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Potential benefits of electonic damage in x-ray imaging[1] STEPHAN KUSCHEL, Pulse@SLAC, US, ANDRE HADDAD, PSI, Switzerland, PHAY HO, ANL, US, FELIX ZIMMERMANN, Pulse@SLAC, US, LEONIE FLUECKIGER, La Trobe Uni, Australia, MATTHEW WARE, Pulse@SLAC, US, JOSEPH DURIS, JAMES MACARTHUR, ALBERTO LUTMANN, PETER WALTER, MING-FU LIN, XIANG LI, JEFF ALDRICH, LCLS@SLAC, US, LINDA YEUNG, ANL, US, CHRISTOPH BOSTEDT, PSI, Switzerland, AGOSTINO MARINELLI, LCLS@SLAC, US, TAIS GORKHOVER, Pulse@SLAC, US — Ionization is generally considered detrimental to the quality of single exposure images recorded with ultra bright modern X-ray sources, such as X-ray free electron lasers (XFELs). We conducted a X-ray coherent diffraction imaging (CDI) study at the Linac Coherent Light Source (LCLS) on single rare gas nanoparticles. Our results indicate that the X-ray scattering cross section may increase due to transient ionic resonances before structural damage degrades the image. We also observe that the samples become increasingly transparent if the pulse parameters correspond to typical values of single particle imaging experiments. Dynamical electronic structure calculations attribute the observed effects to electronic damage and predict amplification of X-ray coherent scattering of up to two orders of magnitude compared to the neutral scattering cross section might be possible. We also demonstrate that ionic resonances are present in images recorded with sub-fs pulses which proves that transient resonances can be exploited before ionic damage.

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