Multipoint Observations of Cavity Mode Oscillations Excited by an Interplanetary Shock

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Cavity mode oscillations (CMOs) are basic magnetohydrodynamic eigenmodes of the magnetosphere predicted by theory. Excitation of CMOs is expected when an interplanetary shock impulsively compresses the magnetosphere, but observational studies of shock-induced CMOs have been sparse. We present a case study of a dayside ULF wave event that exhibited CMO properties. The event occurred when an interplanetary shock impacted the magnetosphere at 0829 UT on 15 August 2015. The shock was observed in the solar wind by THEMIS-B and -C, and magnetospheric ULF waves were observed by multiple spacecraft including Van Allen Probes-A and -B, THEMIS-D, -E, and -A, GOES-13 and -15, and ETS-VIII. The Van Allen Probes were located in the dayside plasmasphere at L=1.5 and L =2.4, and both spacecraft detected compressional poloidal mode oscillations at ~13 mHz (fundamental) and ~26 mHz (second harmonic). At both frequencies, the compressional component of the magnetic field led the azimuthal component of the electric field by ~90 degrees. The frequencies and the phase delay are in good agreement with CMOs generated in a dipole magnetohydrodynamic simulation that incorporates a realistic plasma mass density distribution and an ionospheric boundary condition. The poloidal oscillations were also detected on the ground by the European quasi-Meridional Magnetometer Array, providing additional evidence for the global nature of the waves.

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