Medical Physics in Radiology
at the
German Cancer Research Center (DKFZ)

Head: Prof. Dr. Mark E. Ladd

dkfz.
GERMAN
CANCER RESEARCH CENTER
IN THE HELMHOLTZ ASSOCIATION

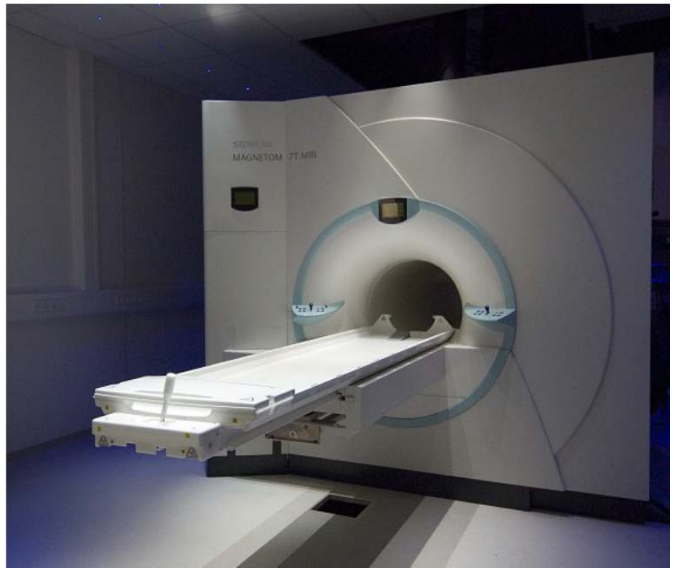
Research for a Life without Cancer

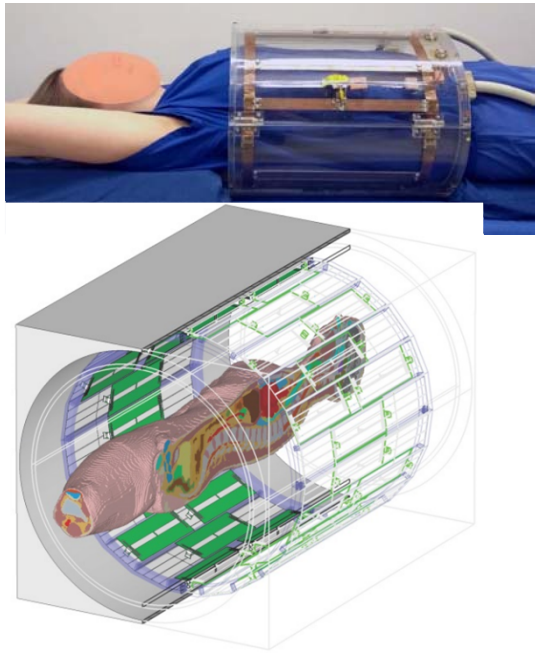
DKFZ – Medical Physics in Radiology

Abteilung Medizinische Physik in Radiologie – Deutsches Krebsforschungszentrum

Main subject: Magnetic Resonance Imaging (MRI)

- **Hardware development for whole-body 7T MRI: MRExcite**





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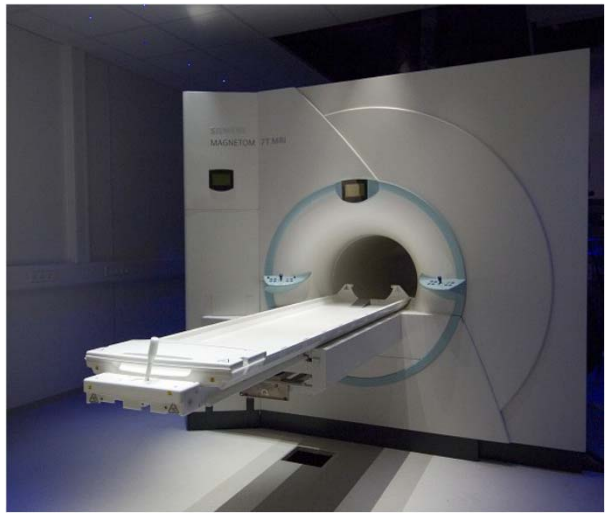
- **Design study: 14 Tesla human MRI**

7 T human MRI



Design study: 14 T

courtesy Tesla Engineering

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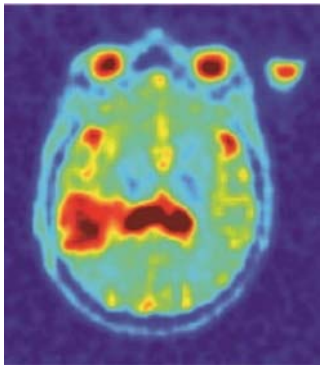
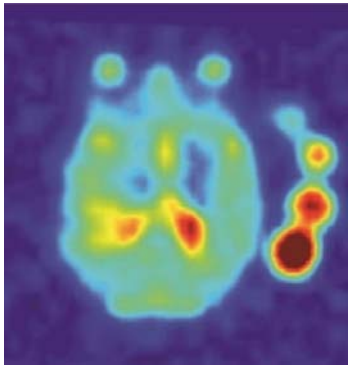
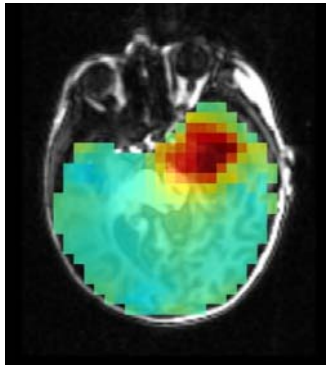
- **X-nuclei imaging: Na, Cl, K, P, O-17**

Concentration of ions (^{23}Na, ^{35}Cl)

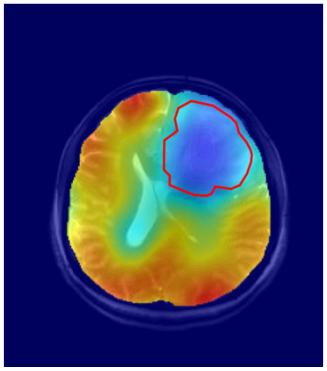




pH mapping (^{31}P)



Oxygen (^{17}O) consumption



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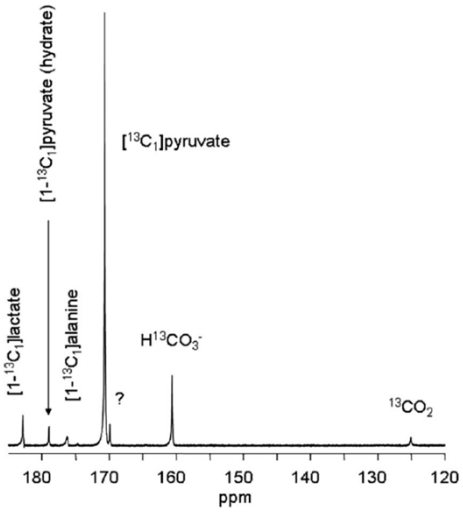
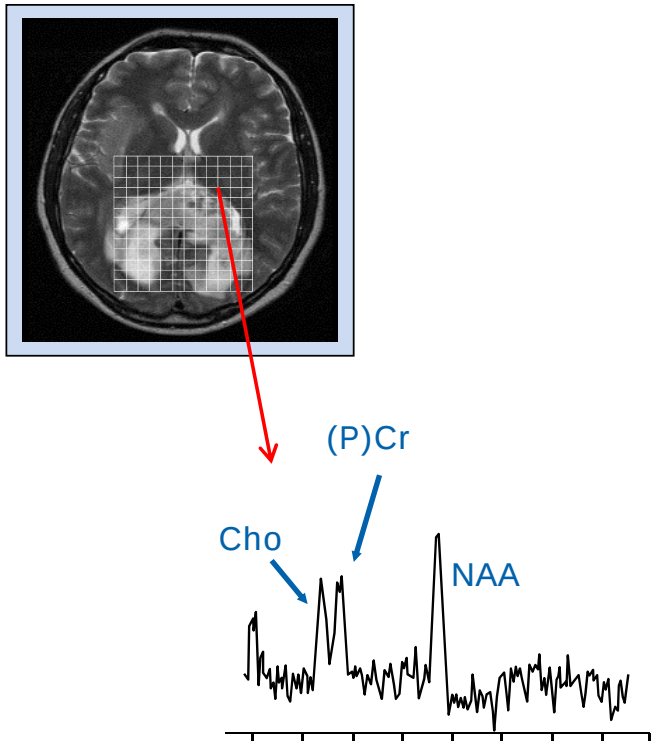
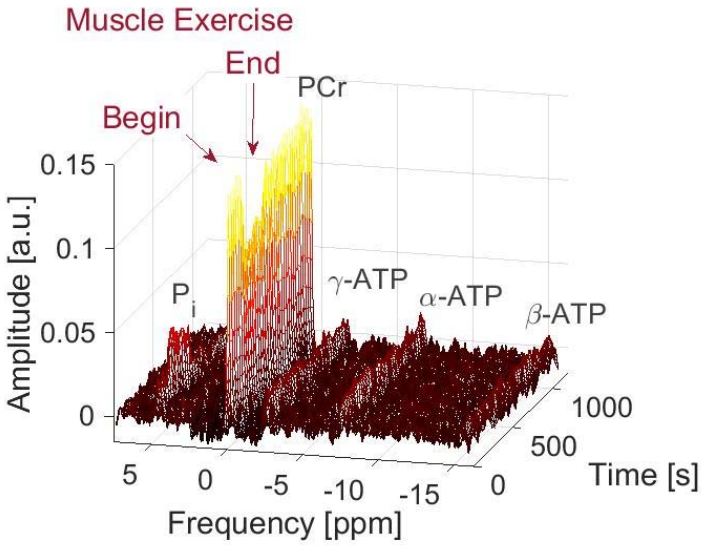
- **Spectroscopy**

Pyruvate





Dynamic ^{31}P calf MRSI



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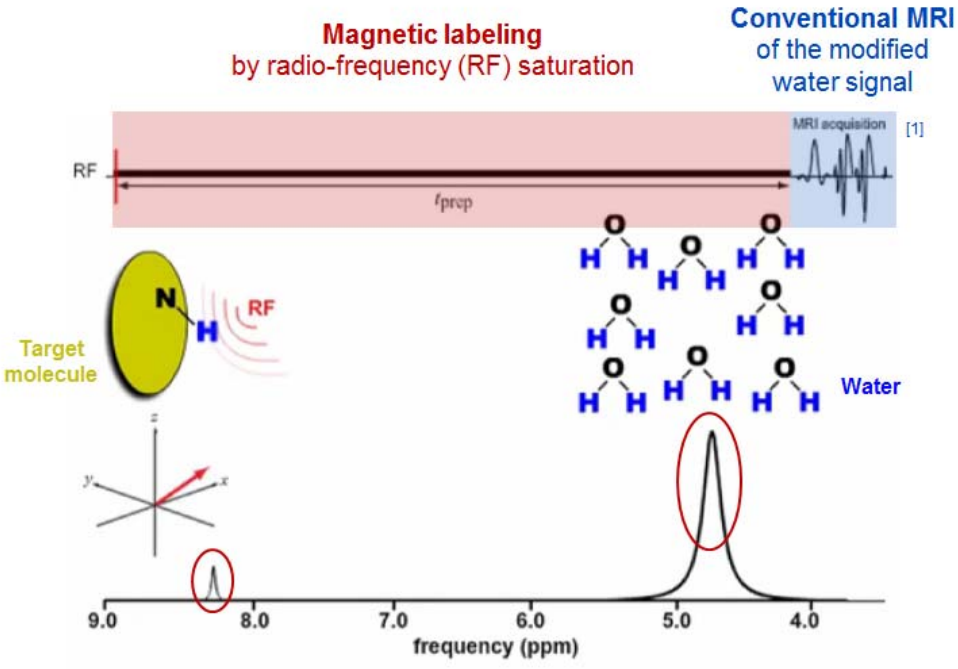
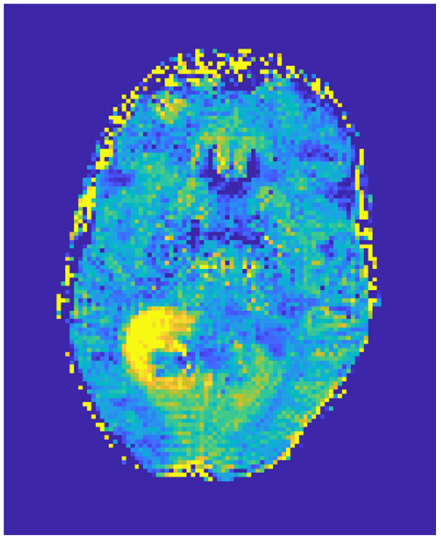
- **Chemical Exchange Saturation Transfer (CEST)**



Protein
CEST MRI



[1] Yadav N. *John Hopkins University*, Baltimore

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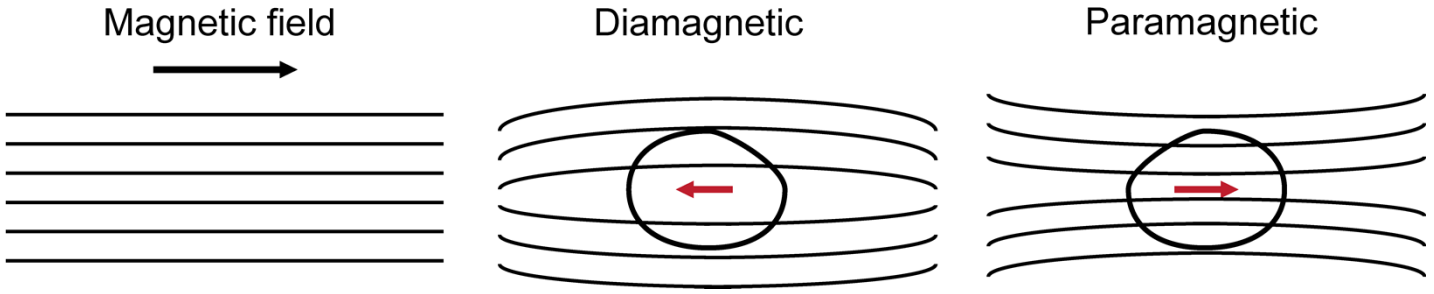
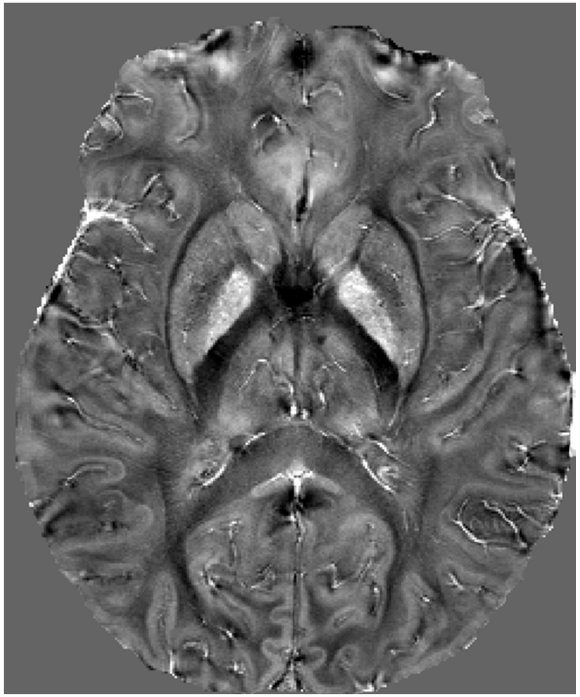
- **Quantitative Susceptibility Mapping (QSM)**





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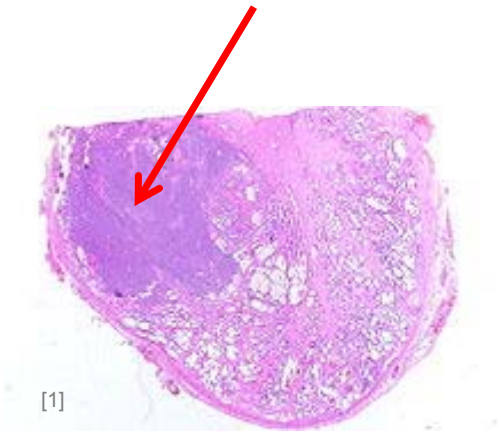
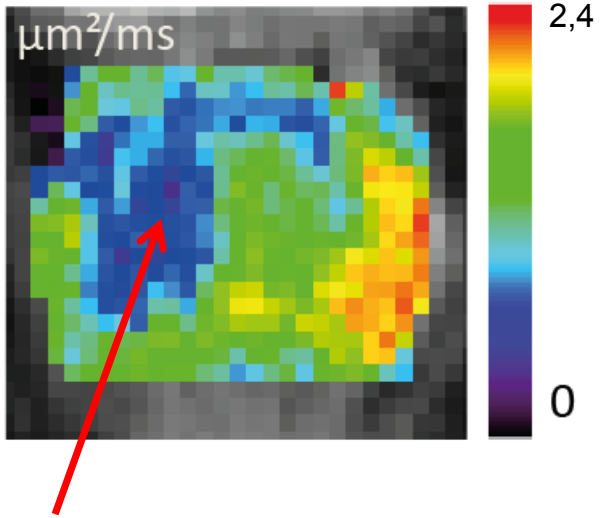
- **Diffusion-Weighted MRI (DWI)**

Tumor: Denser cell packaging

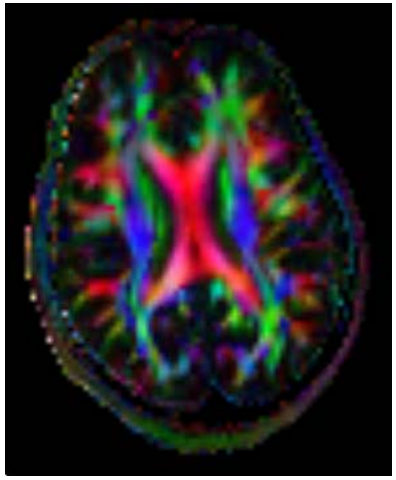


Diffusion coefficient



Reduced diffusion distance

White matter fiber orientation



[1] Wikipedia

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- **Hyperpolarized contrast media: Xe-129, C-13**

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- **Hyperpolarized contrast media: Xe-129, C-13**

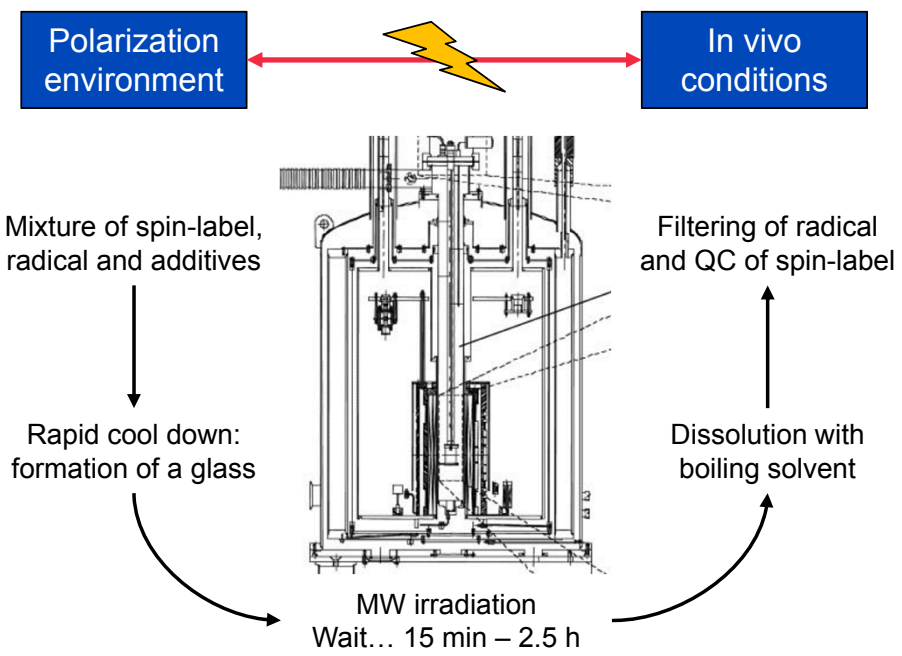
GE Spinlab Polarizer

Cryogenic sample cup: T = 0.8 K

Superconducting magnet: B_0 = 5 T

MW resonator: f = 138.5 – 140.5 GHz

Dissolution system



Ardenkjaer-Larsen et. al., PNAS (2003)

Application in vivo	
+ Dissolution & QC	~ 15 – 20 s
+ Transport to scanner	~ 5 – 10 s
+ Injection process	~ 10 s
Residual polarization in vivo	≈ 1-10%

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- **Further Systems and Topics:**

Combined PET-MRI System

Preclinical 9.4 T PET/MR scanner

- **Optical Imaging:** Fluorescence imaging, mainly for preclinical applications

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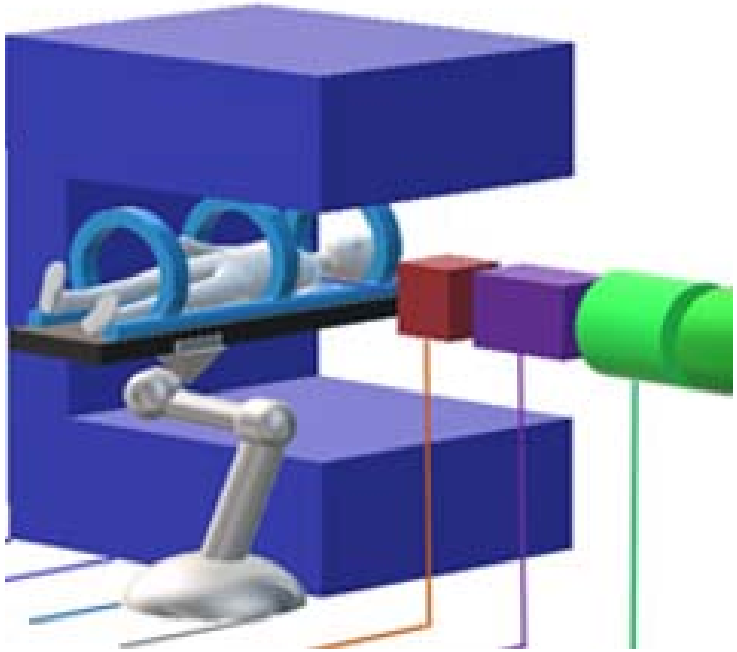
- **Further Systems and Topics:**
  MR-guided radiation therapy, in cooperation with the radiation therapy departments

Combined MR-Linac

Projected MR-guidance at HIT



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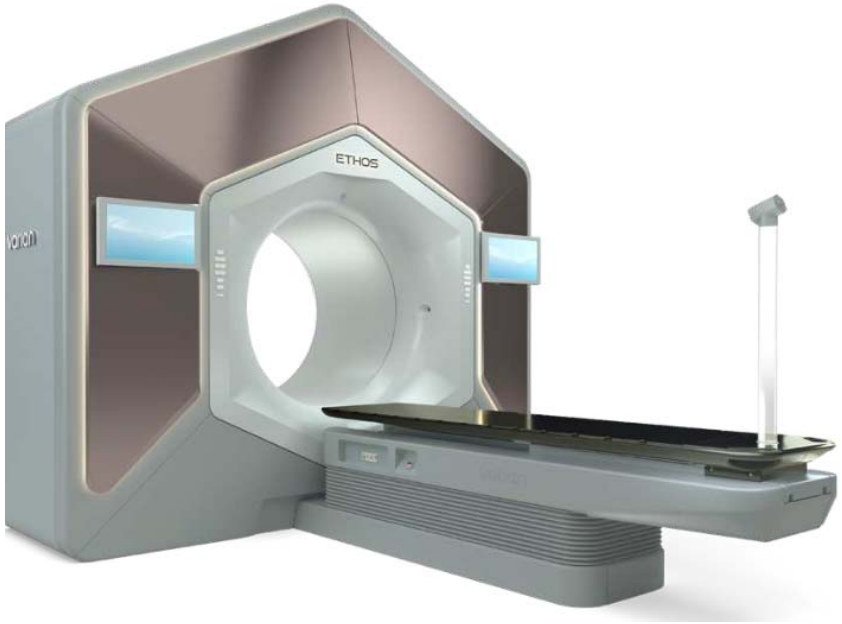
- **Planned Installations**

3 Tesla MRI with strong gradients
e.g. for diffusion MRI

Linear Accelerator
planned with MR guidance using shuttle system
(operated by the radiation therapy departments)



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