

Plume Surface Interactions for the Moon and Mars

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BACKGROUND

When landing a rocket on surfaces such as the Moon or Mars, the exhaust interacts with the ground in a violent manner, potentially launching particles, dust, and debris of all sizes and causing excessive heating.



(Images Credit: NASA/JPL-Caltech)

OBJECTIVES

- Develop experimental setup to model PSI problem
- Test at vacuum conditions simulating Moon or Mars
- Adjustable height and varying angles of 'landing surface'
- Use pressure sensors and Schlieren imaging to study flow

PRELIMINARY AMBIENT TESTING

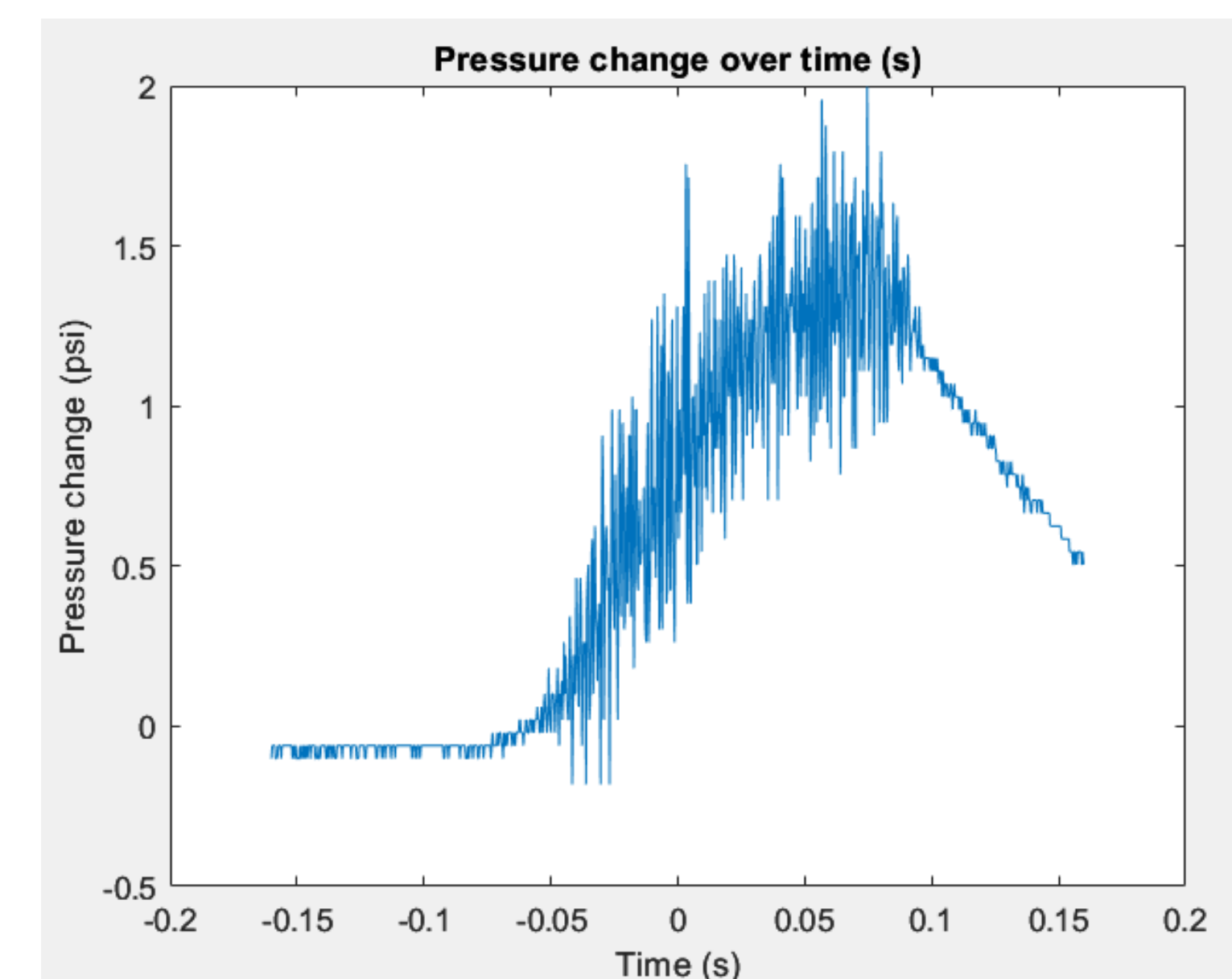
- Sensor returns pressure changes as changes in voltage
- Refrigerant lightly sprayed on sensor to simulate flow pressure
- Voltage over time plot captured from oscilloscope
- Data processed in MATLAB to plot pressure change over time



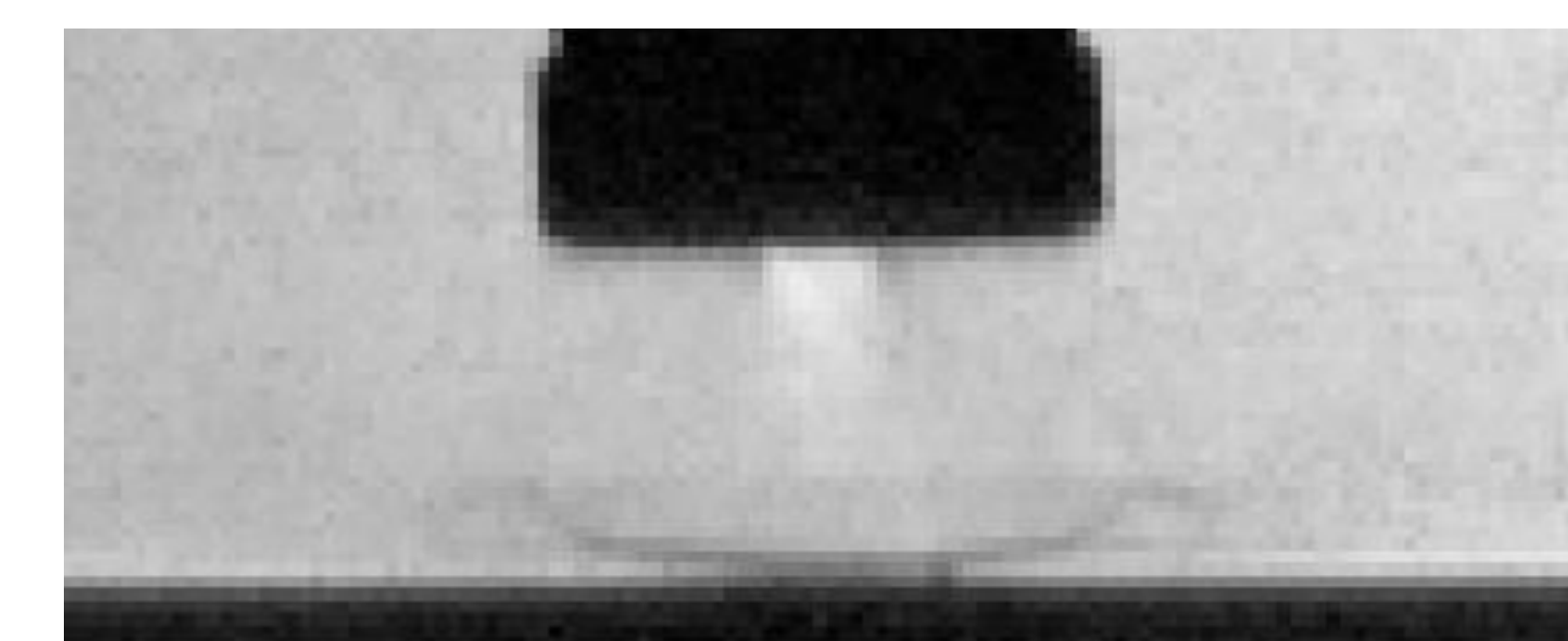
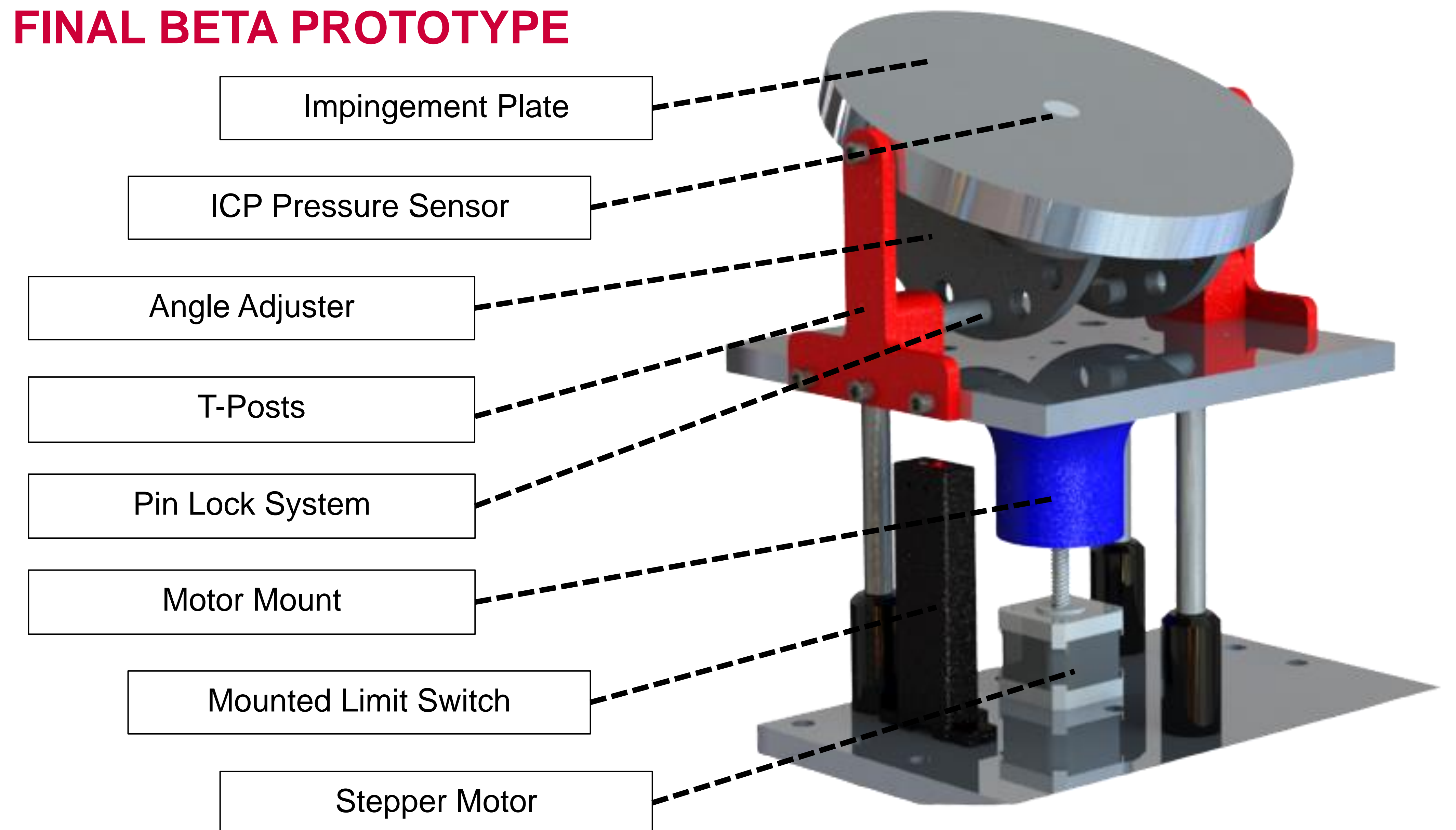
Known as the Plume Surface Interaction (PSI), this occurrence can limit visibility and damage valuable assets. Many CFD models have been created to study this. However, there is limited experimental data available for comparison.

EXPERIMENTAL SETUP & TESTING

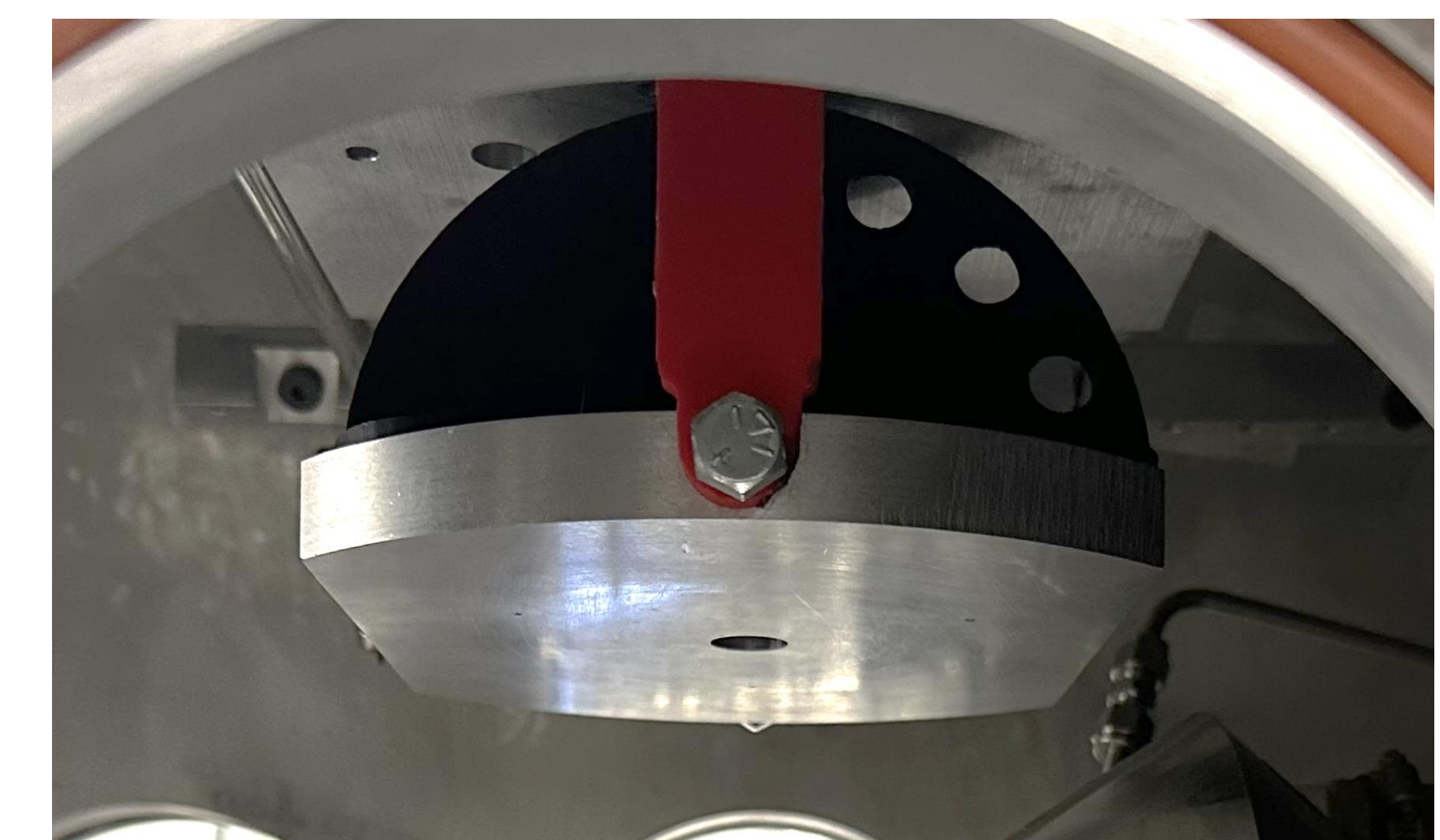
- Model adjusted to accommodate changes in available space
 - Stepper motor used to actuate nozzle from bottom of tunnel
 - Impingement plate positioned above nozzle
 - Captured Schlieren images of flow over plate
 - Studied at various pressures, angles, and heights



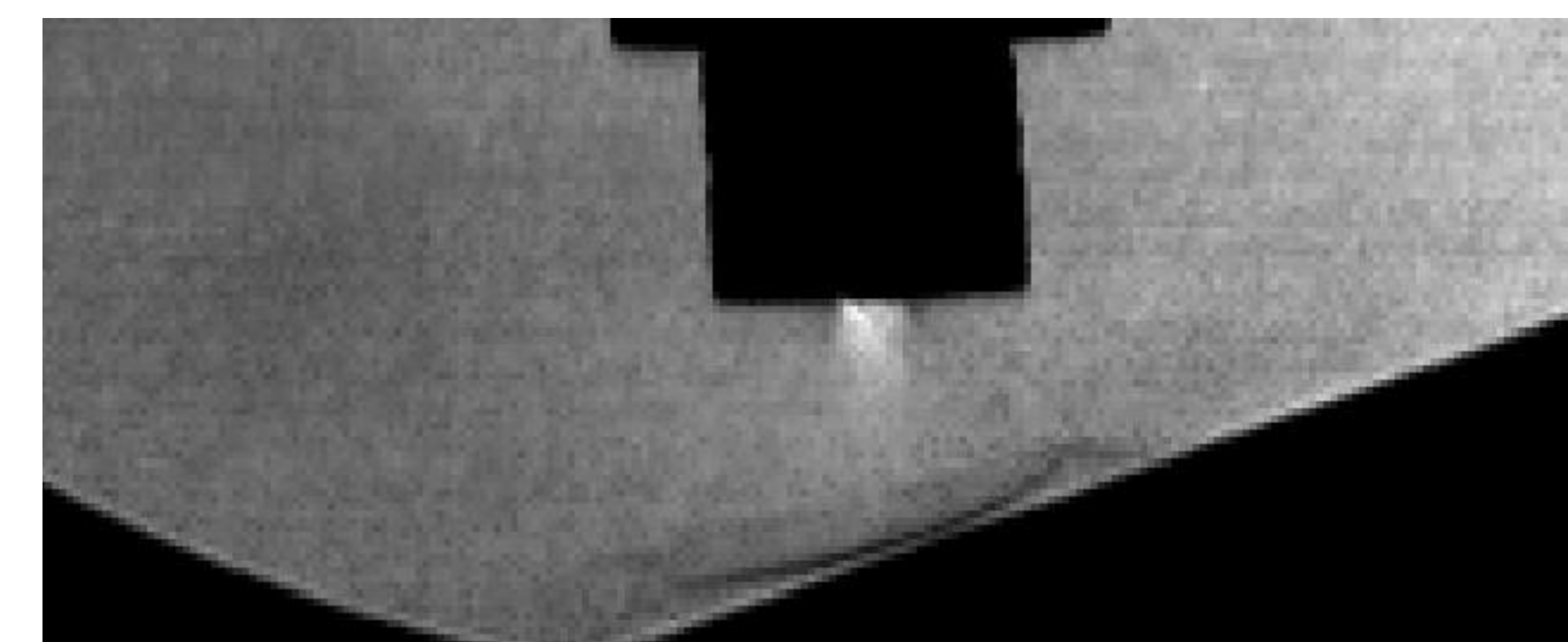
FINAL BETA PROTOTYPE



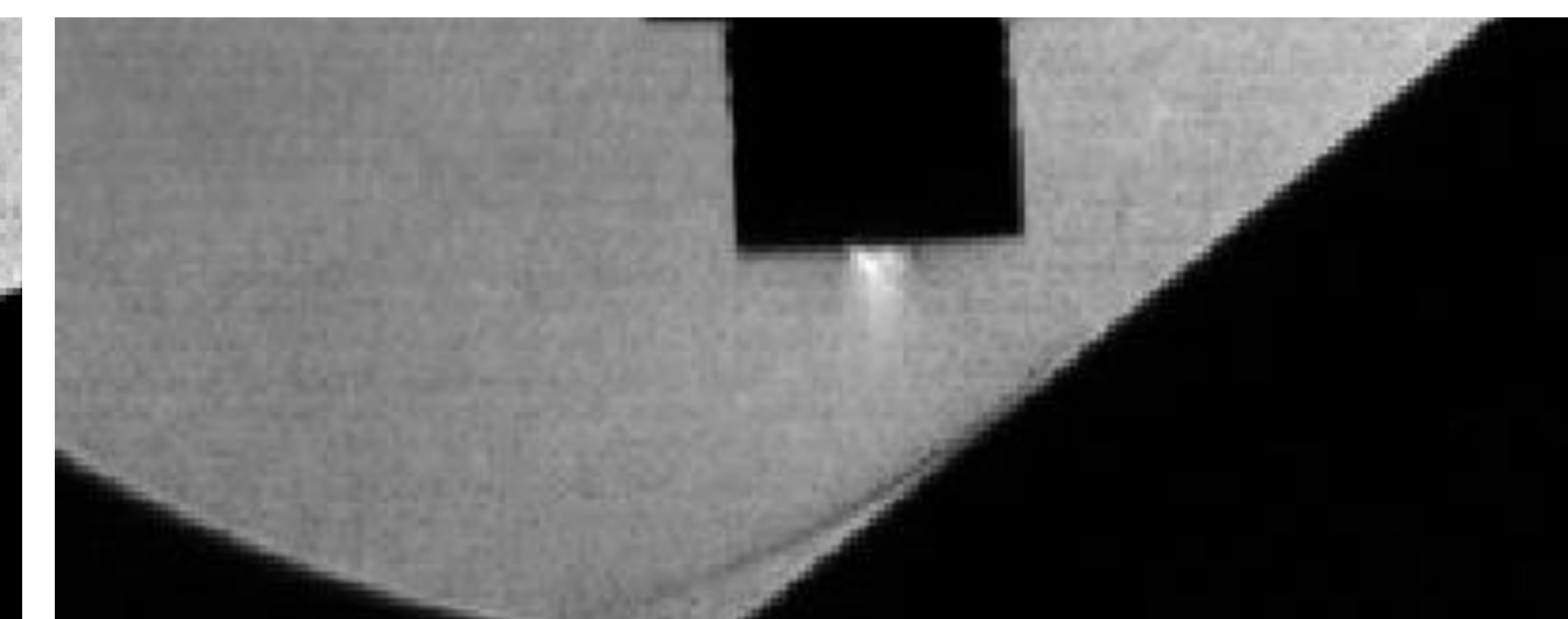
0° Plate Angle, 0.5" Separation



Impingement Plate Inside Test Section



22.5° Plate Angle, 0.75" Separation



45° Plate Angle, 0.75" Separation

