in Figure 1), which is only possible due to the well-preserved transverse coherence. Measuring intensity fluctuations also reveals that only a single or double temporal modes remain in the beam, indicating the delivery of near Fourier transform limited pulses. We also successfully performed a proof of principle Split Pulse XPCS experiment on a model system of small (R = 1 nm) gold nanoparticles dispersed in hexane solvent with hard x-rays and obtained the first time autocorrelation function in the ns time domain.

Figure 1. Typical pattern showing randomly oriented speckles.

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Tests experiments will be reviewed, such as the COXINEL one [21].

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Structure and long-range-order in colloidal self-assembly

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Colloids are able to self-assemble into various structures with periodicity on the scales ranging from nanometres to about a micron. They are widely recognized as an important model system to study nucleation phenomena in freezing, melting and solid-solid phase transitions, jamming and glass formation. In addition, colloidal crystals are attractive for multiple applications since they can be used as large-scale low-cost templates to fabricate novel materials with unique optical properties such as the full photonic bandgap, ‘slow’ photons and negative refraction, as well as materials for application in catalysis, biomaterials and sensors.

Nowadays small-angle X-ray scattering (SAXS) is widely recognised as an indispensable structure characterisation tool at the mesoscopic scales. Recent developments of synchrotron sources and X-ray detectors provide a very fast and effective tool to study colloidal crystals and their real-time development. The high penetration power of X-rays makes SAXS applicable to almost all system types. In addition, the intrinsically low contrast of all materials for X-rays ensures, in the vast majority of cases, a high quality of the scattering data that is free of multiple scattering contributions. SAXS also gives access to a broad range of spatial scales from a nanometre to microns. Moreover, as will be discussed in more detail in the lecture, microradian resolution can be achieved using synchrotron sources and refractive optics [1]. This provides access to periodicities up to several microns. Moreover, positional correlations on distances up to submillimetre can be accessed from the width of diffraction peaks measured with microradian resolution.

The results will be illustrated by a number of examples. In particular, the structure of rhombic crystals spontaneously formed by cubic colloids with rounded corners will be discussed [2,3]. Another example will be the transition to a lower-symmetry body-centred tetragonal structure in a system of magnetic core-shell spherical colloids, which is induced by dipole-dipole interactions between colloids [4]. A short overview of some of our studies of lyotropic colloidal liquid crystals spontaneously formed by highly anisometric colloidal particles [5,6] will be given. Finally, in-situ studies of the self-organization of semiconductor quantum dots of different shape...