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Controlling nonlinear optical evolution of the laser pulse for dark-current-free electron acceleration in the blowout regime[1] S.Y. KALMYKOV, B.A. SHADWICK, University of Nebraska - Lincoln, A. BECK, E. LEFEBVRE, CEA, DAM, DIF, Arpajon, France — Electron density bubble maintained by radiation pressure guides a relativistically intense laser pulse in a rarefied plasmas and accelerates (self-)injected electrons to GeV-scale energy. Optical evolution of the pulse causes slow variations in the bubble shape and potentials, resulting in self-injection of initially quiescent plasma electrons. Spot size oscillations and pulse self-steepening during self-guiding result in massive continuous injection (dark current), jeopardizing quasi-monoenergetic acceleration [1,2]. Using nonlinear plasma lenses [2], as well as a large negative chirp of the laser pulse frequency [3], mitigate these adverse nonlinear optical effects and stabilize the shape of the bubble, suppressing the polychromatic, low-energy background, enabling production of high quality, GeV-scale energy, nC-charge electron beams.
[1] S. Y. Kalmykov et al., Phys. Plasmas 18, 056704 (2011). [2] S. Y. Kalmykov et al., Plasma Phys. Control. Fusion 53, 014006 (2011); [3] S. Y. Kalmykov et al., Physics of Quasi-Monoenergetic Laser-Plasma Acceleration of Electrons in the Blowout Regime, in Laser Pulses/Book 3, (InTech, Rijeka, Croatia; www. intechweb.org); ISBN 978-953-308-56-9.

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