Abstract Submitted
for the DPP17 Meeting of
The American Physical Society

Extreme states of electron-positron plasma in multi-petawatt laser fields EVGENY EFIMENKO, ALEKSEI BASHINOV, ARKADY GONOSKOV, ALEXANDER MURAVIEV, ARKADY KIM, ALEXANDER SERGEEV, Institute of Applied Physics, Russian Academy of Sciences, 46 Ulyanov Street, 603950, Nizhny Novgorod, Russia — The next generation of high-intensity laser facilities, such as ELI and XCELS, will allow reaching intensities sufficient for triggering strong-field QED phenomena. In particular, dense electron-positron-pair plasma can be created through vacuum breakdown by means of QED cascades. We analyze theoretically different nonlinear regimes of electron-positron plasma dynamics in multi-beam laser fields. First, we show that for laser powers of up to 20 PW QED-plasma with extraordinary high particle densities and fluxes, as well as ultra-bright bursts of GeV photons are produced. This could serve for unique sources of intense gamma rays and dense antimatter. This regime is governed by a current instability, which causes transformation of small plasma density perturbations into thin sheets with extreme current. Second, at higher laser powers created QED-plasma enters a self-compression stage driven by the generated magnetic field and reaches unprecedented pair densities on a short time scale. We call this regime a pinch regime and attribute such complex dynamics to inherent interaction of QED-plasma currents produced by counter-streaming electrons and positrons.

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Date submitted: 14 Jul 2017 Electronic form version 1.4