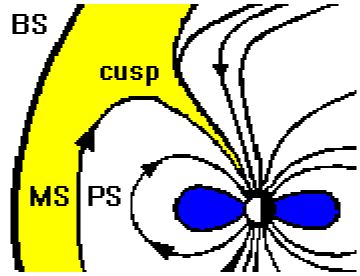
Cusps

Introduction



The magnetic field lines of the Earth can be divided into two parts according to their location on the sunward or tailward side of the planet. Between these two parts, at the dayside boundary of the polar cap on both hemispheres, are funnel-shaped areas with near zero magnetic field magnetitude called the polar cusps. They provide a direct entry for the plasma from the magnetosheath into the magnetosphere (e.g., Reiff et al., 1977; Marklund et al., 1990; Yamauchi et al., 1996).

The high-altitude cusp, which is often called the **exterior cusp**, can be considered to be a part of the magnetospheric boundary layer system. It is connected to the **low altitude cusp** or cusp proper, as some like to call it. The low-altitude cusp can be defined as follows:

The low-altitude cusp is the dayside region in which the entry of magnetosheath plasma to low altitudes is most direct. Entry into a region is considered more direct if more particles make it in (the number flux is higher) and if such particles maintain more of their original energy spectral characteristics.

Measurements have shown, that the cusp is **highly confined** region, extending about 2.5 hours in local time, but only about one degree or less in latitude. However, because of the strong dependence of the cusp position on IMF conditions, the statistical studies tend to show somewhat larger cusp regions.

Phenomena

The magnetosheath plasma penetrating into the low-altitude cusp (and the surrounding low-altitude boundary layer regions) is responsible for , e.g., part of the dayside auroral precipitation. However, recent measurements by the Polar satellite have shown that also ions in the MeV range are present (Chen et al., 1997, 1998). These events have been called as cusp energetic particle (CEP) events.

It is natural that, in addition to plasma, many types of waves and turbulent flows have also access to the ionosphere via the cusp. These include

- solar wind variations
    - including those generated in the foreshock upstream of the bow shock
- radiation from the parallel and perpendicular shocks
- magnetosheath turbulence and waves
- magnetopause boundary variations due to, e.g.,
    - flux-transfer events
    - pressure variations
    - Kelvin-Helmholtz instability
- waves and particle variations which take place in the boundary layers just inside the magnetopause.

The low-altitude cusp is the focus of these phenomena and ground observations are comprised of their superposition.

References

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