Measurements and modeling of Raman side-scatter in ICF experiments*

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Raman side-scatter, whereby the Raman scattered light is resonant at its turning point in a density gradient (Fig. 1), was identified experimentally in planar-target experiments at the National Ignition Facility (NIF) in conditions relevant to the direct-drive scheme of inertial confinement fusion (ICF). This process was found to be one of the principal sources of supra-thermal electrons in such conditions, which can preheat the target and reduce its compressibility. We have developed a new semi-analytical model of the instability, which describes both its convective and absolute aspects; we derived quantitative estimates of the amplification region in typical ICF regimes, which highlights the need for sufficiently large laser spots to allow the instability to develop. Full-scale simulations of these experiments using the laser-plasma interaction code ``pF3d'' show SRS side-scatter largely dominating over back-scatter, and reproduce the essential features observed in the experiments and derived in the theory; we provide extrapolations to the case of spherical geometries relevant to direct-drive and discuss implications for indirect-drive ICF experiments.

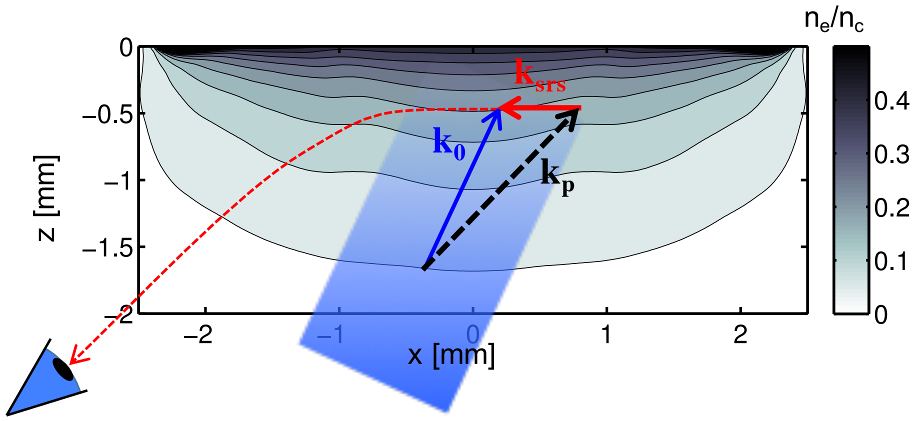

Figure 1: Raman side-scatter geometry for a planar target experiment (density contours in grey color-scale, from DRACO simulations), with a laser beam incident with wave-vector $\mathbf{k_0}$ (in blue) driving a plasma wave ($\mathbf{k_p}$) and a Raman scattered wave $\mathbf{k_{srs}}$ perpendicular to the density gradient.

* This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract No. DE-AC52-07NA27344, and was supported by the LLNL-LDRD Program under Project No. 42074.