

High-Field Experiments Using Relativistic Electron Beams, Lasers, and Materials at FACET-II

D W STOREY¹

¹*SLAC National Accelerator Laboratory, 2575 Sand Hill Rd, Stanford CA, USA. Contact Phone: +6506565940
Contact Email: dstorey@slac.stanford.edu*

The FACET-II National User Facility at SLAC National Accelerator Laboratory provides uniquely high current and density electron beams at 10 GeV, enabling the development of advanced acceleration and coherent radiation techniques, and the study of intense electron beam interactions with lasers and materials. In this presentation, we will highlight recent progress in these high-field experiments across several key areas.

We will discuss the generation of petawatt peak power, relativistic electron beams with megaampere peak current, achieved through an innovative technique using laser-electron beam shaping techniques [1]. Additionally, we will report on recent progress from the E-320 experiment which probes strong field quantum electrodynamics (QED) by colliding 10 GeV electron beams with 10 TW laser pulses, pushing beyond the QED critical (Schwinger) intensity. Our latest results demonstrate the observation of higher order nonlinear Compton scattering and progress towards the direct observation of nonlinear Breit-Wheeler pair positrons.

Finally, we present the demonstration of a novel technique for the extreme focusing of electron beams, utilizing the self-focusing field generated by near field coherent transition radiation when a high current electron beam passes through multiple closely spaced foils [2]. These and other high-field experiments being conducted at FACET-II will be overviewed in this talk.

References

- [1] C Emma, N Majernik, K K Swanson, *et al.*, Phys. Rev. Lett. **134**, 085001 (2025)
- [2] A Sampath, X Davoine, S Corde, *et al.*, Phys. Rev. Lett. **126**, 064801 (2021)