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Imaging Anisotropic Nanoplasma Dynamics in Superfluid Helium Droplets CAMILA BACELLAR, ADAM CHATTERLEY, FLORIAN LACKNER, SRI PEMMARAJU, LBNL, RICO TANYAG, CHARLES BERNANDO, DEEPAK VERMA, SEAN OCONNELL, USC, TIMUR OSIPIV, DIPANWITA RAY, KENNETH FERGUSON, TAIS GORKHOVER, MICHELE SWIGGERS, SLAC, MAXIMILIAN BUCHER, ANL, ANDREY VILESOV, USC, CHRISTOPH BOSTEDT, ANL, OLIVER GESSNER, LBNL — The dynamics of strong-field induced nanoplasmas inside superfluid helium droplets are studied using single-shot, single-particle femtosecond time-resolved X-ray coherent diffractive imaging (CDI) at the Linac Coherent Light Source (LCLS). Intense (˜10^{15} W/cm^2, ˜50 fs) 800 nm laser pulses are employed to initiate nanoplasma formation in sub-micron (200 nm – 600 nm) sized helium droplets. The dynamics of the nanoplasma formation and subsequent droplet evolution are probed by x-rays pulses (˜100 fs, 600 eV) that are delayed with respect to the near-infrared (NIR) pulses by 10's of femtoseconds to hundreds of picoseconds. Pump-probe time-delay dependent effects in the CDI patterns reveal distinct dynamics evolving on multiple timescales. Very fast (<100 fs) appearing features are possibly indicative of electronic dynamics, while slower (≥1 ps) dynamics are likely associated with structural changes correlated to nuclear motion including droplet disintegration. In particular, the CDI images exhibit strong indications for anisotropic dynamics governed by the NIR polarization axis, providing previously inaccessible insight into the mechanisms of nanoplasma formation and evolution.

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