

Exploring the Synergy Between Observations of Astrophysical Jets and Their Experimental Counterparts at Omega

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Over the past four years we have engaged in a series of laboratory experiments with the Omega laser designed to reproduce analogs of jets from young stars. The first set of experiments created a collimated supersonic jet that deflected from an obstacle along the flow. By exploring this platform using various time delays, backlighters, viewing angles, and impact parameters, we were able to observe how the deflected flow interacts with the shocked obstacle and entrains material from the obstacle into the flow. Extensive numerical simulations of the experiment reproduce the observed radiographs well. We connect the laboratory results to stellar jets through observations of molecular hydrogen, which identify entrained material in the HH 110 jet.

A second series of experiments are currently underway that follow how strong shock wave propagate through highly clumpy environments. With the aid of extensive target fabrication work done by General Atomics, we have successfully tested this platform and generated radiographs that bear remarkable similarities to large astrophysical bow shocks in star formation regions. This work also has implications for understanding magnetic compression within jets.

A third observational effort to survey regions of massive star formation for protostellar activity has uncovered some remarkable globules whose fluid dynamical properties are strongly influenced by the winds and ultraviolet radiation from the nearby massive stars. This work, which is being extended to southern hemisphere targets, may motivate future laboratory experiments of radiative ablation and Kelvin-Helmholtz instabilities.