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Recent progress in scattering and imaging experiments at the DiProI CDI end-station of the FERMI seeded FEL.

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The advent of free-electron lasers (FELs) has revolutionized high-resolution imaging by enabling coherent diffraction imaging (CDI) techniques that leverage the intense, ultrafast, and coherent X-ray pulses generated by FEL sources [1-4]. This lensless approach facilitates the reconstruction of complex morphological, electronic, and chemical information at the nanoscale, making it particularly effective for studying dynamic processes such as phase transitions [5], nanoscale spin transport [6], and structural deformations in real time [7]. Recent advancements in multicolor FEL emission [8] have further expanded the capabilities of CDI by enabling simultaneous probing of morphology and spectroscopic properties [9]. In this presentation we will report about the recent progress in time resolved scattering and imaging experiments performed at DiProI end-station [10]. In particular, we will present results on: (a) the possibility of illuminating the samples from two different viewing angles to provide stereoscopic vision of the investigated object [3]; (b) the potential to achieve high-resolution ptychographic imaging at a free-electron laser (FEL) using orbital angular momentum (OAM) in diffraction-based imaging techniques [4]; and (c) the exploration of multicolor imaging, which offers insights across a broad spectrum of elemental edges. In the final part of the presentation, we will discuss the potential extension of these developed approaches from extreme ultraviolet (XUV) to soft X-ray applications, as well as the requirements for bidimensional detectors.

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