# ULTRAFAST X-RADIOGRAPHY AND X-TOMOGRAPHY OF HIGH-PRESSURE AND HIGH-SPEED FUEL SPRAYS

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With brilliant synchrotron x-ray sources, microsecond time-resolved synchrotron x-ray radiography and tomography have been used to elucidate the detailed three-dimensional structure and dynamics of high-pressure, high-speed fuel sprays in the near-nozzle region. The measurement allows quantitative determination of the fuel distribution in the optically impenetrable region due to the multiple scattering of visible light by small atomized fuel droplets surrounding the jet. X-radiographs of the jet-induced shockwaves prove that the fuel jets become supersonic under appropriate injection conditions and that the quantitative analysis of the thermodynamic properties of the shock waves can also be derived from the most direct measurement. In other situation where extremely axial-asymmetric sprays are encountered, mass deconvolution and cross-sectional fuel distribution models can be computed based on the monochromatic and time-resolved x-radiographic images collected from various rotational orientations of the sprays. Such quantitative analysis reveals the never-before-reported characteristics and most detailed near-nozzle mass distribution of highly transient fuel sprays. Most recently, ultrafast phase-contrast imaging techniques have been developed to take single-shot images of the sprays. The time-resolved phase-contrast x-ray images can now be used to understand the fundamentals concerning the primary breakup of high-speed liquid jets.

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