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Rescattering of stimulated Raman sidescattering in nonuniform plasma

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Laser plasma instabilities (LPI) are important unsolved problem in inertial confifinement fusion (ICF), which include stimulated Raman scattering (SRS), stimulated Brillouin scattering (SBS),two plasma decay (TPD) and so on[1–3]. The SRS process has attracted much attention because of the loss of laser energy and the generation of hot electrons to preheat the fuel[4–6]. Upon entering the inhomogeneous plasma, the incident laser undergoes scattering at a range of angles, and numerous occurrences of large-angle scattering have been observed in early experiments[7,8]. As a result of the different directions of the scattered light, SRS in plasma has two main scattering forms: If the scattered light vector is the opposite of the incident light vector, it is stimulated Raman backscattering (SRBS)[9], if the scattered light vector is not collinear with the incident light vector, it is stimulated Raman sidescattering (SRSS)[7,10].

In this work, we construct a theoretical model for the rescatterings of SRSS.We derive the occurrence region and threshold for the higher-order SRSS. Two-dimensional(2D) particle-in-cell (PIC) simulations is shown that rescattering of SRSS occurs under typical parameter space of direct-drive-based scenarios and is consistent with our theoretical model. We explore the effect of the 2nd-order SRSS on the hot electrons. We find that heating by the 2nd-order SRSS has nearly the same consequence as the 1st-order SRSS does, but no cascade acceleration phenomenon is observed. Rescatterings of SRSS under different intensities, density scale lengths, and electron temperatures are performed and discussed in details. Higher-order SRSS observed in high intensity regime and the predominance of side scattering in almost all cases have shown that SRSS and associated rescatterings are robust and important processes in ICF.

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