A Facility for Laboratory Astrophysics Using High Intensity Particle and Photon Beams

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Current frontier astrophysical phenomena typically involve one or more of the following conditions: (1) Very high intensity, high temperature processes, such as gamma ray bursts (GRBs) and supernovae; (2) extremely high energy events, such as ultra high energy cosmic rays (UHECRs) and blazars; (3) Super strong field environments, such as that in the vicinity of black holes and neutron stars. Laboratory experiments can explore the most complex aspects of the problem as well as verify the validity of simulations designed for environments far from accessible in terrestrial conditions.

High energy, high intensity electron and positron beams, such as that at SLAC, are ultra-short ($\sim$ 50fsec), high energy ($\sim$ 30GeV/e), high intensity ($> 10^{20}$W/cm^2), and can be operated at high repetition rates (10 Hz). In addition, such particle beams can be efficiently converted to high fluence photon beams (tunable from x-ray to gamma-ray) by either colliding with laser pulses or channeling through an undulator or a crystal. A dedicated facility using these high intensity beams can provide a unique tool for laboratory astrophysical investigations. Examples of possible experiments that can be performed at such a facility are discussed, and a set of tentative beam parameters for such a facility is given.

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