X-ray Dark-field tomography

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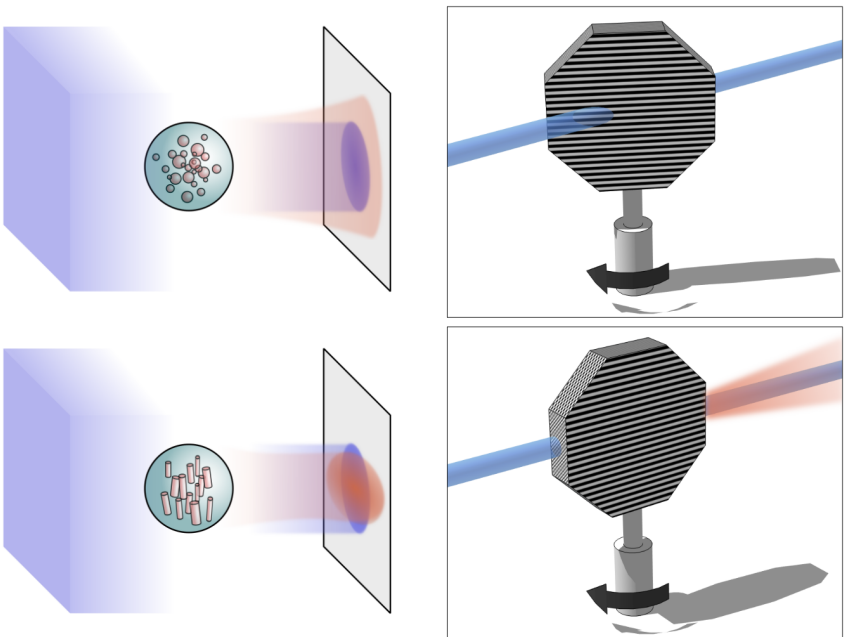
For imaging applications, the scattering of X-rays by different materials is often considered a nuisance that causes deterioration of the images or reconstructed 3D volumes. Yet, coherent and incoherent scattering may carry crucial information on the structure of a sample, in particular at scales smaller than the resolving power of the imaging apparatus. The goal of this project is to develop, validate and apply new scattering-aware X-ray imaging methods. Impact of this research ranges from industry (e.g. carbon fibre composites) to biomedical research (e.g. collagen structure and microcalcifications).

This project is funded by the ERC Consolidator Grant on the theme of “Scattering-Based X-ray Imaging and Tomography (S-BaXIT)”, hosted by the University of Trieste and the Synchrotron Elettra. The focus of the research activities will be on advanced algorithmic methods applied to imaging and tomography.

In this project, the student will work on new X-ray techniques that exploit small-angle X-ray scattering (SAXS) to produce images and tomograms of oriented micro- and nano-structures - a technique called “directional dark-field imaging”. The successful candidate will be responsible for the development of a new X-ray imaging instrument using a high-brilliance liquid-metal-jet source, and its application on relevant samples, such as carbon fibre composites and collagen-rich biological tissues. Measurements will also be done at Elettra and other synchrotron radiation facilities.

The candidate should have a good background in optics and atomic physics. Good programming skills (ideally in python or C/C++) and experience with X-ray or imaging equipment are valuable but not essential.

Interested candidates are encouraged to contact Prof. Thibault (pthibault@units.it) well before the university application deadline (7 June 2021).



Illustrations of scattering mechanisms used for X-ray dark field imaging. On the left: small angle scattering can be either isotropic or directional depending on the inner structure of a sample. On the right: ordered structures can give rise to a strong scattering signal when they are aligned with the propagation direction of the x-ray beam. This effect can also be used to characterise the inner structure.