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Evidence of strong deformation of the magnetotail under low Alfven Mach number solar wind

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The density of the solar wind (SW) around the Earth's magnetosphere at times decreases to only several percent of the usual value, and such density extrema results in a significant reduction of dynamic pressure and Alfven Mach number (MA) of the SW flow. While simple expansion of the Earth's magnetosphere by the low dynamic pressure was assumed in previous studies, a recent simulation study predicted a remarkable dawn-dusk asymmetry of the magnetotail in shape under low density SW and Parker-spiral IMF configuration (Nishino et al., Phys. Rev. Lett., 2008), and thus a direct observation of the magnetotail under these conditions has been awaited. Here we show evidence of strong deformation of the magnetotail under low MA SW from in-situ observations by the Geotail spacecraft. In spite of extremely low dynamic pressure in the SW, the tail magnetopause on the dusk side was located at the usual position, which is consistent with the result of a global MHD simulation that shows a remarkable inclination of the magnetotail toward the dawn. In addition, an enhancement of magnetopause reconnection was detected at the tail magnetopause in this event, which suggests that plasma transport across the magnetopause under low density (low MA) SW can be different from one under the normal SW density condition. The strong deformation of the magnetotail and the enhancement of magnetopause reconnection can be universal phenomenon, because they are attributed to the extremely low MA (low beta) SW environment that may also take place around the Earth's magnetosphere passed by coronal mass ejections (CMEs) as well as around Mercury and in the interstellar medium outside the heliopause.