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Anti-parallel and Component Reconnection at the Magnetopause

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Reconnection at the magnetopause is clearly the dominant mechanism by which magnetic fields in different regions change topology to create open magnetic field lines that allow energy and momentum to flow into the magnetosphere. Observations and data analysis methods have reached the maturity to address one of the major outstanding questions about magnetic reconnection: The location of the reconnection site. There are two scenarios discussed in the literature, a) anti-parallel reconnection where shear angles between the magnetospheric field and the IMF are near 180 degrees, and b) component reconnection where shear angles are as low as 50 degrees. One popular component reconnection model is the tilted neutral line model. Both reconnection scenarios have a profound impact on the location of the X-line and plasma transfer into the magnetosphere.

We have analyzed 3D plasma measurements observed by the Polar satellite in the northern hemisphere cusp region during southward IMF conditions. These 3D plasma measurements are used to estimate the distance to the reconnection line by using the low-velocity cutoff technique for precipitating and mirrored magnetosheath populations in the cusp. The calculated distances are subsequently traced back along geomagnetic field lines to the expected reconnection sites at the magnetopause. The Polar survey of northern cusp passes reveal that both reconnection scenarios occur at the magnetopause. The IMF clock angle appears to be the dominant parameter in causing either the anti-parallel or the tilted X-line reconnection scenario.