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An observation of the dawnward-expanded magnetosphere during low Alfven Mach number solar wind

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The density of the solar wind plasma near the Earth's magnetosphere sometimes decreases to only several per cent of the usual value, and such density extrema result in a significant reduction of the dynamic pressure and Alfven Mach number (M_A) of the solar wind flow. While a symmetric expansion of the Earth's magnetosphere by the low dynamic pressure was assumed in previous studies, a global magnetohydrodynamic (MHD) simulation study predicted a remarkable dawn-dusk asymmetry in the shape of the magnetosphere under low-density solar wind and Parker-spiral interplanetary magnetic field (IMF) configuration. Here, we present observational evidence of the asymmetric deformation of the magnetosphere under low-M_A solar wind and Parker-spiral IMF conditions, focusing on the significant expansion of the dawn-flank magnetosphere detected by the Geotail spacecraft. The solar wind flow had a non-negligible dusk-to-dawn component and partly affected the dawnward expansion of the magnetosphere. Antisunward ion beams detected at the dawn-flank magnetopause suggest that magnetic reconnection frequently occurred due to the very low beta in the magnetosheath. The Walen analysis for the magnetopause boundary data with the ion jets showed high correlations between the ion velocity in the de Hoffmann-Teller frame and the local Alfven velocity, which is consistent with the assumption that the observed ion beams were generated by magnetic reconnection. These observations suggest that altered and enhanced plasma acceleration by magnetic reconnection at the dawnside magnetopause operates under the low-M_A solar wind and Parker spiral IMF conditions and that an altered plasma transport across the dawnside magnetopause is at work under such a low-M_A condition.