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Observations of Magnetospheric Ulf Waves in Connection to the Kelvin-Helmholtz Instability at Mercury

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Abstract : The magnetospheric magnetic field data from the MESSENGER spacecraft is investigated to establish the presence of ultra-low frequency (ULF) waves in connection to 131 previously observed nonlinear Kelvin-Helmholtz waves (KHWs) at Mercury. Distinct ULF signatures are detected in 44 out of the 131 magnetospheric traversals prior to or after observing a KHW. In particular, 39 of these 44 ULF events are highly coherent at the frequency of maximum power spectral density. The waves observed at the dayside, which appears mainly at the duskside and naturally following the KHW occurrence asymmetry, are significantly different to the events behind the dawn-dusk terminator and have the following distinct wave characteristics: they oscillate clearly in the perpendicular (azimuthal) direction to the mean magnetic field with a wave normal angle more in the parallel than the perpendicular direction, increase in absolute ellipticity with distance from noon, are almost exclusively right-hand polarized, and are observed mainly for frequencies in the range 0.02-0.04 Hz. These results indicate that the dayside ULF waves are likely to shear Alfvén waves driven by KHWs at the magnetopause, which in turn manifests the importance of the Kelvin-Helmholtz instability in terms of mass transport throughout the Mercury magnetosphere.

Keywords : ultra-low frequency waves, kelvin-Helmholtz instability, magnetospheric processes, mercury, messenger, energy and momentum transfer in planetary environments
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