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Prospects for Incoherent Diffractive Imaging at a Compact XFEL[1] ANDREW SHEVCHUK, JOHN SPENCE, RICHARD KIRIAN, KEVIN SCHMIDT, Department of Physics, Arizona State University, BIOXFEL COLLABORATION — The first generation of compact X-ray free-electron lasers (XFELs) is currently under construction and will have the capability to produce much shorter X-ray pulses than large XFELs, albeit also with much lower intensity. This presents a challenging question: What techniques are well-suited to imaging biomolecules with shorter yet weaker X-ray pulses? We analyze the viability of a new technique known as incoherent diffractive imaging (IDI) under these conditions. IDI applies the principles of intensity interferometry (famously known in quantum optics via the Hanbury Brown and Twiss effect) to image biomolecules using their coherent X-ray fluorescence and has some advantages over the standard technique of coherent diffractive imaging, including elemental specificity and 3D structural information in a single diffraction pattern. We study IDI through theory and simulations with a model of inner-shell fluorescence generated by semiclassical dipole radiators (i.e., excited high-Z atoms). Our results suggest that IDI will benefit substantially from the sub-femtosecond pulse duration possible at compact XFELs despite a pulse fluence orders of magnitude smaller than that currently achievable at large XFELs.

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