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Experimental/observational overview: what laboratory can offer to astro- and vice-versa[1]

MICHAEL BROWN, Swarthmore College

There has been a recent synergy among laboratory experiments, astrophysical observations, and computation models. Important progress can be made if specific problems in plasma physics can be addressed by targeted experiments, careful astrophysical observations, and well-designed computer models. I will review some of the areas in which collaborative progress has been made (magnetic reconnection, astrophysical dynamos, turbulence) then focus on two specific problems. First, ion temperatures in the turbulent high corona and solar wind are known to scale with the ion mass ($T_i \propto M_i$). Laboratory measurements of ion temperature during reconnection-driven events in the MST reversed field pinch have a one scaling ($T_i \propto \sqrt{M_i}$) whereas impulsive events in the SSX reconnection device have another scaling ($T_i \propto Z/M_i$). Computer simulations are being planned to help sort out the discrepancies but evidently, different physics pertains in each system. Second, solar loops can now be imaged at sub-arcsecond resolution (scales $\leq 700\ km$ at the solar surface). The Hinode satellite has been used to resolve structure and dynamics of solar activity to the smallest scales. Both the Caltech Solar Coronal Loop Simulation Experiment and the Princeton Solar Flux Loop Experiment on MRX employ fast framing cameras to study rapid dynamics such as filamentation and footpoint motion. These magnetized loops formed in the laboratory can also be studied with internal probes to measure stability thresholds, Alfvén wave activity, and plasma relaxation. Connections among these laboratory experiments, space observations, and simulations will be emphasized.

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