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Evidence for newly closed magnetosheath field lines at the dayside magnetopause under northward IMF

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We analyze the structure of the high-latitude magnetopause under steady interplanetary magnetic field (IMF). We use 56 magnetopause encounters of Cluster spacecraft from 2001 to 2003 to explore the statistical properties of the magnetosheath electron boundary layer, observed outside the high-latitude dayside magnetopause. We focus on the occurrence of low absolute parallel heat flux in this layer and its dependence on the magnetic field clock angle simultaneously measured by Cluster. The low absolute parallel heat fluxes result from the presence of bidirectional heated electrons in the magnetosheath electron boundary layer and are primarily observed when the local magnetic field is northward. The bidirectional heated electrons are interpreted as the signature of newly closed magnetosheath field lines that have reconnected at the high-latitude magnetopause, tailward of the cusp, of both hemispheres. This study demonstrates that double high-latitude reconnection is a tenable mechanism for the formation of the low-latitude boundary layer and potentially of the cold, dense plasma sheet. Although the efficiency (in terms of mass and energy transfer) of this mechanism is still to be investigated, it is an obvious way of capturing solar wind plasma under northward IMF.