Motion of Solar Wind Plasma near IMF Discontinuities

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The interplanetary space of solar system is filled by solar wind plasma constantly flowing outward from the solar coronal region. The magnetic field existing in the solar wind is termed the interplanetary magnetic field (IMF). Due to large conductivity of the solar wind, IMF seems to frozen into the solar wind plasma flow. However, spacecraft measurements by GEOTAIL, WIND, IMP8, Explorer and Cluster in the interplanetary space revealed the complexity of the solar wind plasma flow and IMF dynamics. IMF discontinuities are one of the fundamental microstructures of the solar wind plasma. In particle, large changes of the IMF direction can occur twice per hour on average and last over tens of seconds. How are they created? What do they tell us about the solar corona? How do the structure the solar wind? Do they have an impact on Earth magnetosphere and ionosphere?

Answering the above questions is based on understanding the motion of solar wind plasma particles near IMF discontinuities. The motion of charged particles in slowly changing magnetic fields exhibits the property of adiabatic invariance. The invariance follows from the assumption that the fields seen by the particle change little during the Larmor orbit. If a new adiabatic invariant is applied, however, particles near discontinuities in magnetic fields, so-called boundary particles, can be constrained to remain near the discontinuity, even an arbitrary boundary, as the particle drifts along the discontinuity.