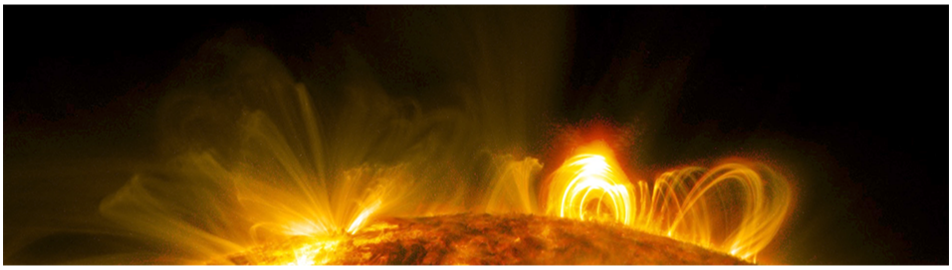

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Non-thermal electron acceleration by magnetically driven reconnection in the laboratory*

Tuesday, 16 November 2021 10:15 (15 minutes)

Magnetic reconnection is a ubiquitous astrophysical process that rapidly converts magnetic energy into some combination of plasma flow energy, thermal energy, and non-thermal energetic particles, including energetic electrons. Various reconnection acceleration mechanisms in different low-beta and collisionless environments have been proposed theoretically and studied numerically. However, none of them have been heretofore confirmed experimentally, as the direct observation of non-thermal particle acceleration in laboratory experiments has been difficult. Here we report the direct measurement of accelerated non-thermal electrons from low-beta magnetically driven reconnection in experiments using a laser-powered capacitor coil platform. The angular dependence of the measured electron energy spectrum and the resulting accelerated energies, supported by particle-in-cell simulations, indicate that the mechanism of direct electric field acceleration by the out-of-plane reconnection electric field is at work. Scaled energies using this mechanism show direct relevance to astrophysical observations. Our results therefore support one of the proposed acceleration mechanisms by reconnection, and establish a new approach to study reconnection particle acceleration with laboratory experiments in relevant regimes.

*A. Chien, L. Gao, S. Zhang, H. Ji, E. Blackman, W. Daughton, A. Stanier, A. Le, F. Guo, R. Follett, H. Chen, G. Fiksel, G. Bleotu, R. Cauble, S. Chen, A. Fazzini, K. Flippo, O. French, D. Froula, J. Fuchs, S. Fujioka, K. Hill, S. Klein, C. Kuranz, P. Nilson, A. Rasmus, R. Takizawa, “Direct measurement of non-thermal electron acceleration from magnetically driven reconnection in a laboratory plasma”, submitted (2021).

Primary author: JI, Hantao (Princeton University)

Presenter: JI, Hantao (Princeton University)

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