Investigation of Laser-Produced Plasmas During the Irradiation Using Collective Thomson Scattering

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Dr. Tomita’s talk:

- Ion feature of Collective Thomson scattering (CTS) is a powerful method to diagnose droplet Sn plasma

velocity field and pressure
Ion feature of collective Thomson scattering: Experimental setup

<table>
<thead>
<tr>
<th></th>
<th>Probe laser</th>
<th>Ablation laser</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength</td>
<td>532 nm</td>
<td>1064 nm</td>
</tr>
<tr>
<td>Pulse width</td>
<td>4 ns</td>
<td>7 ns</td>
</tr>
<tr>
<td>Laser energy</td>
<td>4 mJ</td>
<td>200 mJ</td>
</tr>
<tr>
<td>Spot diameter (FWHM)</td>
<td>50 μm</td>
<td>650 μm</td>
</tr>
</tbody>
</table>

Measured space and time:
- Space: \( Z = 0.13 \) to 0.4 mm \( Y = -0.2 \) to 0.2 mm
- Time: -2, 0, 2, 4 ns from the peak of ablation laser

Laser peak intensity: \( 6 \times 10^9 \) W/cm\(^2\)
Time evolution of CTS spectra at 0.13 mm above target

-2 ns

0 ns (Laser peak)

2 ns

4 ns

- Electron density \( n_e \) \( \propto \) Intensity
- Electron temperature \( T_e \) \( \propto \) \( \Delta \lambda_{\text{peak}} \)
- Ion drift velocity \( v_d \) \( \propto \) Doppler shift

* Assume \( T_e = T_i \),
* Ion charge \( Z_i \) from FLYCHK
Temporal resolved 2-D Sn plasma $T_e$ and $n_e$ profile, during the laser pulse
Measured Sn plasma parameter marked in Sasaki et al, JAP 2010, Fig. 15:

(a) in-band emissivity, \( \sim 10^{10} \) (W cm\(^{-3}\))
(b) spectral efficiency, \( \sim 10 \% \)
(c) in-band opacity, \( \sim 100 \) (cm\(^{-1}\))
(d) Mean charge, \( \sim 8 \)
Double pulse: 20~50 eV Sn plasma
Measured Sn plasma parameter marked in Sasaki et al, 2010, Fig. 15:

(a) in-band emissivity, $\sim 10^{10}$ (W cm$^{-3}$)
(b) spectral efficiency, $\sim 10\%$
(c) in-band opacity, $\sim 100$ (cm$^{-1}$),
(d) Mean charge, $\sim 8$

in-band EUV energy per pulse is estimated to be 1.3%.

Ongoing work
Measurable for CTS, (532 nm probe laser)