LAWRENCE
LIVERMORE
NATIONAL
LABORATORY

LLNL-CONF-452894

Towards laboratory-produced relativistic electron-positron pair-plasmas

H. Chen, S. C. Wilks, D. D. Meyerhofer, P. Beiersdorfer, R. Cauble, F. Dollar, K. Falk, A. Hazi, C. D. Murphy, J. Park, J. Seely, C. I. Szabo, R. Shepherd, R. Tommasini, K. Zulick

September 2, 2010

14th International Workshop on Radiative Properties of Hot Dense Matter
Marbella, Spain
October 4, 2010 through October 8, 2010

Disclaimer

Abstract for 14th International Workshop on Radiative Properties of Hot Dense Matter
Marbella, Spain, October 4 – 8, 2010

Towards laboratory-produced relativistic electron-positron pair-plasmas

Hui Chen1, S. C. Wilks1, D. D Meyerhofer2, P. Beiersdorfer1, R. Cauble1, F. Dollar3, K. Falk4, A. Hazi1, C. D. Murphy4, J. Park1, J. Seely5, C. I. Szabo5, R. Shepherd1, R. Tommasini1, K. Zulick3
1. Lawrence Livermore National Laboratory, Livermore, CA 94551, USA
2. LLE, University of Rochester, Rochester, NY 14623, USA
3. University of Michigan, Ann Arbor, MI 48109, USA
4. University of Oxford, Oxford, UK
5. Naval Research Laboratory, Washington, DC 20375, USA

Relativistic pair-plasmas and jets are believed to exist in many astrophysical objects and are often invoked to explain energetic phenomena related to Gamma Ray Bursts and Black Holes. On earth, positrons from radioactive isotopes or accelerators are used extensively at low energies (sub-MeV) in areas related to surface science positron emission tomography and basic antimatter science. Experimental platforms capable of producing the high-temperature pair-plasma and high-flux jets required to simulate astrophysical positron conditions have so far been absent. In the last few years, we performed extensive experiments generating positrons with intense lasers [1, 2] where we found that relativistic electron and positron jets are produced by irradiating a solid gold target with an intense picosecond laser pulse. The positron temperatures in directions parallel and transverse to the beam both exceeded 0.5 MeV, and the density of electrons and positrons in these jets are of order 10^{16} cm^{-3} and 10^{13} cm^{-3}, respectively. With the advent of high-energy ultra-short laser pulses, we expect that a charge-neutral, relativistic pair-plasma is achievable, a novel regime of laboratory-produced hot dense matter. This talk will present some details of the laser-produced pair-plasma experiments.

*This work performed under the auspices of the U.S. DOE by LLNL under Contract DE-AC52-07NA27344 and was funded by LDRD #10-ERD-044.

[1] Chen, Hui, et al., Phy. Rev. Lett. **102**, 105001 (2009)
[2] Chen, Hui, et al., Phy. Rev. Lett. **105**, 015003 (2010)