***Laser–Plasma Interaction (LPI) Experiments**:* Stimulated Brillouin scattering (SBS) was investigated under NIF direct-drive coronal and full beam-smoothing conditions (1-THz, 2-D SSD with polarization smoothing). Negligible SBS scattering levels (see Fig. 1) are observed in the region where NIF is most vulnerable to SBS, i.e., the transition region between the foot of the NIF laser pulse and the onset of the main drive pulse. The corresponding time-resolved SBS spectrum at the highest irradiation intensity (5.4×10^{14} W/cm^2) attained in these experiments with 1-THz UV bandwidth and polarization smoothing is shown in Fig. 2(a). This spectrum shows that the SBS is generated in the subsonic region and is most likely due to SBS amplification of laser light backscattered from the critical surface. (SBS from thermal fluctuations can be ruled out because of the prevailing density and velocity gradients in these regions.)

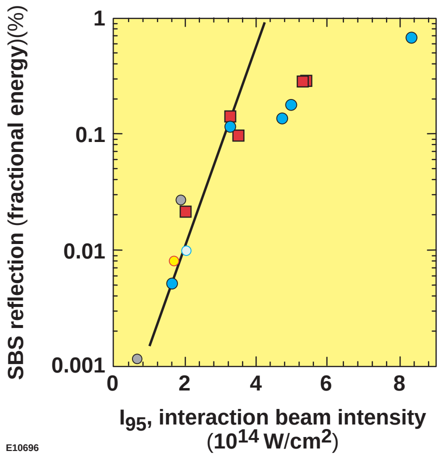

Figure 1. SBS energy reflectivity for a fully smoothed OMEGA interaction beam under plasma conditions similar to those in direct-drive NIF ignition targets during the rise of the main drive pulse. Different spot types correspond to different phase plates. The blue dots represent reduced bandwith (0.5 THz) while all other data points represent 1 THz. Polarization smoothing is applied in all cases.

When the bandwidth is reduced to 0.5 THz while still maintaining polarization smoothing, a more-intense SBS signal emanating from the supersonically expanding corona is observed [Fig. 2(b)]. This signal shifts toward shorter wavelengths during the interaction time. Two-dimensional simulations of the plasma show that there are indeed flat regions in the expansion velocity of the corona that travel down the density gradient and toward higher expansion velocities as time progresses. The SBS threshold in these regions is approximately 2 to 4×10^{13} W/cm^2—well below the average irradiation intensity—and SBS growth from thermal noise is likely.

The homogeneous growth rate under these plasma conditions is $\gamma \sim 10^{12}$ s^{-1}, resulting in a growth time of the same order of magnitude as the coherence time of the speckle distribution at 1 THz. Thus, the relevant intensity for the SBS process is likely to be well below the peak speckle intensity and probably approaches the smooth envelope intensity.

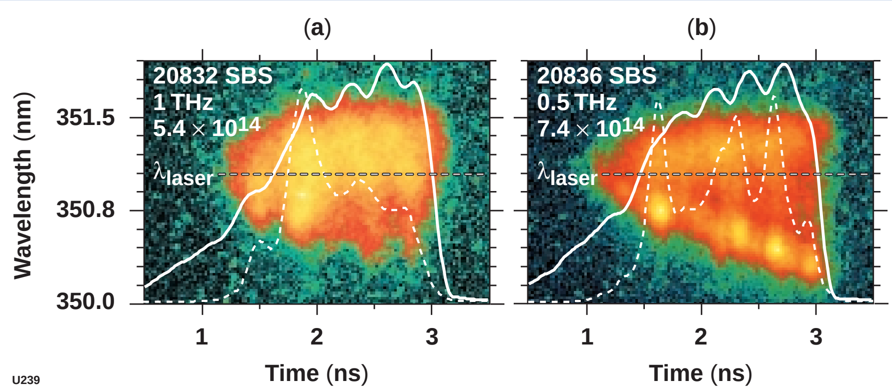

Figure 2. Time-resolved SBS spectra from long-scale-length plasmas on OMEGA. The plasma conditions are similar to the NIF direct-drive ignition target at the onset of the main drive pulse. Superposed on the spectra are the pulse shapes (white) and the spectrally integrated SBS power (dotted white). (a) A spectrum for fully smoothed beams at 1-Thz, 2-D SSD and polarization smoothing; (b) the same but with reduced SSD bandwidth of 0.5 THz.

NIF plasma simulations show much the same expansion behavior as the plasma generated in these OMEGA experiments. The corresponding inhomogeneous SBS thresholds are also very similar, and it is reasonable to infer that SBS is very unlikely to be a significant problem for direct-drive NIF ignition targets.

OMEGA Operations Summary: During the Month of September OMEGA produced 98 target shots over 11 shot days. LLE's integrated spherical experiment (ISE) campaigns received 32 shots. LANL used a three-day week for one day of direct-drive-cylinder shots and two days of high-yield-implosion shots in support of NIF neutron diagnostics development (28 total shots). Scientists from LLNL split a three-day week into four separate campaigns on NIF diagnostics development, indirectly driven implosions, radiation flow, and hot-electron production (32 shots total). A one-day NLUF dynamic diffraction campaign was also conducted (6 shots). Work continued on the Cryogenic Target Handling System (CTHS) in parallel with target shot activity. The CTHS is now capable of supporting up to three cryogenic target shots per week.

Contact: Wolf Seka (716) 275-3815; fax: (716) 275-5960; e-mail: seka@lle.rochester.edu
John M. Soures (716) 275-3866; fax: (716) 256-2586; e-mail: jsou@lle.rochester.edu