Laboratory evidence for proton energization by collisionless shock surfing

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Collisionless shocks are ubiquitously in the Universe and are held responsible for the production of non-thermal particles and high-energy radiation. Without particle collisions, theoretical works show that microscopic instabilities are able to mediate energy dissipation and allow for shock formation. Using our platform where we couple high-powerful lasers (JLF/Titan at LLNL and LULI2000) with high-strength magnetic fields, we have investigated the generation of magnetized collisionless shock and the associated particle energization [1]. We have diagnosed the plasma density, temperature, as well as the electromagnetic field structures and particle energization in the experiments, under various conditions of ambient plasma and B-field [2]. We have also modelled the formation and interpenetration of the shocks using both macroscopic hydrodynamic simulations and kinetic particle-in-cell simulations [3]. By varying the parameters of the expanding plasma launched in the ambient gas, as well as those of the background magnetic field, we investigate the bridge between the simulated dissipation mechanisms and observed particle energization, as will be reported here.

References

[1] W. Yao, *et al.*, Nat. Phys. **17**, 1177-1182 (2021)

[2] W. Yao, *et al.*, MRE **7**, 014402 (2021)

[3] A. Fazzini, W. Yao, *et al.*, arXiv:2202.03465 (2022)