***Modeling of Mercury's Pick-up Ion Dynamics and its Response to Changes in IMF Conditions***

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The three MESSENGER flybys of Mercury provided the opportunity to observe the magnetosphere of Mercury under three different interplanetary magnetic field (IMF) conditions: stable northward IMF during the first flyby, stable southward IMF during the second flyby, and variable northward-southward IMF during the third flyby. Although the details of exosphere – magnetosphere coupling are still to be identified and understood, the MESSENGER observations have given clear indications that the neutral exosphere emissions respond to IMF changes.

To investigate exosphere – IMF coupling, we upgraded our multi-fluid Hall magnetohydrodynamic (MHD) model to track the dynamics of exospheric pick-up ions along with solar wind ions and electrons. This model was then used to provide a global view of the topology of the magnetosphere under the three IMF conditions encountered during the MESSENGER flybys, and to assess how pick-up ions adapt in each situation to changes in global magnetospheric structure. We show that each IMF–magnetosphere configuration not only affects exosphere interaction by constraining pick-ion dynamics but, more importantly, it determines the location and the amount of surface available for sputtering by solar wind ions.