School of Physics and Astronomy

OPTICS SEMINAR

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X-ray speckle-based phase-contrast imaging – State of the art and applications

In the last decades, X-ray phase-contrast imaging has found a wide range of applications in fields like biomedicine and materials science as well as optics characterisation and metrology. Its significantly higher sensitivity to small density differences is a major advantage over conventional absorption X-ray imaging, particularly for low absorbing specimens. The growing interest in X-ray phase-contrast imaging techniques has led to the development of a number of different methods to retrieve the phase-shifting properties of a sample.

One of the most recent phase-sensitive technique is X-ray speckle-based imaging. It relies on using a near-field speckle pattern, created by a random phase modulator such as a piece of sandpaper, as a wavefront marker. The sample-induced modulations of the speckle pattern are analysed to retrieve the phase-contrast information and additionally the complementary transmission and dark-field (small-angle scattering) signals of the sample under study.

X-ray speckle-based multimodal imaging has seen rapid development in the last years, including the demonstration of various operational modes, the extension to tomography, and the translation to higher X-ray energies and polychromatic laboratory X-ray sources. Recent efforts have focussed on optimising and simplifying acquisition and reconstruction approaches and making the technique more flexible and adaptable to specific demands on signal sensitivity and spatial resolution.

Compared to other phase-sensitive imaging methods, X-ray speckle-based multimodal imaging benefits from a simple experimental setup, cost-effectiveness and relatively low requirements on the spatial and temporal coherence of the X-ray beam, making it compatible with most existing (synchrotron and laboratory-based) X-ray imaging setups and hence accessible to a wide user community.

I will present the basic principles and existing operational modes of X-ray speckle-based imaging, followed by an outline of the latest developments of the technique. In the second part of my talk, I will present various applications in the fields of biomedicine for 3D virtual histology, geology and materials science, as well as X-ray optics characterisation.

Date:	Tuesday 10 March
Time:	2pm
Venue:	L1, Seminar Room 107, 10 College Walk, Clayton