Single Particle Detection and Image Enhancement in XFEL Coherent Diffraction - Experiment and Simulation

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XFEL-based Coherent X-Ray Diffraction Imaging (CXDI) has emerged to be a very promising technique to obtain images of nano-size objects without employing X-ray lenses. In principle, the image resolution of CXDI can be the wavelength of X-ray photons. However, in practice the obtainable image resolution currently reaches only a few nano meters the best. Systematic studies were carried out by scattering experiments at SACLA on nano particles of gold and virus of sizes ranging from a few nanometers to $\sim$80 nm. The X-ray speckle patterns obtained from single and two-particle scatterings were analyzed using a SAXS scheme along with computer calculations. The results are expressed in a master curve of image visibility in terms of electron density, particle size, and X-ray flux density. With given flux limitation, we further demonstrate the image enhancement using two-particle interference scattering effect. Such enhancement using strong scatters in XFEL-CDI experiments can be in general a remedy to image weak-biological objects.