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X-ray Photon Correlation Spectroscopy (XPCS) - I

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Many of the world's synchrotrons are completing upgrades to fourth generation light sources this decade which provides the source with a huge boost in brightness and coherence. X-ray photon correlation spectroscopy (XPCS) is a powerful technique which relies on the coherence of x-rays and is used to study dynamics in materials at the micro to atomic scale. When coherent light is used to illuminate a sample, it scatters and forms an interference pattern on the two-dimensional detector known as speckle. Measuring speckle patterns as a function of time is the basis of XPCS. Using the speckle pattern movies, you can compute characteristic fluctuation times of your sample and further connect them to specific spatial features such as defect motion using theory and modelling¹. In this way XPCS provides insight into the temporal and spatial evolution of material properties, from diffusion and relaxation processes to phase transitions and non-equilibrium phenomena^{2,3}.

This tutorial will provide a comprehensive introduction to the principles and applications of XPCS, combining short lectures with hands-on analysis examples and exercises. The lecture portion will cover the fundamental concepts of XPCS, including the theory of x-ray coherence, speckle and photon correlation spectroscopy, experimental implementation, and data analysis techniques. Topics will include the advantages and limitations of XPCS compared to other techniques, instrument design and optimization, data interpretation and some of the possible pitfalls.

The hands-on component will allow participants to gain practical experience with XPCS data analysis using Python, as well as explore case studies of XPCS applications in magnetic materials. By the end of this tutorial, participants will have a solid understanding of the principles and practices of XPCS, as well as the skills to design XPCS experiments and analyze data. This tutorial is intended for researchers and students interested in using XPCS to study dynamics in materials and will provide a valuable opportunity for hands-on learning and discussion.

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Session Classification: Tutorials + coffee break