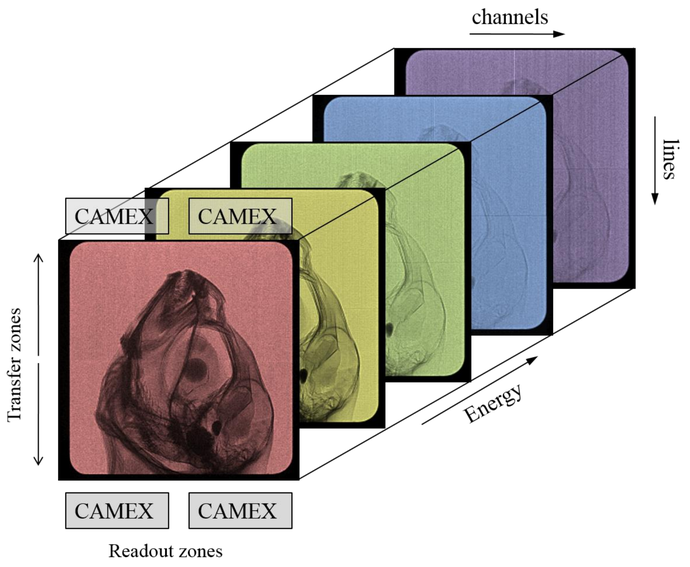
Radiation Physics research group
Centre for X-ray Tomography

Hyperspectral X-ray imaging

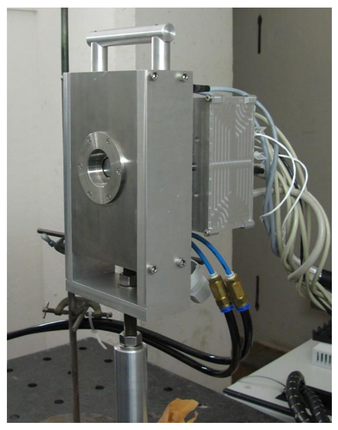
Exploit the full X-ray spectrum

The Radiation Physics research group is a world-wide pioneer on the use of hyperspectral X-ray imaging. Similar to conventional hyperspectral imaging (around the visible light spectrum), a single 'datacube' consists of a large number of 2D images showing the same object but imaged at different X-ray energies. From this vast amount of data, chemical information about the object can be obtained.

Using an in-house developed framework for readout and processing of the raw data, new methodologies can be easily developed.



A *datacube* acquired using the SLcam, measuring the same object at 1024 X-ray energies simultaneously.



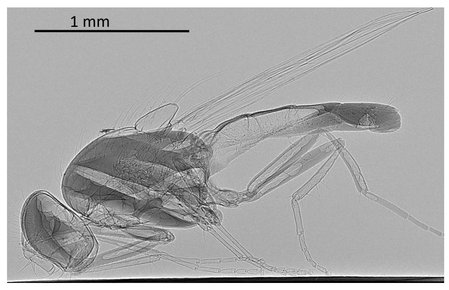
The SLcam or Color X-ray Camera, a prototype hyperspectral X-ray detector

Phase Contrast and Dark Field

Beyond traditional X-ray imaging

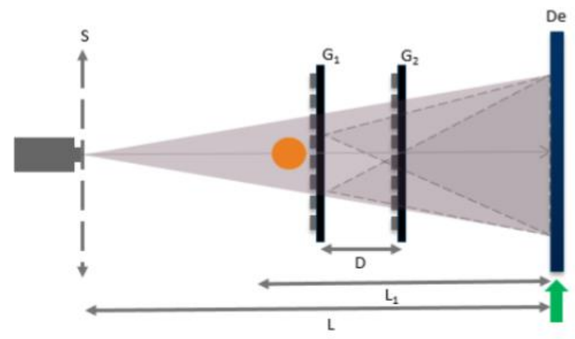
Traditional X-ray imaging contrast relies on the attenuation of the X-ray beam. However, recent developments have also demonstrated new contrast mechanisms, such as phase contrast and dark field. These mechanisms enable to visualize features that would not be visible in conventional X-ray imaging, and allow to extract more information from the data.

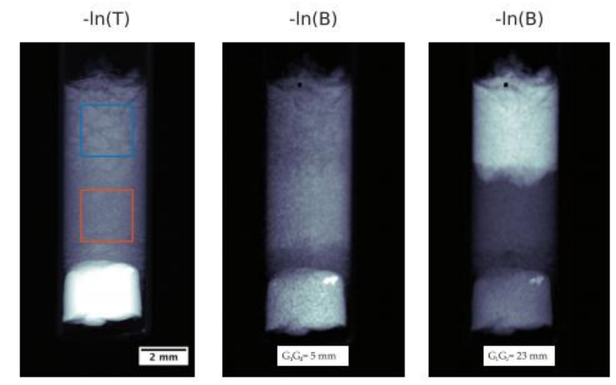
X-ray phase contrast



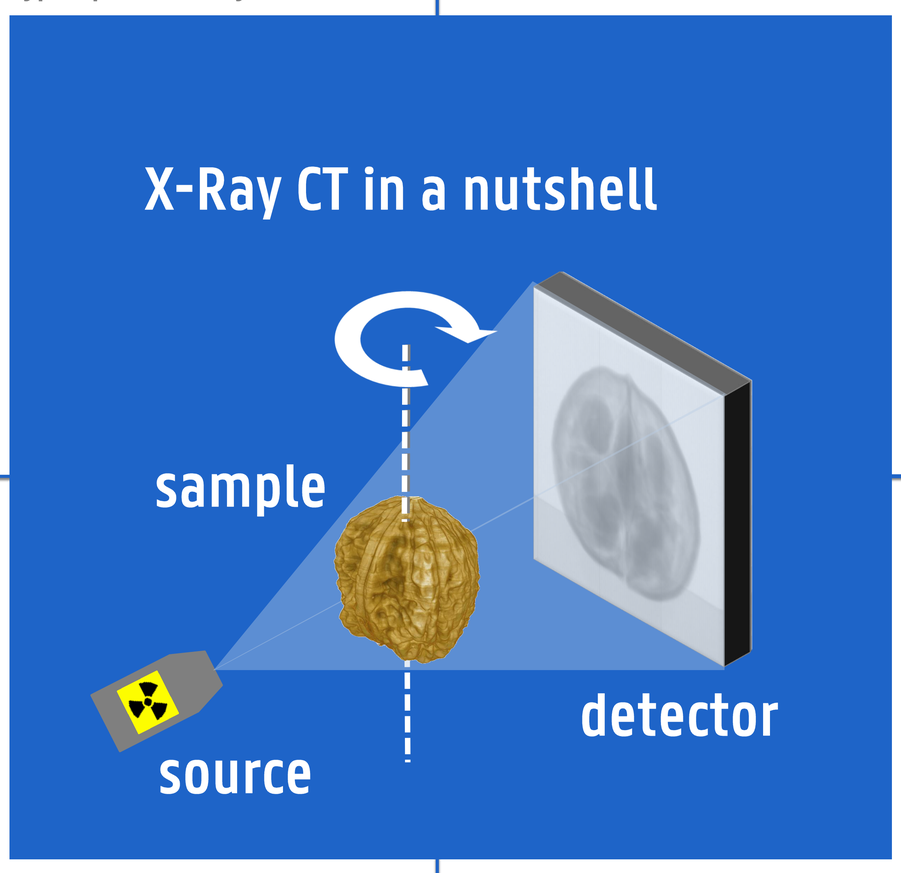
X-ray phase contrast image of a fly, showing extreme details due to an edge-enhancement effect

X-ray dark-field contrast





Top: setup for a dual-phase grating interferometer. The distance between the two gratings defines the sensitivity towards certain feature sizes, as illustrated in the image below (from Kagias *et al.*, 2017)



Synchrotron facilities

Breaking new frontiers

At synchrotron facilities, the brilliance of the X-ray beam is much higher than in lab-based facilities. This allows for new methodological developments. The Radiation Physics group has several close collaborations with research groups at these facilities, in the scope of which several exciting experiments have been conducted.

The SLcam mounted at the I13-1 Coherence Branchline of the Diamond Light Source, the UK national synchrotron facility, for experiments on hyperspectral ptychography

A color diffractogram acquired at DLS I13-1. Red corresponds to the low energy, green to medium energy and blue to high energy.

Smart*Light

A novel X-ray source for µCT

In the scope of a large-scale Interreg Vlaanderen-Nederland project, a novel X-ray source is being developed at TU Eindhoven, which will have a performance in between conventional lab-based sources and synchrotron sources. As such, it will be a cost-efficient alternative for synchrotron facilities. The Radiation Physics research group is responsible for the design and construction of a µCT end-station at this unique source.

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