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Comparison of Ultra-Low-Frequency Waves at Mercury under Northward and Southward IMF

Scott A. Boardsen, James A. Slavin, Brian J. Anderson, Mario H. Acuña, Haje Korth, Sean C. Solomon

The trajectories of the two MESSENGER flybys of Mercury on 14 January 2008 and 6 October 2008 were very similar with respect to planetary magnetic latitude and local time of day. During the first flyby, however, the vertical component of the interplanetary magnetic field (IMF) was northward and the magnetosphere was quiet, while during the second flyby the IMF was southward and the magnetosphere was highly disturbed. These flybys thus present an opportunity to investigate similarities and differences in ultra-low-frequency (ULF) wave activity between quiet and highly active magnetospheric conditions. Observed outbound from closest approach (CA) during both flybys was a "boundary layer" (BL) whose beginning was delineated by a step decrease in magnetic field strength but no change in orientation. There was a strong increase in ULF wave activity at frequencies greater than the He^+ cyclotron frequency just before closest approach that persisted almost continuously up to the outbound magnetopause crossing during both flybys. During the first flyby a frequency drift was observed in these waves from just above the He^+ cyclotron frequency to just below the H^+ cyclotron frequency between CA and the inner edge of the BL. However, no such drift was apparent during the second flyby. Overall these waves exhibited lower coherence during the second flyby, and their bandwidths were larger, than during the first flyby. Within the boundary layer, larger-amplitude ULF waves were detected under both magnetospheric conditions, but the ULF wave power was four times larger during disturbed conditions than during quiet conditions. At longer periods, a quasi-periodic 20-to-30-s oscillation was observed throughout the second flyby. We consider whether this low-frequency oscillation is more likely due to Na^+ pickup-ion instabilities or alternatively reflects signatures of quasi-periodic intense reconnection events.