Understanding Multiscale Transients in Mercury's Plasma Environment under Northward IMF Condition: Data Analysis Tools and First Results

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We explore multiscale properties of transient anisotropic magnetic field fluctuations recorded by MESSENGER spacecraft during its first flyby (14 Jan 2008) through the Mercury's magnetosphere, with the emphasis on key boundary regions participating in the solar wind - magnetosphere interaction. The study is based on a set of new data analysis tools enabling us to investigate complex forms of magnetic field variability associated with a superposition of stochastic and deterministic modes of plasma behavior. Our analysis reveals (1) an extended foreshock system filled with packets of ULF oscillations organized across large spatial distances into quasi-periodic shocklet structures merging with an eroded bow shock, (2) broad-band intermittent fluctuations in the dusk magnetosheath containing transient anisotropic structures suggestive of flux transfer events in the neighboring plasma regions, (3) signatures of a partly-developed turbulent cascade involving both MHD and kinetic scaling domains in the Kelvin-Helmholtz region of the inbound magnetopause and in the adjacent cross-tail current sheet, as well as (4) remarkable similarity between the inner current sheet observed at 19:10:35 and the outbound (eastern) magnetopause encountered several minutes later confirming the presence of a "double magnetopause" (J. Slavin et al., 2008). We also report preliminary results indicating the presence of (5) Na+ ion cyclotron oscillations at the dawn magnetopause.