Contribution ID: **977** Type: **Poster**

1P42 - Momentum Coupling in Magnetized Plasmas

Monday 24 June 2019 13:00 (1h 30m)

Many interesting and important problems in plasma science involve the differential motion of regions of plasma, threaded by the same magnetic field lines. In all reference frames, there is a difference in the motional electric field between regions, a difference in potential parallel to the magnetic field, and currents that couple the different regions, thus transferring momentum by J x B forces. Examples of this dynamic interaction include the coupling between the ionosphere magnetosphere and solar wind; plasma generation in space, charged or large extended spacecraft including tethers, the penetration of plasma jets into plasma-sphere, and the interaction of Jupiter with its moon Io. The standard model for interaction is a MHD-like picture where oblique Alfvén waves mediate the coupling current. If the currents are large and spread over the largest possible volume the coupling is strong. If sheaths and charge layers form, the coupling is diminished. In the years leading up to the flight of the Tethered Satellite System, TSS-1R, in 1996, this standard model was applied but it never lead to definite predictions of the tether current, and the mission results showed no dependence on the Alfvénic parameters. The results did indicate a plasma probe-type interaction, but unlike anything known at that time and still not fully explained today. We are exploring the lessons learn from TSS, to see if the standard model of momentum coupling needs repair, and to better understanding of the problem of a positively charged probe in a flowing plasma. Our approach includes a unique ExB drift plasma chamber, numerical simulation, and theoretical review. Results from all fronts will be discussed.

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Session Classification: Posters Fundamental Research and Basic Processes and Power Electronics

Track Classification: 1.3 Space Plasmas