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Experimental validation of the two-plasmon-decay common-wave process

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Direct-drive inertial confinement fusion requires multiple overlapping laser beams that can drive the two-plasmon-decay (TPD) instability. When multiple overlapping laser beams with polarization smoothing are used, the total energy in TPD-generated hot electrons was shown to scale with the overlapped intensity.[1] This scaling would not be expected if the beams drive the TPD independently according to the single-plane wave growth rates. Experiments were conducted on OMEGA EP, in large-scale-length plasmas, to validate the common-wave process, where the total energy in hot electrons is measured to be similar when one or two polarized beams are used at the same overlapped intensity and significantly reduced when four beams with the same overlapped intensity are used.[2] A theoretical model of the common-wave process shows that multiple laser beams can share an electron-plasma wave in the region bisecting the electromagnetic wave vectors. For two beams, this region defines a plane; for four beams, it defines a line. In this region, the convective gain of the dominant mode is proportional to the overlapped intensity and a geometric factor. When the TPD instability is saturated, the hot-electron temperature increases rapidly (25 keV to 90 keV), consistent with Zakharov simulations.[3] This work was supported by the U.S. Department of Energy Office of Inertial Confinement Fusion under Cooperative Agreement No. DE-FC52-08NA28302.

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[1] C. Stoeckl *et al.*, Phys. Rev. Lett. **90**, 235002 (2003).
[2] D. T. Michel *et al.*, "Experimental Validation of the Two-Plasmon-Decay Common-Wave Process," submitted to Physical Review Letters.
[3] D. H. Froula *et al.*, Phys. Rev. Lett. **108**, 165003 (2012).