Cooperative stimulated Raman scattering driven by two or multiple, picosecond laser pulses

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Backward stimulated Raman scattering (SRS) excited collectively by two laser pulses is investigated in the picosecond regime both experimentally and numerically [1] [2]. The experiments have been carried out at the LULI facility using two co-propagating 1-μm wavelength, 1.5-ps duration laser pulses focused in a preformed underdense plasma. A particular emphasis is laid on the configuration where the pulses are focused side-by-side, with a lateral distance of 80 − 90 μm, but not simultaneously.

It is experimentally demonstrated that a weak-intensity speckle, ineffective when fired alone in a preformed plasma, yields a significant SRS-induced reflectivity if launched a few picoseconds after a strong one. The data have been obtained by using both highly space-time resolved Thomson diagnostics and space-resolved SRS reflectivity measurements. By choosing either parallel or orthogonal polarizations for the two laser pulses, our experiments shed light on the role of either electrostatic or electromagnetic seeding in enhancing SRS from weak-intensity speckles. A major finding is that seeding operates over unexpectedly long times (15 − 20 ps under our experimental conditions). Similar results are obtained in lower-density plasmas, or when the weak pulse is smoothed by a random phase plate, thus leading to multiple speckle interaction, while the strong pulse is focused within the speckle pattern. The data are discussed with the help of particle-in-cell numerical simulations, which confirm the destabilizing effect of the strong pulse over the weak one after a short transient time.

References

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