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The fluid dynamics of microjet explosions caused by extremely intense X-ray pulses CLAUDIU STAN, HARTAWAN LAKSMONO, RAYMOND SIERRA, PULSE Institute, SLAC National Accelerator Facility, DESPINA MILATHIANAKI, JASON KOGLIN, LCLS, SLAC National Accelerator Facility, MARC MESSERSCHMIDT, BioXFEL STC, GARTH WILLIAMS, LCLS, SLAC National Accelerator Facility, HASAN DEMIRCI, PULSE Institute, SLAC National Accelerator Facility, SABINE BOTHA, KAROL NASS, Max-Planck Institute for Medical Research, HOWARD STONE, Princeton University, ILME SCHLICHTING, ROBERT SHOEMAN, Max-Planck Institute for Medical Research, SEBASTIEN BOUTET, LCLS, SLAC National Accelerator Facility — Femtosecond X-ray scattering experiments at free-electron laser facilities typically requires liquid jet delivery methods to bring samples to the region of interaction with X-rays. We have imaged optically the damage process in water microjets due to intense hard X-ray pulses at the Linac Coherent Light Source (LCLS), using time-resolved imaging techniques to record movies at rates up to half a billion frames per second. For pulse energies larger than a few percent of the maximum pulse energy available at LCLS, the X-rays deposit energies much larger than the latent heat of vaporization in water, and induce a phase explosion that opens a gap in the jet. The LCLS pulses last a few tens of femtoseconds, but the full evolution of the broken jet is orders of magnitude slower – typically in the microsecond range – due to complex fluid dynamics processes triggered by the phase explosion. Although the explosion results in a complex sequence of phenomena, they lead to an approximately self-similar flow of the liquid in the jet.

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