

Enhancement of quasi-stationary magnetic fields via of the plasma density profile in the regime of relativistic self-channeling

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A novel approach to enhance quasi-stationary magnetic fields generated via the inverse Faraday effect during the self-channeling of circularly polarized laser radiation at relativistic intensity is investigated in this work. A previously established method [1] is generalized for constructing self-consistent, stationary, axisymmetric laser-plasma structures to the case of transversely inhomogeneous plasma density distributions. To circumvent discontinuous solutions encountered elsewhere [2], a small regularization parameter with the physical meaning of temperature is introduced. This method describes filaments formed during the relativistic self-focusing of circularly polarized radiation [3, 4]. As a result, the generated axial magnetic field increases by more than an order of magnitude compared to the homogeneous case and becomes comparable in magnitude to the magnetic field of the laser wave. This opens a path toward achieving teragauss-level quasi-stationary fields at laser intensities of 10^{26} W/cm².

[1] Kim A, Tushentsov M *et al.* 2002 *Phys. Rev. Lett.* **89** 095003

[2] Feit M D, Komashko A M *et al.* 1998 *Phys. Rev. E* **57** 7122

[3] Kim A, Tushentsov M *et al.* 2002 *Phys. Rev. E* **65** 036416

[4] Korzhimanov A V and Kim A V 2008 One-dimensional steady-state structures at relativistic interaction of laser radiation with overdense plasma for finite electron temperature (*Preprint arXiv:0810.4215*)