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Guiding of laser beams in plasmas by electromagnetic cascade compression[1] S. KALMYKOV, G. SHVETS, Institute for Fusion Studies, The University of Texas at Austin, Texas — The near-resonant beatwave excitation of an electron plasma wave (EPW) can be employed for generating trains of few- femtosecond electromagnetic pulses in rarefied plasmas. The EPW produces a co-moving index grating that induces a laser phase modulation at the difference frequency. As a result, the cascade of sidebands red- and blue-shifted by integer multiples of the beat frequency is generated in the laser spectrum. When the beat frequency is lower than the electron plasma frequency, the phase chirp enables laser beatnote compression by the group velocity dispersion. In the 3D cylindrical geometry, the frequency-downshifted EPW not only modulates the laser phase, but also causes the pulse to self-focus [P. Gibbon, Phys. Fluids **B** 2, 2196 (1990)]. After self-focusing, the laser beam inevitably diverges. Remarkably, the longitudinal beatnote compression can compensate the intensity drop due to diffraction. Thus, a train of high intensity radiation spikes with continually evolving longitudinal profile can be self-guided over several Rayleigh lengths in homogeneous plasma. High amplitude of the EPW is maintained over the entire propagation length. Numerical experiments on the electron acceleration in the cascade-driven (cascade-guided) EPW show that achieving GeV energy is possible under realistic experimental conditions.

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