Multi-Angled Multi-Pulse Time-Resolved Thomson Scattering on Laboratory Plasma Jets

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Overview
- Objective: Study the properties of plasma jets produced from radial foils [1] using Thomson scattering.
- This work focuses on using time-resolved Thomson scattering to measure the changing electron temperature as the probe laser heats the plasma of the jet.
- The goal of the latest experiments: to collect scattering from two different locations at two different times.

Setup

Diagnostic Setup
- Spectrometer: 750 mm Czerny-Turner
- Grating: 2400 lines/mm
- Instrumental FWHM: 0.42 Å
- Streak camera sweep speed: 20 ns full streak
- Temporal resolution: 250 ps with a 125 μm input slit
- Laser: two 2.5 J pulses, FWHM of 2.2 ns @ 526.5 nm
- Pulse delay: 12 ns

Next steps
- Use this diagnostic in other experiments where time resolved Thomson scattering would be of interest.
- Gather more data with jets other than Al, to see if we can understand the results.
- Switch from reverse to standard polarity, and compare the experimental results to PERSEUS simulations.
- Shorten the gap time between pulses to scatter from a still heated plasma.

Summary
- We have enabled the use of a streak camera to acquire temporally resolved Thomson scattering spectra at two points in time and from two different locations.
- Measured heating of 40–50 eV within 2 ns on Al jets.
- Jets begin to cool at the end of the laser pulse.
- Ti and Cu jets showed more heating than Al jets and also had some difficult to interrupt spectra.
- Trying to measure the density in this parameter range is challenging with the accuracy of our measurements.

Results

Results from streak-camera spectra – Al
- Increased separation of the ion-acoustic peaks in time shows heating of the plasma jet by the laser.
- Time points are shown as single points, while the time integration of each pulse is shown as a colored band.

Density Measurements
- Tried to measure n₀ by comparing the peak separation at 2 different angles [3].
- May show some drop in n₀ as the laser heats plasma.
- Not enough change in temperature ratio based on the assumed electron density for accurate measurements.

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References