HEDLA 2022
13th International Conference on High Energy Density Laboratory Astrophysics
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Laboratory observation of electron acceleration in turbulent collisionless shocks

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Collisionless shocks are ubiquitous in astrophysical plasmas and play an important role in magnetic field amplification and in the efficient acceleration of high-energy electrons and protons. While diffusive shock acceleration is well established, the details of particle injection remain a long-standing puzzle, particularly for electrons. I will present a recent effort to study high-Mach number turbulent collisionless shocks using laser-produced plasmas at the National Ignition Facility. I will describe the experimental characterization of the shock structure and nonthermal electron acceleration and the comparison with large-scale particle-in-cell simulations [1]. I will then discuss how these results are helping us reveal the microphysics of shock formation and electron injection in high-Mach number astrophysical shocks, such as those associated with young supernova remnants.

References

[1] F. Fiuza *et al.*, Nature Physics **16**, 916 (2020)