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# Input to LLE annual report

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## Input to LLE FY11 Annual Report

In FY2011, an LLNL/LLE/NRL team performed a Laboratory Basic Science experiment on the OMEGA EP laser system to study positron production during high intensity laser interactions with high Z targets. This experiment was a follow-on to those of April 2009 and August 2010. In the previous experiments, a record number of positrons was produced using the 1 kJ, 10 ps OMEGA EP backlighter interacting with a 1 mm thick Au target [1]. It was deduced that a non-neutral pair plasma was made in those shots [2]. In FY2011, thanks to the facility improvements the laser energy was extended to 1400 J for the Backlighter beam. The FY 2011 experiments had two main objectives; to measure the energy scaling of the positron generation and to measure angular divergence of the electron-positron jets created. The preliminary results are shown in Figure 1 and Figure 2, for the energy scaling and angular divergence, respectively. A seemingly faster increase in positron number was observed once the laser energy exceeded 1 kJ. The electron-positron jet has a very narrow angular divergence of about 6-7 degrees. On these shots, the Gamma-Crystal spectrometer (with the energy coverage between 40 keV to 700 keV) that was modified to reduce the background radiation was further tested. Annihilation of electron positron radiation was not observed, perhaps due to low efficiency of the crystal as well as the detector.

Positron research has extended over diverse fields from particle physics and astrophysics to medical application. This often requires the production of large numbers of positrons on a short time scale, which has been difficult to supply. The new OMEGA EP results could alter the direction of the quest of establishing a laser-produced positron source for research in these fields.

[1] Chen, Hui, Wilks, S, Meyerhofer, D. D, et al., *Relativistic Quasi-monoenergetic Positron Jets From Intense Laser-Solid Interactions* Physical Review Letter **105**, 015003 (2010).

[2] Chen, Hui, Meyerhofer, D. D. et al., *Towards laboratory produced relativistic electron-positron pair plasmas*, High Energy Density Physics, **7**, 225 (2011)

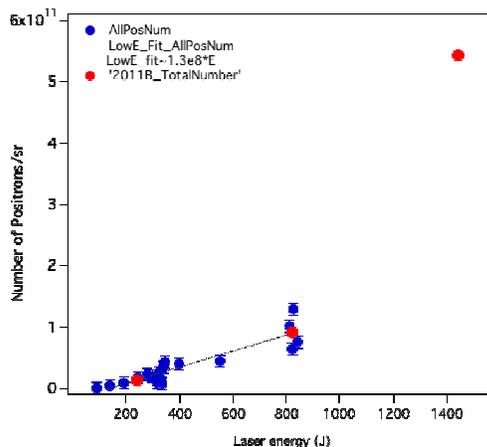


Figure 1. Positron number as a function of laser energy. Red dots are form FY11 EP experiments. Blue dots are all previous data.

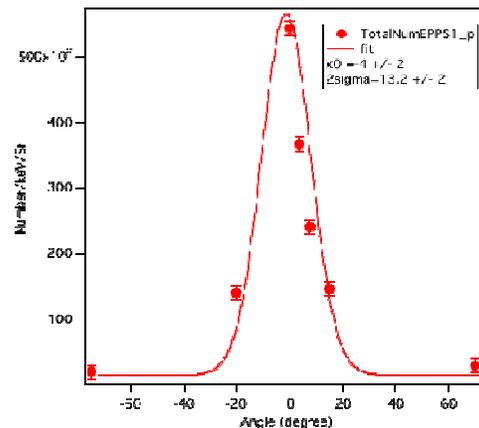


Figure 2. Angular divergence of the positron jet measured from FY11 EP experiments.