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Measuring Cavitation with Synchrotron X-Rays[1] DANIEL DUKE, ALAN KASTENGREN, CHRIS POWELL, Argonne National Laboratory, X-RAY FUEL SPRAY GROUP, ENERGY SYSTEMS DIVISION TEAM — Cavitation plays an important role in the formation of sprays from small nozzles such as those found in fuel injection systems. A sharp-edged inlet from the sac into the nozzle of a diesel fuel injector is shown to inititate a strong sheet-like cavitation along the boundary layer of the nozzle throat, which is difficult to measure and can lead to acoustic damage. To investigate this phenomenon, a diagnostic technique capable of mapping the density field of the nozzle through regions of intense cavitation is required. Available visible-light techniques are limited to qualitative observations of the outer extent of cavitation zones. However, brilliant X-rays from a synchrotron source have negligible refraction and are capable of penetrating the full extent of cavitation zones. We present the early results of a novel application of line-of-sight, time-resolved X-ray radiography on a cavitating model nozzle. Experiments were conducted at Sector 7-BM of the Advanced Photon Source. Density and vapor distribution are measured from the quantitative absorption of monochromatic X-rays. The density field can then be tomographically reconstructed from the projections. The density is then validated against a range of compressible and incompressible numerical simulations.

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