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Bringing astrophysics to laboratories

Yutong Li
Institute of Physics, CAS, Beijing, China,

With high-power laser systems, scientists are able to create the extreme conditions of physical experiments in the laboratory presently. Such experimental conditions are unprecedented, and can be used to simulate some representational celestial objects and phenomena, which allow scientists to study many important and critical astrophysical issues in laboratories [1]. In this talk, we will overview our recent experimental studies of laboratory astrophysics in China.

1. Magnetic reconnection (MR) is believed to play an important role in many different plasma phenomena including solar flares, star formation, and other astrophysical events. Based on the quasi-steady state of the magnetic fields produced by high power laser pulses, we reconstruct the topology of magnetic reconnection in laboratory by using the Shenguang II laser in Shanghai and the Gekko XII laser in Osaka. We have observed emission of energetic electrons with a spectrum similar to that from solar flares.

2. Most astronomical and astrophysical shock waves are collisionless, which means that the shocks are not formed by coulomb collisions. We will present the generation of collisionless shockwaves in the interaction between two counter-streaming laser-produced plasmas. Numerical simulations indicate that the shockwaves are excited by electrostatic instability. We also observe formation of plasma filaments, which is believed to be caused by Weibel instability.

3. Jet deflection is an interesting astronomical phenomenon that collimated jets usually propagate away from their initial trajectories. When two high-density plasmas jets propagating perpendicular to each other, we observe large angle deflection of the jets. This may throw light on the understanding of the fantastic HH 110/270 system.

4. Strong magnetic field of hundreds of Teslas is demonstrated on the SG-II laser facility by irradiating 2 kJ in 1 ns on a planar plate attached on the end of one open-ended coil. The magnetic field is generated by cold background electrons to neutralize the positively charged laser foci. The strong magnetic fields generated is of significance to many research areas including plasma and beam physics, astrophysics, and atomic and molecular physics, etc., by providing physical conditions of a new regime in a controllable way

References

[1] Bruce A. Remington, R. Paul Drake, and Dmitri D. Ryutov, Rev. Mod. Phys. 78, 755–807 (2006).
[2] X. Liu, Y. T. Li, Y. Zhang, et al., New J. Phys., 13,093001 (2011).
[3] J. Y. Zhong et al., Astrophys. J. Suppl. Ser. 225， 30(2016)
[4] B. J. Zhu, et al., Appl. Phys. Lett. 107, 261903 (2015)
[5] D. W. Yuan, et al, Astrophysical Journal 815, 46 (2015)
[6] J. R. Zhao, et al., Sci. Report 6, 27363 (2016)