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Relativistic self-focusing of multi-color laser pulses in plasmas.[1] G. SHVETS, S. AUSTIN YI, S. KALMYKOV, IFS, The University of Texas at Austin — An intense laser beam (with a power less than critical for the relativistic self-focusing) can be guided in plasmas with the help of an additional small-amplitude co-propagating beam (few- percent of the main beam energy). The guiding is effective if the beams' frequency detuning is slightly below the electron plasma frequency. The enhanced guiding is caused mostly by the near-resonantly driven 3D electron density perturbation (plasma beatwave). Another intriguing effect of the nonlinear guiding of ultra-short ($< 1/\omega_p$) radiation spikes is observed during the later stage of laser propagation. Periodic train of such spikes is self-consistently generated via electromagnetic cascading [S. Kalmykov and G. Shvets, Phys. Rev. Lett. **94** 235001 (2005); Phys. Rev. E **73** 046403 (2006)]. The guiding effect of the plasma wave partly suppresses the diffraction and results in a multi-centimeter guided propagation of the intense pulse train. Acceleration of externally injected electrons in the cascade-driven wake is quasi-monoenergetic and is characterized by low normalized transverse emittance and near-GeV energy gain.

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