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A Plasma Based Beam Combiner for Very High Fluence and Energy[1]

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Recent work at NIF has demonstrated a plasma-based optic that combines the energy and fluence of many laser beams into a single bright beam, thus creating a new technique for designing future high energy density physics experiments. The technique uses the Cross Beam Energy Transfer (CBET) process [1] and shows for the first time that a plasma can combine beams to produce a single beam that emerges with energy and fluence beyond that of any of those input for delivery to a range of experimental targets. In an initial demonstration multiple beams of the National Ignition Facility (NIF) laser have been combined in a plasma to produce a directed pulse of light with 4 +_1 kJ of energy in its 1 ns duration which is 3.6 times the energy and 3.2 times the fluence of any of the incident beams during that period and is NIFs brightest 1ns duration beam of UV light [2]. These enhancements are due to the non-linear interaction of the beams with a self-generated plasma diffractive optic which is far more damage resistant than existing solid state optics, and is inherently capable of producing much higher single beam fluence and radiance than solid state refractive or reflective optics can. The initial results are presently being used to further validate models of CBET [3] which predict a larger number of non-resonant pump beams will scale up outputs still further. [1] R. K. Kirkwood et al Plasma Phys. Control. Fusion 55, 103001 (2013). [2] R. K. Kirkwood et al submitted to Nature Physics. [3] D. Turnbull et al Phys. Rev. Lett. 118, 015001 (2017).

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