Stimulated Raman Scattering as a Coronal $T_e$ Diagnostic for Direct-Drive Experiments at the National Ignition Facility

$I_{14} = 7.1$, CH target

$I_{14} = 11.3$, CH + Si target

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Stimulated Raman scattering (SRS) in current polar-direct-drive (PDD) implosions at the National Ignition Facility (NIF) show a wavelength-dependent cutoff consistent with Landau damping of the plasma waves.

- Time-dependent SRS spectra are taken in two locations on the NIF, within 30° of the south pole.
- The lower end of the SRS spectra is consistent with the Landau cutoff \( k_p \lambda_{De} \sim 0.25 \).
- SRS signals are consistent with multibeam SRS sidescattering.
- The Landau cutoff can be used as a coronal \( T_e \) diagnostic*,** and compares well with 2-D \textit{DRACO} simulations.

Collaborators


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The shortest SRS wavelength is determined by Landau damping of the plasma wave at $k_p \lambda_{De} \sim 0.25$.
The Landau cutoff interpretation of the lower SRS wavelength limit varies with an assumed sidescatter angle.

NIF PDD shot N140228-004, $I_{14} = 7.8$, CH target

Landau cutoff assuming backscatter only ($\theta = 0^\circ$)

Landau cutoff assuming $50^\circ$ sidescatter only
The SRS Landau cutoff is well simulated with 2-D DRACO over a wide range of target parameters.

- DRACO predictions presently favor a large-sidescatter angle (50°) SRS limit
- More detailed analysis including refraction may modify this interpretation
The SRS spectra of imploding PDD shells can be used to discriminate between different model assumptions in hydrodynamic simulations.

NIF PDD shot N140228-004, SRS spectrum in B318, $I_{14} = 7.8$, CH target

**DRACO simulations with cross-beam energy transfer and nonlocal transport**

**DRACO simulations with inverse bremsstrahlung and nonlocal transport**
Laser–plasma interaction signatures pack crucial SRS and two-plasmon-decay (TPD) information for direct-drive experiments near the equator

- The highest intensities are near the equator
- Refraction limits some signals to equatorial regions

[Diagram showing laser beam directions and intensity distribution with labels for equator, pole, and view.]

Highly desirable diagnostic location near equator.

Past (and hopefully future) SRS streaks

Current SRS streaks

Equator
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