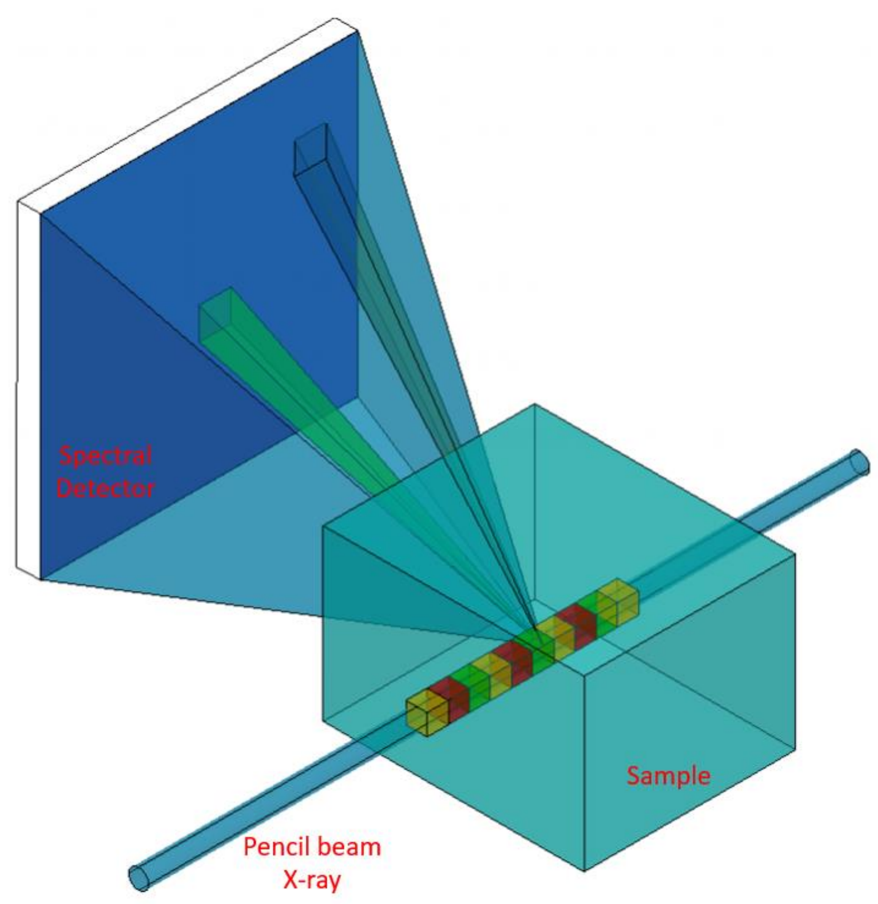
Radiation Physics research group
Centre for X-ray Tomography

Simulation of X-ray imaging
Predict and quantify

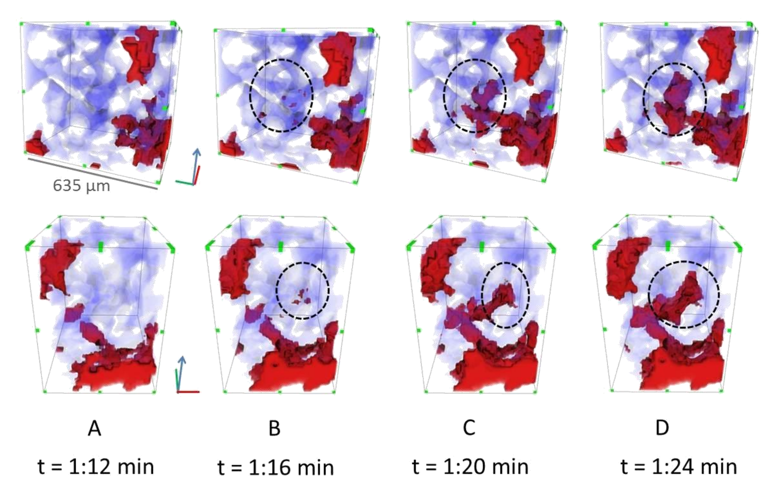
The Radiation Physics group developed a realistic projection simulator for laboratory based X-ray CT and X-ray fluorescence. Being able to create simulated data is key in the development of new algorithms for data processing, the optimization of acquisition schemes and the training and evaluation of machine learning methods.



Geometry of XRF imaging, where a pencil beam is used as primary radiation to generate fluorescence. Both the primary X-ray beam and the fluorescent radiation undergo attenuation by the sample

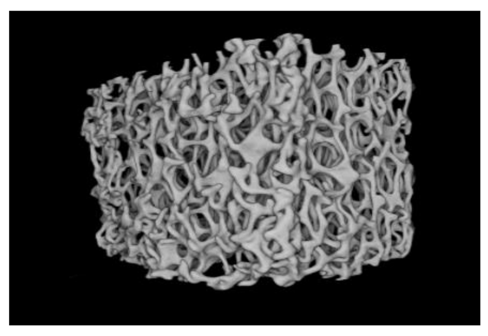
4D-µCT dynamic imaging
Analyzing fast processes

Due to its non-destructive nature, X-ray imaging is ideal for the investigation of dynamic processes. Using the novel rotating-gantry imaging system at UGCT, fast processes can be visualized and analysed. However, the complexity of the data processing as well as the amount of image artefacts increases, and intensive research is necessary to obtain quantitative results from this big data.



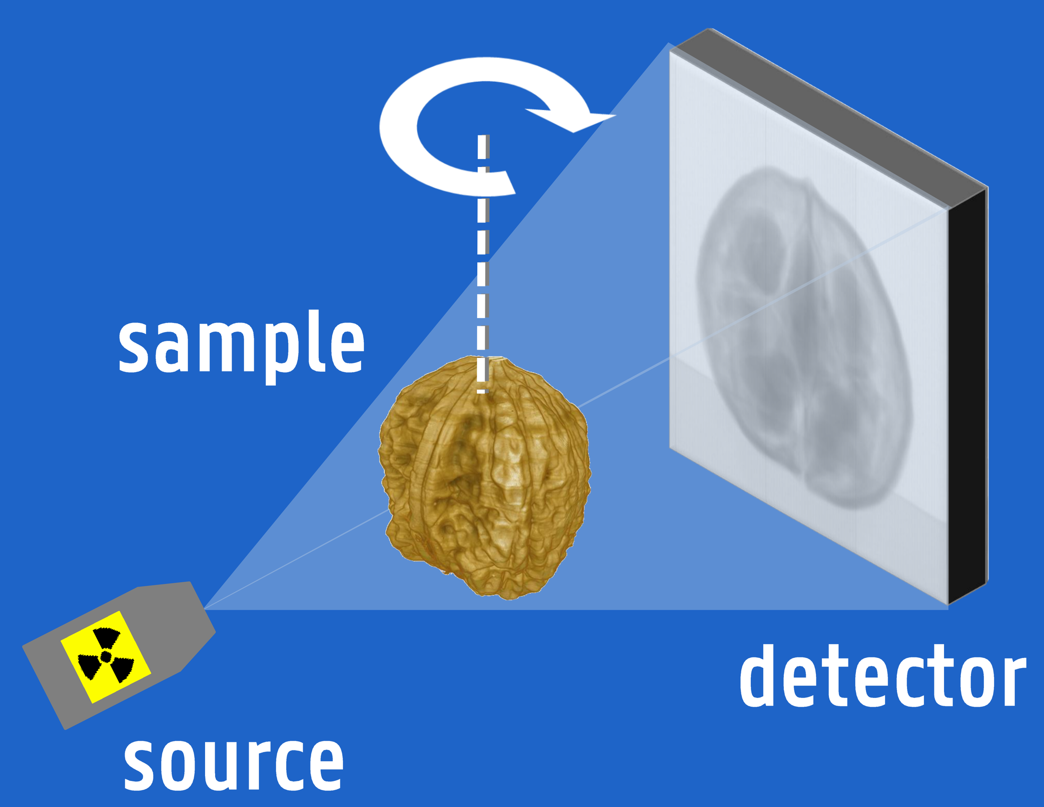
Oil filling of pores in a geomaterial. Understanding the processes behind this is crucial to develop CO_2 sequestration. A movie can be viewed online through the QR-code

An example of peripheral equipment mounted on the rotating-gantry system, needed to induce the dynamic processes



Compression of Al foam. A time lapse movie showing the local stress as function of time can be viewed online through the QR-code

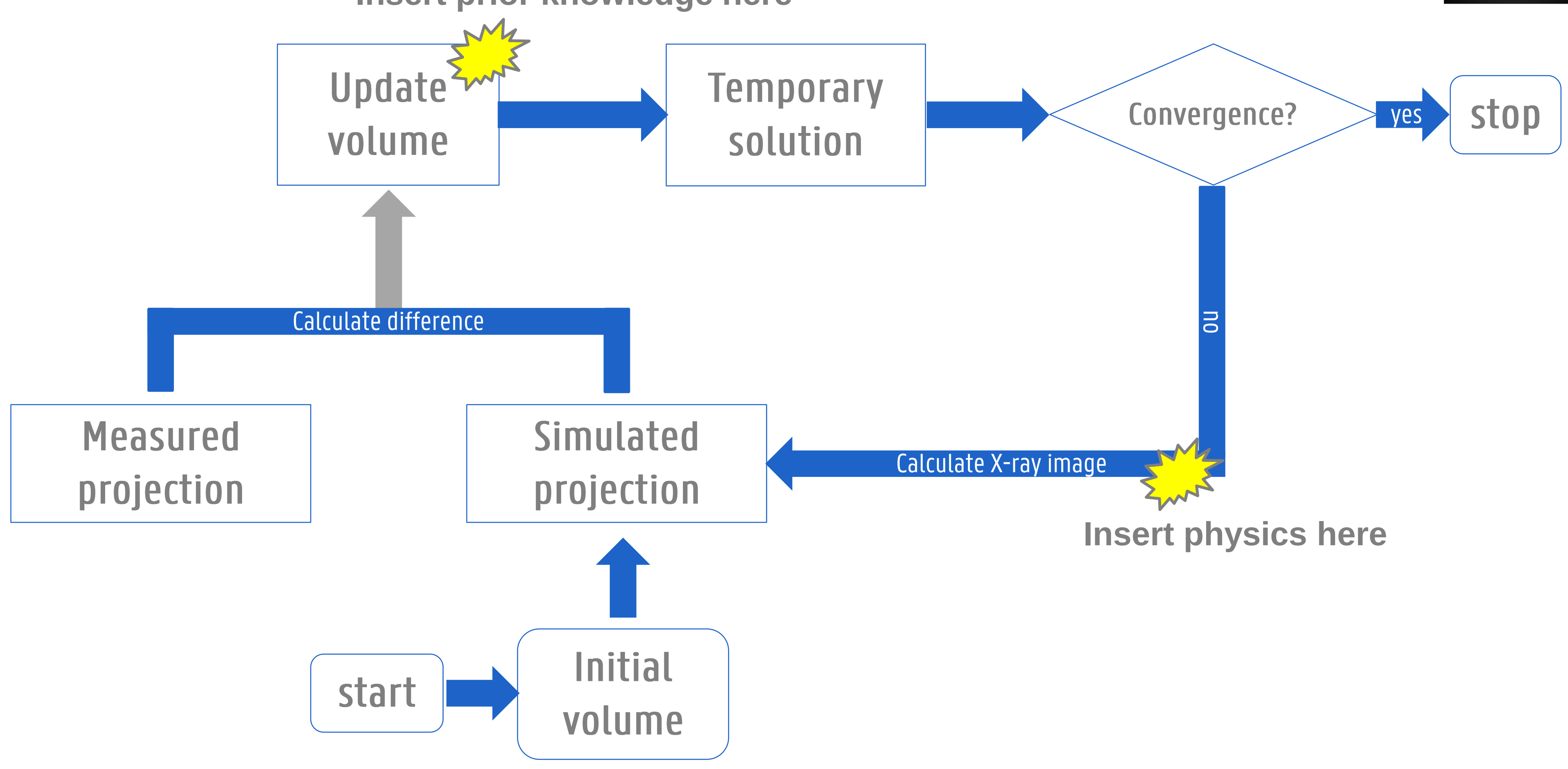
X-Ray CT in a nutshell



Iterative CT reconstruction
Exploit prior knowledge

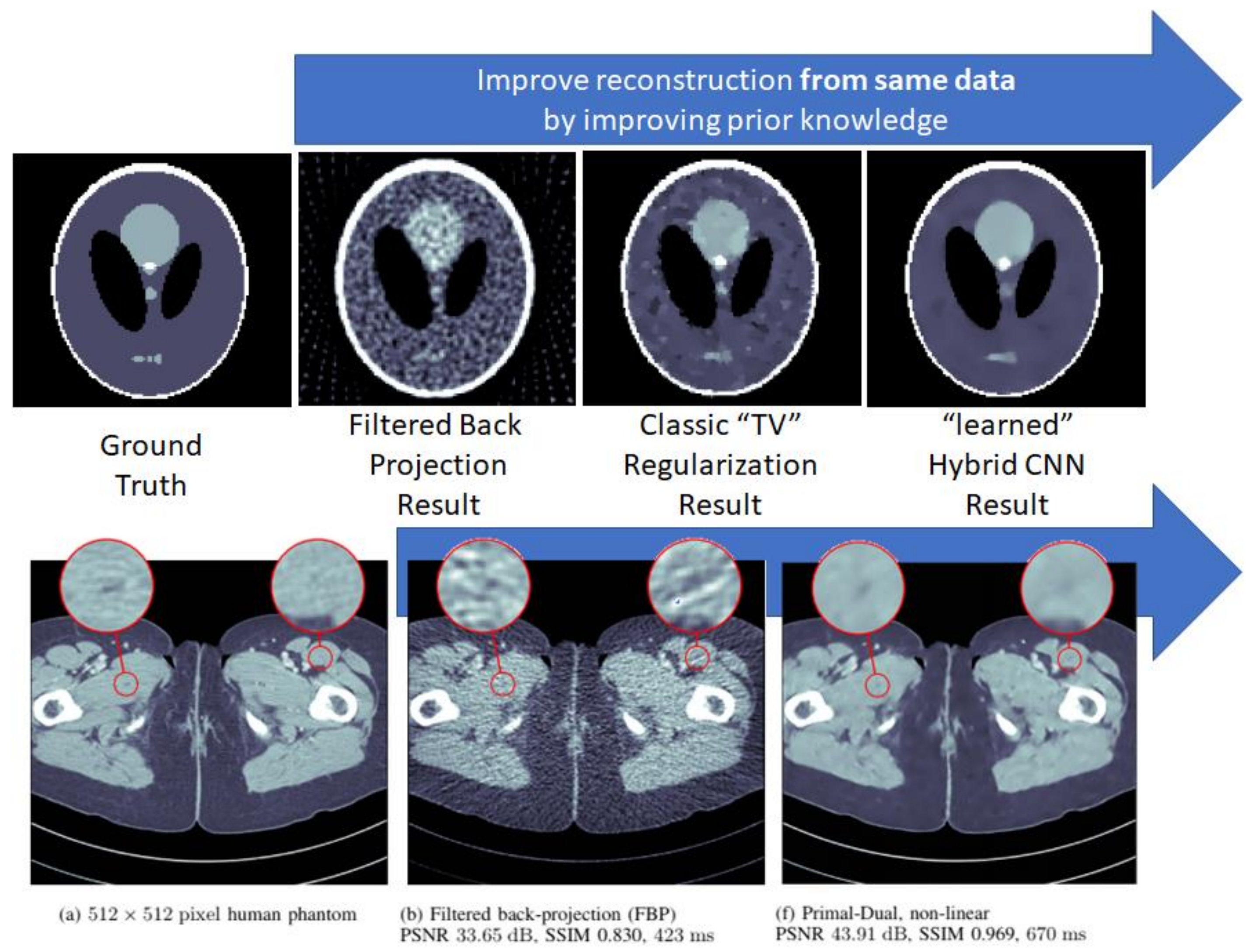
In contrast with traditional, analytical CT reconstruction, iterative reconstruction allows for a flexible integration of X-ray physics and prior knowledge about the sample, enabling an improvement of the resulting image quality.

To overcome the computational demands of these novel techniques, high-end GPUs from the gaming industry are used.



Hybrid neural networks
Machine learning for µCT

Even when using iterative reconstruction, some datasets contain too little information to generate a high-quality result (in other words: the inverse problem is ill-posed). Machine learning has the potential of overcoming this limitation by training the computer to 'recognize the most plausible solution', just like humans would do it. The simulation tools available at the research group are a strong asset for this purpose!



From: Adler *et al.*, 2018

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