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Electron Acceleration during Laser-Driven Magnetic Reconnection in a Low beta Plasma

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Magnetic reconnection (MR) is a fundamental plasma process in which the magnetic-field topology undergoes dramatic rearrangement, and magnetic energy is converted to kinetic energy, thermal energy, and particle acceleration. MR plays a key role in several plasma eruptions, especially in solar flares, geomagnetic substorms, and tokamak disruptions. Laser-Driven MR (LDMR) was constructed with self-generated or induced magnetic fields has been experimentally and theoretically studied extensively, where ten to hundred tesla magnetic fields are generated in a high-power laser-plasma interaction. For small scale, short-lived and strong fields, LDMR provides one unique opportunity to study both global and local physics of MR.

Acceleration of particles during MR has been observed in the universe and been a hot topic for a long time. However, how those particles are generated is still one open question. Bringing this kind of natural large-scale acceleration to the laboratory is one big challenge. In this talk, we will discuss both experiments and simulations on electron acceleration in a low beta LDMR with a millimeter plasma device. We found the electron energy spectrum shows a typical power law, and the spectral index is much flatter than those of in a high beta plasma. The coincidence of electronic energy spectra between experiments and simulations indicates that the parallel electric field acceleration plays a significant role. The efficient particle energization in low beta plasmas may help us understanding the strong particle energization in solar flares and accretion disk coronae.