# Interplanetary and Magnetospheric Alfvén Shocks: Properties and Consequences

*B. T. Tsurutani[1], G. S. Lakhina[2], J. S. Pickett[3] , N. Lin[4] and F. Guarnieri[5]*

[1]*Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA*
[2]*India Institute of Geomagnetism, Mumbai, India*
[3]*University of Iowa, Iowa City, IA*
[4]*University of Minnesota, Minneapolis, MN*
[5]*Brazilian National Institute for Space Research-INPE*

We use Ulysses, Polar and Cluster data to illustrate some properties of nonlinear Alfvén waves in both interplanetary space and within the magnetosphere. Nonlinear Alfvén waves phase-steepen (dispersion) to form discontinuities at their leading edges. Power spectral "broadening" is one of the consequences of this physical process. Ponderomotive forces acting at the phase-steepened edges heat the ambient plasma forming magnetic decreases/holes/bubbles via the diamagnetic effect. The heating of the ions and electrons lead to a myriad of microinstabilities (Langmuir, ion acoustic and whistler mode waves in the solar wind). Another example is the generation of the largest amplitude (~17 nT peak-to-peak) proton cyclotron waves (via the temperature instability) detected within the magnetosphere (to date). Also related to this "inverse cascade in wave spectra" is the formation of "electron holes". We also would like to address the rate of Alfvén wave dissipation and the heating of the ambient solar wind.