APS WK5: Dark field x-ray microscopy for mesoscale phenomena in ordered materials at APS-U

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Materials with complex mesoscale structure display a wide range of properties, from enhanced mechanical strength to shape memory to electrical polarization and magnetism, that can be controlled and manipulated via routes including synthesis, processing, and phase transformation. An ability to observe how these internal building blocks (domains, microstructures, etc.) interconnect and rearrange themselves, e.g., as they are heated or cooled, optically stimulated (via optical, electrical, or magnetic means), dynamically stressed, or bent, etc., in real time is of great interest. A special X-ray imaging modality, known as dark-field X-ray microscopy (DFXM) is poised to do just that in the hope of reconstructing in real time three-dimensional network of these 'mesoscopic' structures deep inside materials indispensable to metallurgy, condensed-matter physics, and device applications. However, a set of critical experimental capabilities, analyses methods, and algorithms need to be developed for reconstruction of readily interpretable images and subsequent extraction of essential features of interest for a successful use of DFXM, which is an active field of research here in the US and abroad. The primary goal of this workshop is to bring researchers together to share their experience, assess experimental needs of user community of DFXM at APS-U, and outline a development path forward for this exciting diffraction-contrast imaging modality for quantum, functional, structural, and ordered materials.