Geophysical Research Abstracts
Vol. 18, EGU2016-17844, 2016
EGU General Assembly 2016

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Abstract

In this study, we examined a large number of plasma structures (filaments), observed with the Cluster spacecraft during two years (2007-2008) in the dayside magnetosphere but consisting of magnetosheath plasma. To reduce the effects observed in cusp regions and on magnetosphere flanks, we consider these events inside the narrow cone ($\leq 30^{\circ}$) about the subsolar point. Two important features of these filaments are: (i) their stable anti-sunward motion inside the magnetosphere whereas the ambient magnetospheric plasma moves in the opposite (sunward) direction, and (ii) between these filaments and the magnetopause there is a strip of magnetospheric plasma, separating these filaments from the magnetosheath. The stable earthward motion of these filaments and the existence of a strip of magnetospheric plasma between these filaments and the magnetopause show the disconnection of these filaments from the magnetosheath, as suggested earlier by many researchers. These events cannot also be a consequent of back and forth motions of magnetopause position or surface waves propagating on the magnetopause. However, these observation results contradict the theoretical studies by Schmidt, 1960; Schindler, 1979; Ma et al., 1991; Dai and Woodward, 1994, 1998; et al., who reported that the motion of such filaments through the magnetosphere is possible only when the magnetic field in these filaments is aligned with (or very close to) the ambient magnetic field, that is not consistent with observation results. And the main goal of this study is to resolve this problem. For this purpose, we examined a large number of these events and showed that this contradiction may exist because of the theoretical studies and observations are related to different events: the theoretical studies are related to the case when the magnetic field in these filaments is aligned with the filament orientation, whereas the observation results may be related to the cases of a rotating magnetic field in these filaments. In the last case, the filaments with rotating magnetic field may propagate through the magnetosphere, if their magnetic field (not measured for a short time interval but averaged for their rotation period) is approximately aligned with the ambient magnetic field. In this case, these filaments may penetrate into the magnetosphere even when their rotating magnetic field is significantly inclined to the ambient magnetic field.