High Resolution Phase Contrast Imaging of Strong Shock-Cloud Interactions

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X-Ray Phase Contrast Imaging (XPCI)

- Conventional x-ray absorption imaging is limited by its need for significant differences in target absorption characteristics.
- In contrast XPCI is sensitive to phase shifts introduced by, for example, the steep density gradients produced by strong shocks and material interfaces.
- This allows for the use of low atomic number targets with greater sensitivity to density gradients, as well as working well with polychromatic sources.

Experimental Setup

- The target consisted of a plastic ‘cloud’ of density 1g/cm³ inserted into a low density foam (200 mg/cm³).
- Long-pulse beamlines will generate shocks, distort the cloud and initiate Hydrodynamic instabilities.
- Using two XPCI backlighters enables measurements along and transverse to the shock axis.

Target and Beams

Foam cylinders: density 50 -200mg/cm³ 300µm in length with 150µm radius inserted into 25µm thick walled sleeve, plastic ablator and molybdenum radiation shield.

Plastic sphere: polystyrene sphere, 25µm to 75µm radius. This gives a density contrast of 5 to 20.

- Long-pulse beams of nanosecond duration at 2 omega will drive the shock. The pulse duration and energy will be varied throughout the experiment to observe the different responses of the target.
- Two backlighter source size will be minimised with the use of 5µm pin-hole.

DUED Simulations

- Hydrodynamic simulations were performed using the DUED code.
- The output was then fed into x-ray phase contrast and absorption simulation models.

References