Beam tracking phase tomography with laboratory sources

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X-ray phase contrast imaging (XPCi) can offer enhanced contrast with respect to standard x-ray absorption radiography, by exploiting the phase variation that x-rays experience when travelling through an object as an additional contrast mechanism [1]. Several XPCi techniques have been developed in the last years [1], each offering different advantages and capabilities. Recently, the transfer to laboratory sources of "speckle-tracking" computed tomography (CT) approaches has been the subject of a high profile publication [2], and received significant media attention. While this is an important step towards the translation of XPCi methods, speckle tracking faces challenges in the presence of strong scattering signals, especially if polychromatic beams are used [3]. Moreover, and possibly most importantly, it requires a spatially coherent source (e.g. a liquid metal jet source in ref. [2]).

We have recently observed that both these problems can be tackled through a stronger modulation of the x-ray beam, obtained for example through a single absorbing mask similar to those used in Edge Illumination (EI) XPCi, which is known to work under relaxed spatial coherence conditions [4]. If a detector with sufficient resolution is available, the second mask used in EI can be eliminated, and variations in the shaped beams can be directly "tracked" by the detector [5], simultaneously yielding attenuation, phase and scattering information. While we had previously shown that this "beam tracking" approach works with micro-focal lab sources [6], and can be implemented in CT mode with synchrotron radiation [7], we present here a modified approach where a fully polychromatic laboratory sources with a focal spot of 70 μm has been used. This results in a sub-micron coherence length at the mask, which has a period two order of magnitude larger, therefore realising an incoherent implementation of beam tracking which has much wider translation potential. This notwithstanding, strong phase signals are recovered and the dark-field image is successfully retrieved. This talk will briefly outline the method's principle and present some key results.

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