



MESSENGER Observations of Asymmetries at Mercury's Magnetotail Current Sheet

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Dawn-dusk asymmetries in the Earth's magnetotail current sheet have been observed and remain an active area of research. With an internal magnetic dipole field structure similar to Earth's, similar dawn-dusk asymmetries might be expected in Mercury's magnetotail current sheet. However, no observation of dawn-dusk asymmetries has been reported in the structure of Mercury's magnetotail. Using 4 years of MESSENGER's magnetic field and plasma data, we analyzed 319 current sheet crossings. From the polarity of B_z in the cross-tail current sheet, we determined that MESSENGER is on closed field lines about 90% of the time. During the other 10% MESSENGER observed negative B_z indicating that it was tailward of the Near Mercury Neutral Line (NMNL). The B_z magnetic field is also observed to be higher at the dawnside than the duskside of the magnetotail current sheet by approximately a factor of three. Further the asymmetry decreases with increasing downstream distance. A reduction (enhancement) in B_z should correspond to a more (less) stretched and thinned (thickened) current sheet. Analysis of current sheet thickness based upon MESSENGER's observations confirms this behavior with mean current sheet thickness and B_z intensity having dawn-dusk asymmetries with the same sense. Plasma β in the current sheet also exhibits a dawn-dusk asymmetry opposite to that of B_z . This is consistent with expectations based on MHD stress balance. Earlier studies had shown a dawn-dusk asymmetry in the heavy ion in Mercury's magnetotail. We suggest that this enhancement of heavy ions in the duskside current sheet, due to centrifugal acceleration of ions from the cusp and gradient-curvature drift from the NMNL, may provide a partial explanation of the dawn-dusk current sheet asymmetries found in this study.