DPP14-2014-000498

Abstract for an Invited Paper
for the DPP14 Meeting of
the American Physical Society

Relativistic electron-positron jets and plasmas using intense lasers

HUI CHEN, Lawrence Livermore National Laboratory

High-flux jets of electron-positron antimatter with temperatures of a few trillion degrees have been produced in experiments at high-intensity laser facilities [1-5]. These breakthrough experiments open up a novel area of experimental high-energy-density plasma astrophysics identified in several recent national reports. These experiments are on a path toward the production of relativistic electron-positron "pair" plasmas [2], allowing for interactive study of a state of matter otherwise found only in exotic astrophysical systems such as active galaxies, quasars, gamma ray bursts, black holes, and conditions existing shortly after the Big Bang. This presentation describes the physical processes for making pairs and summarizes recent results from several large intense laser facilities [2, 3]. These results include the pair jet energy, angular divergence and emittance [4]; the pair jet temperature and density; pair production scalings [6] and collimation by external magnetic fields [5]; and sensitivity to laser intensity (10^{18} - 10^{21} Watts/cm^2), contrast (10^7 - 10^{10}), and energy (100 - 2000 J). The presentation concludes with discussion of possibilities to exploit laser-produced pair jets and plasmas.

This work was performed under the auspices of the U.S. DOE by LLNL under Contract DE-AC52-07NA27344.

[1] H. Chen, S. C. Wilks, J. D. Bonlie, *et al.*, Phys. Rev. Lett. **102**, 105001 (2009)
[2] H. Chen, S. C. Wilks, D. D. Meyerhofer, *et al.*, Phys. Rev. Lett. **105**, 015003 (2010)
[3] H. Chen, M. Nakai, Y. Sentoku, *et al.*, New J. Phys. **15,** 065010 (2013)
[4] H. Chen, J. C. Sheppard, D. D. Meyerhofer, *et al.*, Phys. Plasmas **20**, 012507 (2013)
[5] H. Chen, G. Fiksel, D. Barnak, *et al.*, Phys. Plasmas (Letter) **21**, 040703 (2014)
[6] H. Chen, F. Fiuza, A. Link, Y. Sentoku, *et al.*, submitted (2014)