Exploring driven collisionless reconnection in the Terrestrial Reconnection Experiment (TREX)

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The newly developed Terrestrial Reconnection Experiment (TREX) [1] in the Wisconsin Plasma Physics Laboratory (WiPPL) [2] is optimized to study magnetic reconnection in a regime where Coulomb collisions between electrons and ions are sufficiently infrequent that kinetic effects in the electron dynamics are retained (see Fig. 1). In this fully collisionless regime electron pressure anisotropy develops and is fundamental to the structure of the electron diffusion region. The observed signatures of reconnection include narrow electron jets and current layers with widths down to the scale length of the electron skin depth, confirming previous results from fully kinetic simulations. Meanwhile, the experimental rate of reconnection is surprisingly large, with inflow speeds to the reconnection region being similar to the Alfvenic outflow speeds observed in the reconnection exhaust. Consequently, the normalized reconnection rate, on the order of unity, is about an order of magnitude larger than those typically observed in undriven systems. Driven reconnection scenarios are important to a range of systems including the interaction of stellar winds with planetary magnetospheres. The large rate of reconnection observed in TREX may also be helpful to explain burst of radiations from energetic electrons generated in supernova remnants.

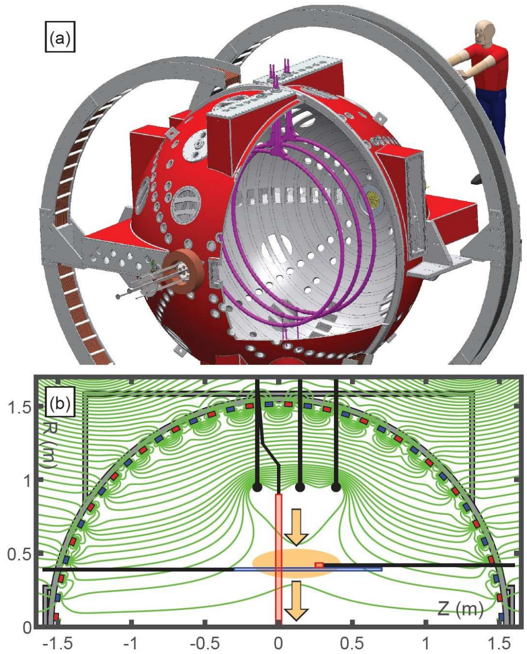

Figure 1: *(a) Engineering sketch of the Big Red Ball (BRB) showing the internal configuration used for the TREX experiments. (b) A cross-section of BRB with the magnetic field line geometry shown in green.*

References

[1] J. Olson, et al., Phys. Rev. Lett **116**, 255001 (2016)

[2] C.B. Forest, et al., Jour. Plasma Phys., **81**, 345810501 (2015)