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Monoenergetic electron acceleration in plasmas by an ultrashort petawatt laser pulse[1] SERGUEI KALMYKOV, Institute for Fusion Studies, The University of Texas at Austin, Austin, Texas, L.M. GORBUNOV, P. N. Lebedev Physics Institute, RAS, Moscow, Russian Federation, P. MORA, CPhT, Ecole Polytechnique, France, Y. AVITZOUR, G. SHVETS, IFS, UT Austin, Texas — Focusing an ultra-short (tens of fs) petawatt laser pulse in a wide focal spot ($\sim 100\ \mu$m) in rarefied plasma ($\sim 10^{17}$ cm^{-3}) enables accelerating electrons up to 1 GeV by a laser wake-field without a channel. An ultrashort laser pulse with an overcritical power for relativistic self- focusing propagates in plasmas as in vacuum. The nonlinear quasi-plane plasma wake effectively traps and accelerates injected electrons with a wide range of initial energies. The accelerating and focusing phases of the nonlinear three- dimensional axi-symmetric laser wake can almost entirely overlap starting from a certain distance behind the laser pulse in homogeneous plasma. Such a field structure results from the curvature of phase fronts due to the transversely inhomogeneous relativistic plasma frequency shift. Consequently, the number of trapped low-energy electrons can be much greater than that predicted by the linear wake theory. This effect is favorable for quasi-monoenergetic acceleration of several hundreds of pC to about 1 GeV per electron. External electron injection into the plasma wake (RF-based, colliding laser pulses etc.) is discussed.

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