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Magnetopause surface waves: THEMIS observations compared to MHD theory

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On October 5 and 6, 2011, the three inner THEMIS spacecraft observed magnetopause oscillations caused by the passage of a boundary surface wave. The configuration of the spacecraft (in a plane basically tangential to the magnetopause) allowed for determination of the corresponding wave vector via cross-correlation analysis. We compared measurements from both sides of the magnetopause and the wave characteristics with ideal MHD theory of surface waves. Quantitative agreement is achieved if a slightly higher than observed plasma velocity is assumed in the plasma depletion layer. Based on this comparison, we can infer that the surface wave was not generated or amplified by the Kelvin-Helmholtz-instability. Instead, the propagation direction of the surface wave and the direction of the interplanetary magnetic field suggest that the wave's source is related to the foreshock or the quasi-parallel bow shock. Additionally, slight spacecraft separations in boundary normal direction allowed us to reconstruct the magnetopause structure and wave form. Interestingly, the wave featured steeper trailing edges, contrary to most other observations of magnetopause surface waves as well as predictions from Kelvin-Helmholtz theory.