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Free-electron x-ray laser measurements of collisional-damped plasmons in isochorically heated warm dense matter PHILIPP SPERLING, HAE-JA LEE, ELISEO GAMBOA, SLAC National Accelerator Laboratory, HEIDI REINHOLZ, GERD ROEPKE, Institut fuer Physik, Universitaet Rostock, Rostock, Germany, ULF ZASTRAU, Institut fuer Optik und Quantenelektronik, Friedrich-Schiller-Universitaet, Jena, Germany, LUKE FLETCHER, SIEGFRIED GLENZER, SLAC National Accelerator Laboratory — Collisional-damped plasmons were obtained in highly-spectrally resolved measurements of isochorically heated solid aluminum providing for the first time the determination of electron-electron and strong electron-ion collisions. 8 keV x-rays from the Linac Coherent Light Source have been focused to micrometer diameter focal spots heating solid aluminum foils to temperatures up to 7 eV. The forward scattering spectra show plasmons that directly determine the density and temperature from the plasmon frequency shift and from the detailed balance relation indicating a warm dense matter state with large ion coupling parameters of up to 40. These experiments show a non-quadratic plasmon dispersion relation shifted to lower plasmon energy shifts at wave numbers of $0.5 \text{ \AA} < k < 2 \text{ \AA}$ not predictable by dispersion relations like the Gross-Bohm relation and the Born-Mermin approximation. Therefore, the measured collisional-damped plasmons indicate collisions beyond the Born approximation and have been described successfully by taking into account electron-electron collisions as well as strong electron-ion collisions. In this talk, we will discuss the first measurement of strong collisions affecting strong collisions in the electron-ion collision model and conductivity.

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