Expanding Horizons of Laboratory Plasma Astrophysics

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Plasma astrophysics, the application of plasma physics principles to the Universe, lies at the frontier of science and human intelligence. Recent advances have been led primarily by observatories, ground based and space-borne, and by large-scale numerical computations. In the laboratory, significant progress has been made in plasma production, controls, and diagnostics, most of which benefited largely from fusion research. As a result, laboratory study of fundamental plasma astrophysics processes, or laboratory plasma astrophysics, has become increasingly plausible and exciting. In this talk, I would like to highlight some of recent example achievements from experiments in magnetized plasmas [1], high-energy-density plasmas [2], as well as electrically conducting and non-conducting liquids [e.g., 3]. The bright future of this growing field will be reflected in discussions of near-term major scientific opportunities [4], including several new intermediate-scale laboratory experiments that either just became available [5,6] or are currently under construction [7].

[1] Biennial International Workshops on the Interrelationship between Plasma Experiments and in the Laboratory and in Space (IPELS). The most recent one can be found at: http://tanuki.t.u-tokyo.ac.jp/IPELS2013/

[2] Biennial International Conferences on High Energy Density Laboratory Astrophysics (HEDLA). The most recent one can be found at: http://hedla2014.sciencesconf.org

[3] H. Ji and S. Balbus, "Angular Momentum Transport in Astrophysics and in the Lab", Physics Today **66**, 27 (2013).

[4] Report from Workshop on Opportunities in Plasma Astrophysics (WOPA), http://w3.pppl.gov/conferences/2010/WOPA/index.html

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[6] E. Thomas Jr, R. L. Merlino and M. Rosenberg, "Magnetized dusty plasmas: the next frontier for complex plasma research", Plasma Physics and Controlled Fusion **54**, 124034 (2012).

[7] H. Ji and W. Daughton, "Phase diagram for magnetic reconnection in heliophysical, astrophysical, and laboratory plasmas," Physics of Plasmas **18**, 111207 (2011).