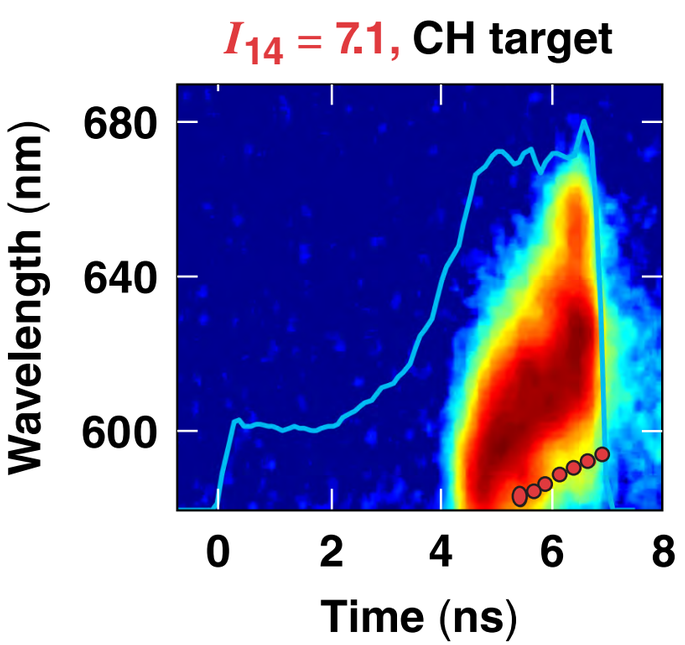
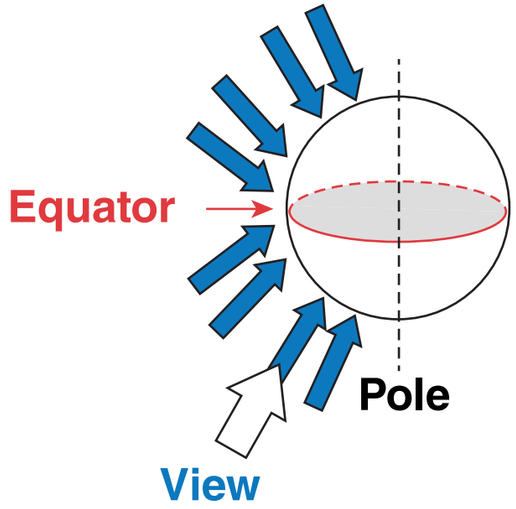
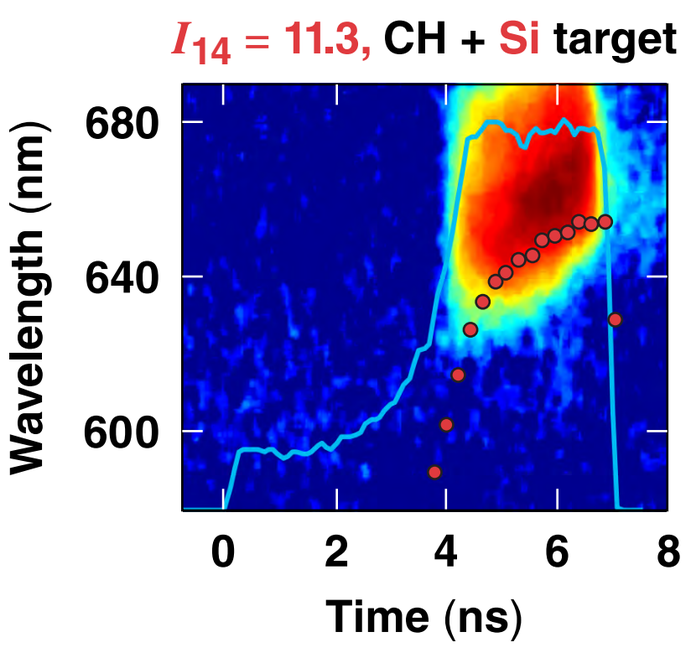
Stimulated Raman Scattering as a Coronal T_e Diagnostic for Direct-Drive Experiments at the National Ignition Facility





Polar-direct-drive illumination



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Summary

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 *DRACO* simulations

*W. Seka *et al*., Phys. Fluids 27, 2181 (1984).
**B. La Fontaine *et al*., Phys. Rev. Lett. 68, 484 (1992).

Collaborators

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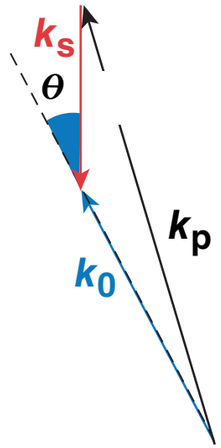
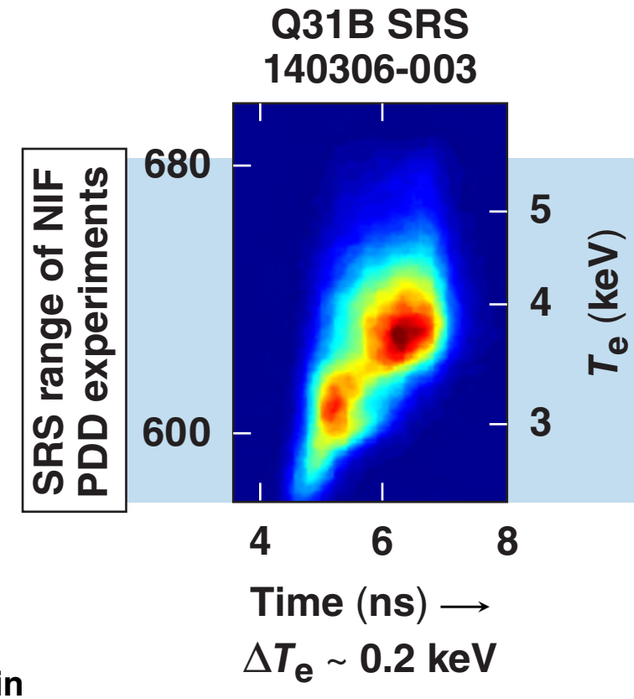
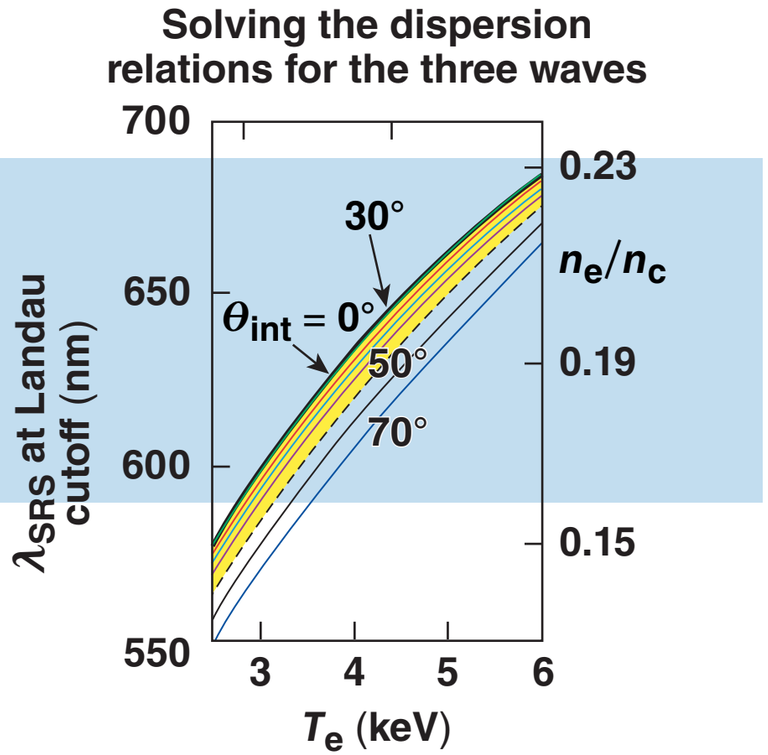
The shortest SRS wavelength is determined by Landau damping of the plasma wave at $k_p\lambda_{De} \sim 0.25$



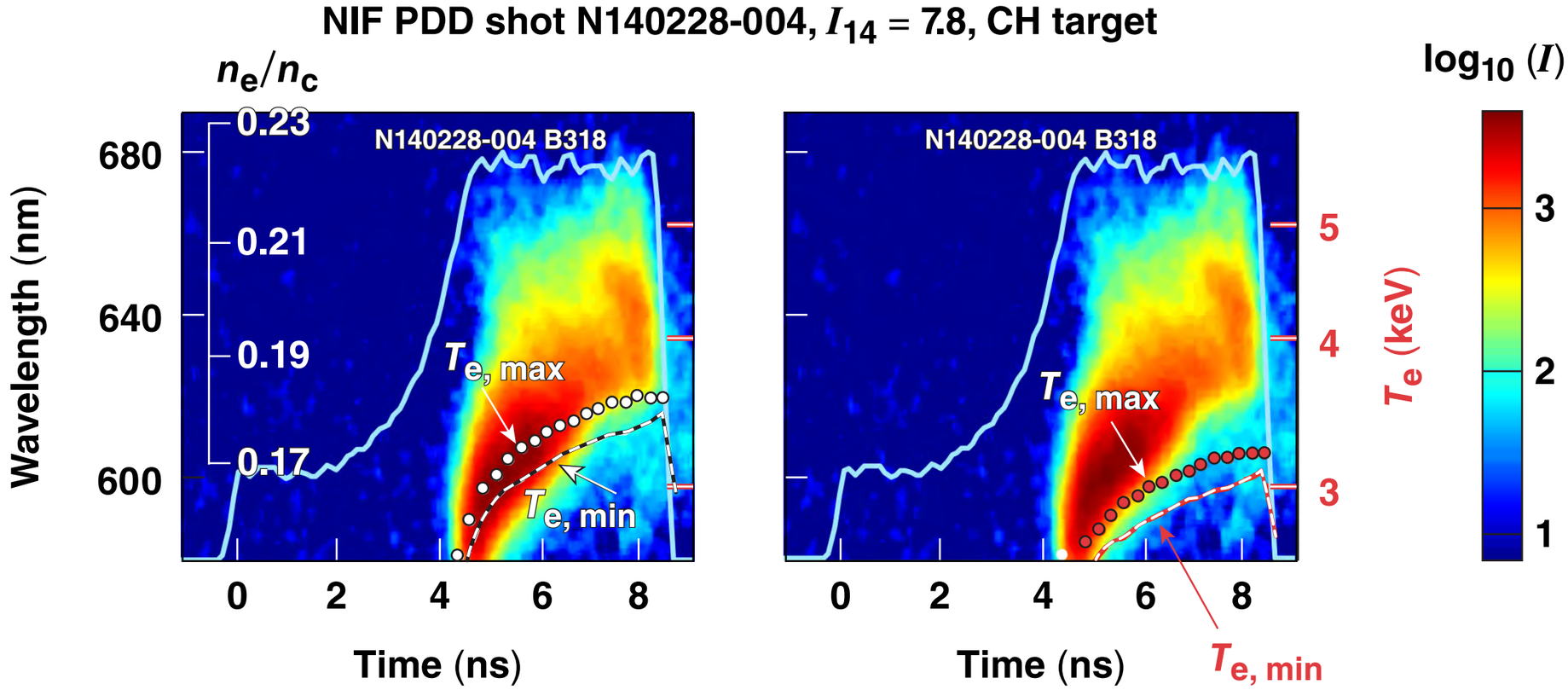
Landau damping of the EPW* limits at $k_p\lambda_{De} \sim 0.25$ ⇒ $\lambda_{SRS} > \lambda_{min}$





*EPW: Electron plasma wave
**EM: Electromagnetic

The Landau cutoff interpretation of the lower SRS wavelength limit varies with an assumed sidescatter angle



Landau cutoff assuming backscatter only (θ = 0°)

Landau cutoff assuming 50° sidescatter only

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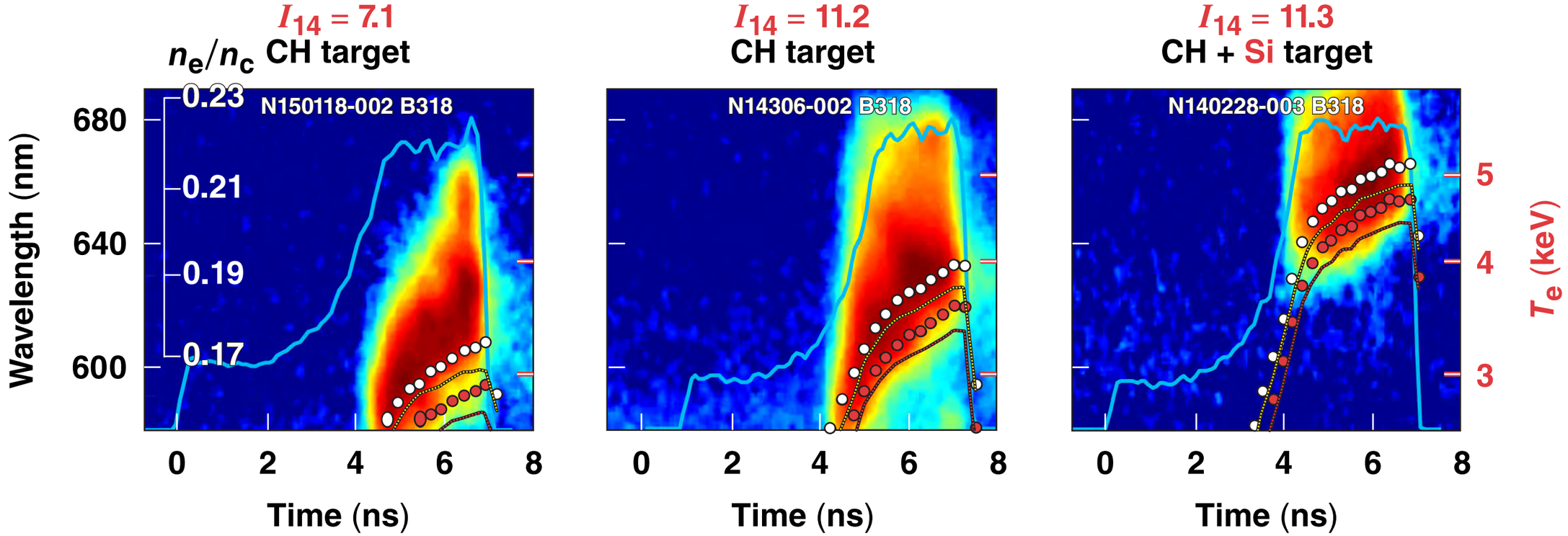
The SRS Landau cutoff is well simulated with 2-D *DRACO* over a wide range of target parameters



- *DRACO* predictions presently favor a large-sidescatter angle (50°) SRS limit
- More detailed analysis including refraction may modify this interpretation

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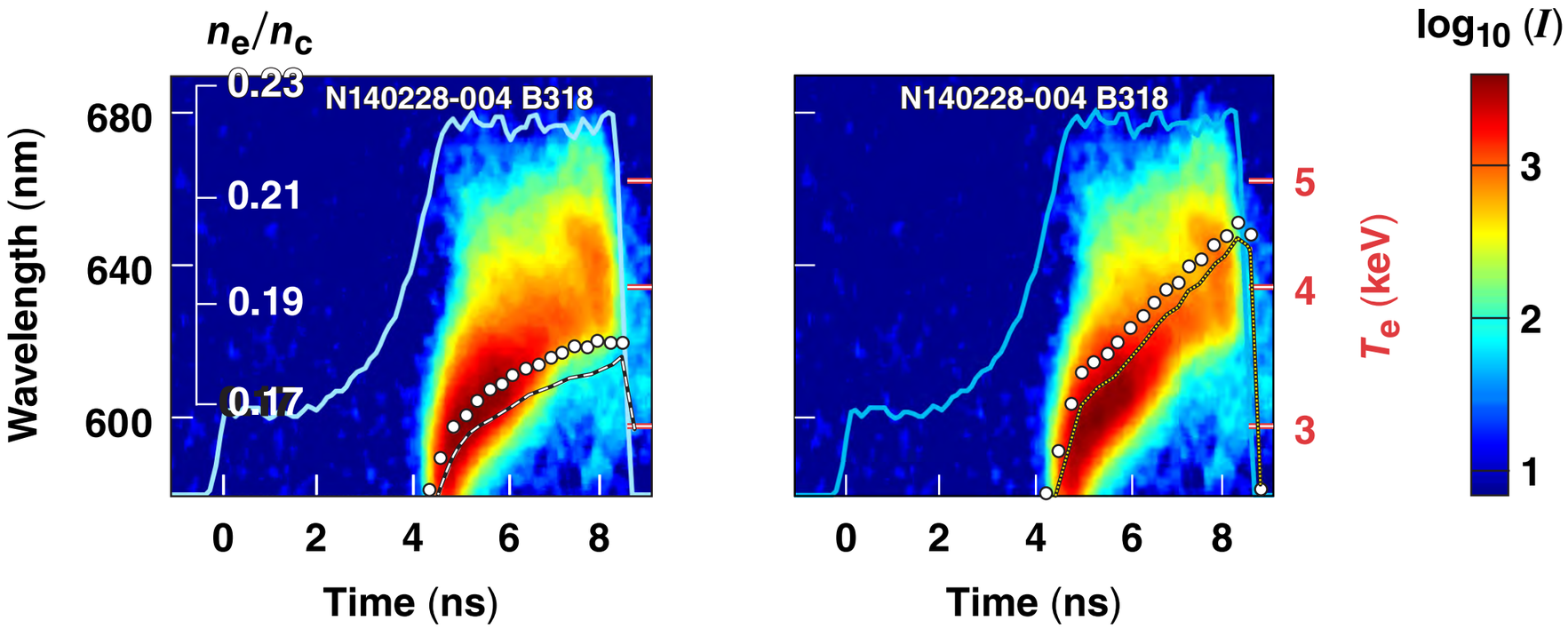
The SRS spectra of imploding PDD shells can be used to discriminate between different model assumptions in hydrodynamic simulations

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**

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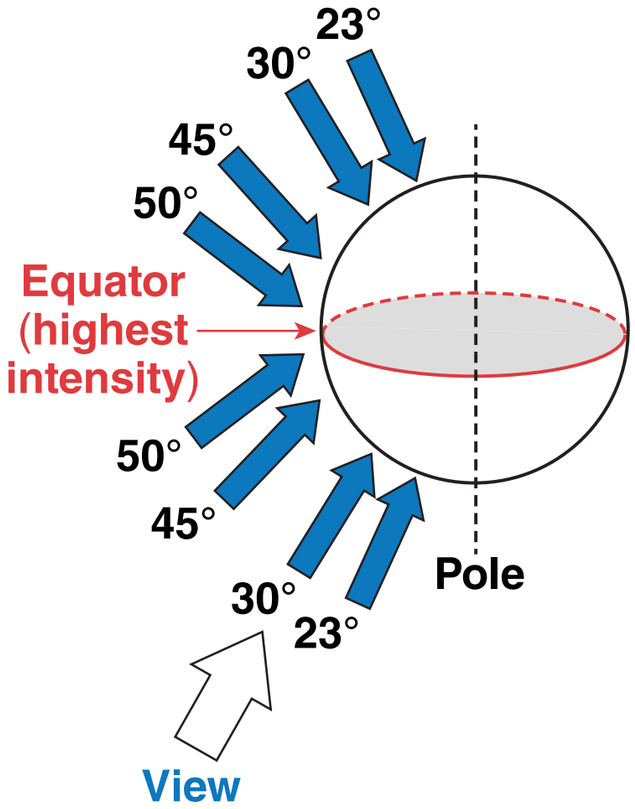
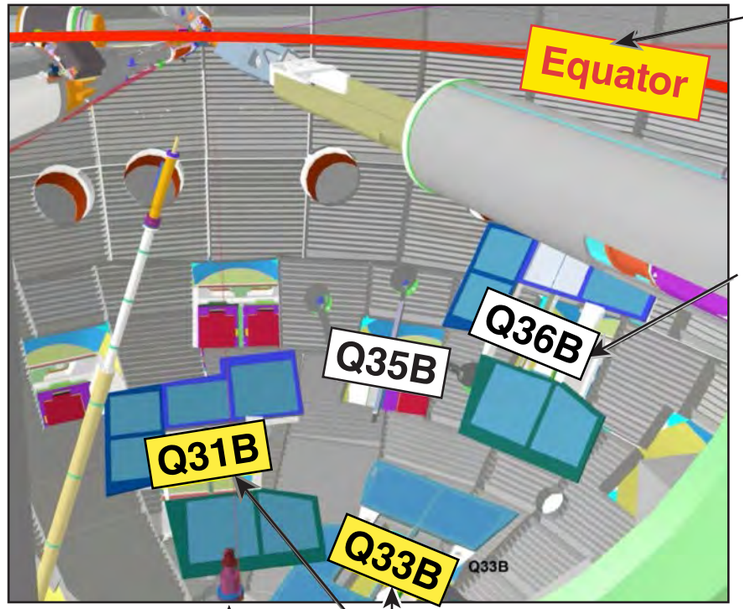
Laser–plasma interaction signatures pack crucial SRS and two-plasmon–decay (TPD) information for direct-drive experiments *near* the equator

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



PDD illumination



Highly desirable diagnostic location near equator.

Past (and hopefully future) SRS streaks

South pole

Current SRS streaks

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Summary/Conclusions

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