

Space Plasmas in the Solar System, including Planetary Magnetospheres (D)
Half a Century of Plasma Studies: Lessons Learned (D33)

MAGNETIC RECONNECTION: A FUNDAMENTAL PROCESS IN SPACE PLASMAS

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For many years, collisionless magnetic reconnection has been recognized as a fundamental process, which facilitates plasma transport and energy release in systems ranging from the astrophysical plasmas to magnetospheres and even laboratory plasma. Beginning with work addressing solar dynamics, it has been understood that reconnection is essential to explain solar eruptions, the interaction of the solar wind with the magnetosphere, and the dynamics of the magnetosphere. Accordingly, the process of magnetic reconnection has been and remains a prime target for space-based and laboratory studies, as well as for theoretical research. Much progress has been made throughout the years, beginning with indirect verifications by studies of processes enabled by reconnection, such as Coronal Mass Ejections, Flux Transfer Events, and Plasmoids. Theoretical advances have accompanied these observations, moving knowledge beyond the Sweet-Parker theory to the recognition that other, collisionless, effects are available and likely to support much faster reconnection rates. At the present time we are therefore near a break-through in our understanding of how collisionless reconnection works. Theory and modeling have advanced to the point that two competing theories are considered leading candidates for explaining the microphysics of this process. Both theories predict very small spatial and temporal scales, which are, to date, inaccessible to space-based or laboratory measurements. The need to understand magnetic reconnection has led NASA to begin the implementation of a tailored mission, Magnetospheric MultiScale (MMS), a four spacecraft cluster equipped to resolve all relevant spatial and temporal scales. In this presentation, we present an overview of current knowledge as well as an outlook towards measurements provided by MMS.