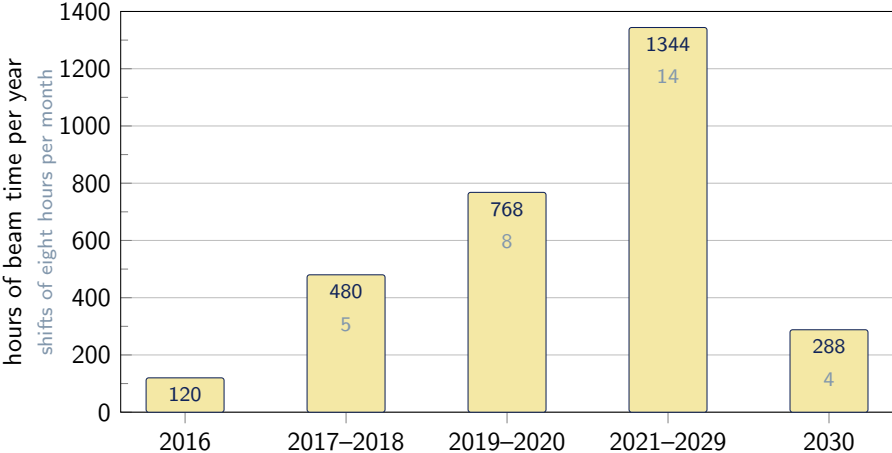


Dedicated Laboratories and Equipment

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- ▶ main laboratory radiation biology
histology equipment, cell counter, X-ray reference radiation source, washing room, freezer, cooling cell
- ▶ dosimetry laboratory
water phantoms, dosimeters, scintillation detector
- ▶ software laboratory
research licences for treatment planning system (RaySearch), Monte Carlo simulation



Beam Time for Non-Clinical Research



Links to Universities – Professorships

Medical Radiation
Physics with Special-
isation in Ion Therapy

Medical Radiation
Physics and
Oncotechnology

Applied and
Translational
Radiation Biology



Lembit Sihver



Dietmar Georg



Wolfgang Dörr



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Links to Universities – Research Programme

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Non-Clinical Research Strategy

2016 – 2017 – 2018

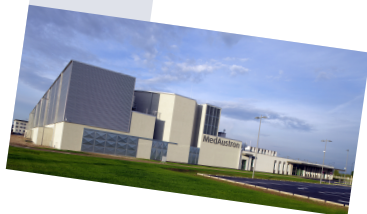


MEDICAL
UNIVERSITY
OF VIENNA



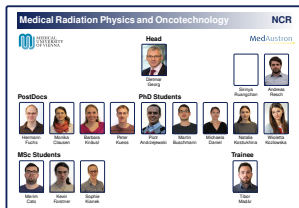
TECHNISCHE
UNIVERSITÄT
WIEN

This book presents, for each of the different research groups (i.e. Medical Radiation Physics and Oncotechnology, Applied and Translational Radiobiology, Radiation Physics), an interim research strategy for non-clinical research at MedAustron for the years 2016 to 2018. More specifically, it describes in detail the intended research activities, the involved researchers and personnel, the required equipment and the necessary beam time.



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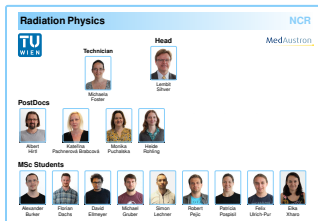
Links to Universities – Work Packages



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- [1] Patties I, Haagen J, Dörr W, Hildebrandt G, Glasow A. Late inflammatory and thrombotic changes in irradiated hearts of 5ZBL/6 wild-type and atherosclerosis-prone ApoE-deficient mice. *Strahlenther Onkol* 191 (2): 172–179; Feb. 2015.
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- [13] Fuchs H, Alber M, Schreiner T, Georg D. Implementation of spot scanning dose optimization and dose calculation for helium ions in Hyperion. *Med Phys* 42 (9): 5157–5166; Aug. 2015.
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- [16] Pachnerová Brabcová K, Štěpán V, Karamitos M, et al. Contribution of indirect effects to clustered damage in DNA irradiated with protons. *Radiat Prot Dosim* 166: 44–48; Sept. 2015.
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- [12] Góra J. “Adaptive radiotherapy and treatment planning strategies for ion beam therapy”. PhD thesis. Department of Radiation Oncology, Medical University of Vienna, Dec. 2015.

🔗 PhD Theses: 4

🔗 MSc Theses: 2

🔗 BSc Theses: 6

18 publications

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Publications and Theses – 2016 (preliminary)

- [1] Buschmann M, Seppenwoolde Y, Wiezorek T, Weibert K, Georg D. Advanced optimization methods for whole pelvic and local prostate external beam therapy. *Phys Med* 32 (3): 465–473; Mar. 2016.
- [2] Knäusel B, Fuchs H, Dieckmann K, Georg D. Can particle beam therapy be improved using helium ions? – A planning study focusing on pediatric patients. *Acta Oncol* 55 (6): 751–759; June 2016.
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3 publications and 12 submitted

- [1] Hager M. "A Software Solution for the Dosimetric Verification of Treatment Plans with a Three-Dimensional Ionization Chamber Array". Master's thesis. MedTech, Fachhochschule Wiener Neustadt, 2016.
- [2] Kertesz H. "ARDOS Phantom: Research applications including further developments". Master's thesis. MedTech, Fachhochschule Wiener Neustadt, 2016.
- [3] Gnam L. "Monte Carlo based Dose Calculation for an X-Irradiator in pre-clinical Research". Master's thesis. Department of Radiation Oncology, Medical University of Vienna, Jan. 2016.
- [4] Guber A. "Expression von γ H2AX in HaCaT-Zellen im zeitlichen Verlauf nach Strahlenexposition – Abhängigkeit von den Kulturbedingungen". Bachelor's thesis. Biomedizinische Analytik, Fachhochschule Wiener Neustadt, May 2016.
- [5] Gruber S. "Epithelial cell signaling in radiation-induced oral mucositis as a basis for biological targeting – preclinical studies". PhD thesis. Department of Radiation Oncology, Medical University of Vienna, May 2016.
- [6] Illedits S. "Strahleneffekte auf Fibroblasten: Veränderungen der γ -H2AX-Expression". Bachelor's thesis. Biomedizinische Analytik, Fachhochschule Wiener Neustadt, May 2016.
- [7] Komornik L. "Radiogene Veränderungen in der Expression von γ -H2AX in FaDu-Tumorzellen – Einfluss der Kulturbedingungen". Bachelor's thesis. Biomedizinische Analytik, Fachhochschule Wiener Neustadt, May 2016.
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- [9] Reumann V. "Strahleninduzierte Veränderungen der Expression von TGF- β in normalen humanen Fibroblasten". Bachelor's thesis. Biomedizinische Analytik, Fachhochschule Wiener Neustadt, May 2016.
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- [12] Zeiler J. "Manifestation hypoxischer Bereiche in Tumor-Sphäroiden in Abhängigkeit der Sphäroidgröße". Bachelor's thesis. Biomedizinische Analytik, Fachhochschule Wiener Neustadt, May 2016.

📄 PhD Theses: 1

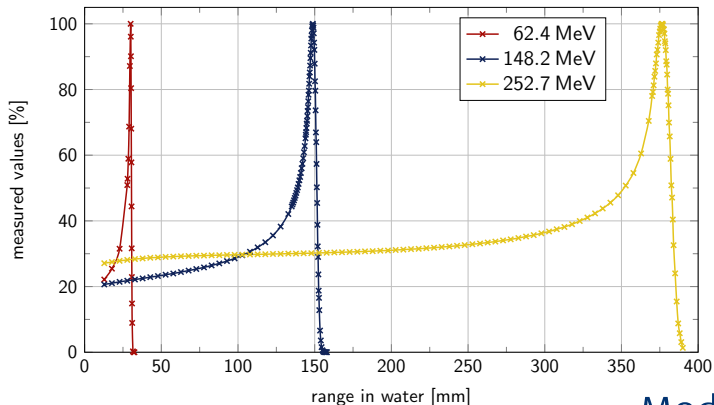
📄 MSc Theses: 3 (+5)

📄 BSc Theses: 8

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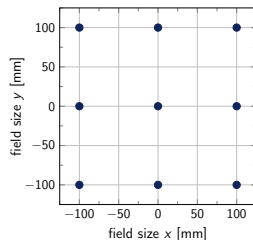
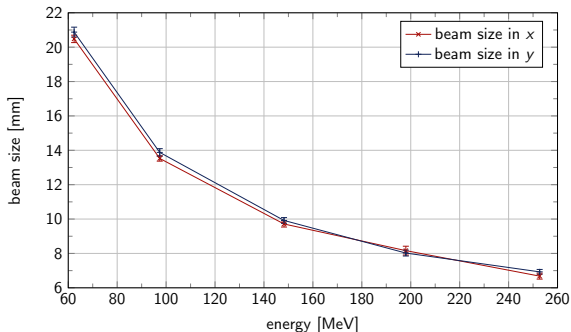
Status and Outlook

- ▶ acceptance tests of delivered beam parameters finished in August/September 2016
 - ▶ proton ranges: 30 mm to 380 mm \Leftrightarrow energy: 62.4 MeV to 252.7 MeV



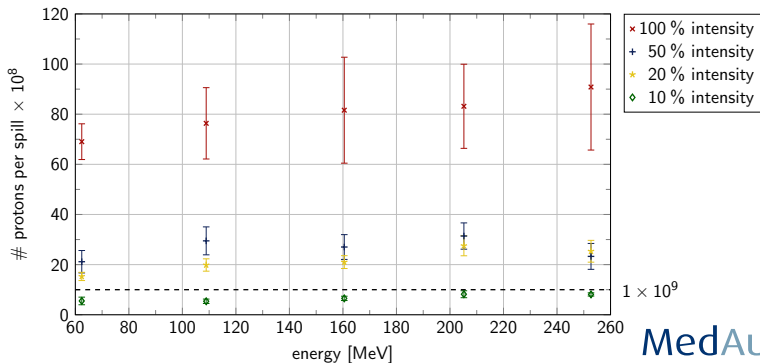
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 - ▶ scanning system and beam size of 4 mm FWHM at isocentre in vacuum



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Status and Outlook

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 - ▶ scanning system and beam size of 4 mm FWHM at isocentre in vacuum
 - ▶ $>10^9$ protons per spill
- ▶ non-clinical research programme started with beam time in October
 - ▶ five shifts (5 \times 8 hours) per month beam time with successive increase in the upcoming years
 - ▶ commissioning of dosimetric equipment and treatment planning system
- ▶ beginning of clinical operation by the end of 2016
- ▶ commissioning of additional beam lines and beam parameters, such as 800 MeV protons and carbon ions
- ▶ first carbon beams for non-clinical research in January 2018
- ▶ additional ion beams (He, O) at the earliest in 2020

Thank you for your attention!

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