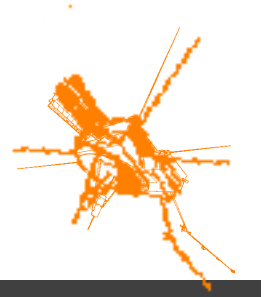
Ulysses Solar Maximum Mission Science Results



- **A pair of slow mode shocks found in a Coronal Mass Ejection-result supports concept of magnetic merging inside plasma clouds ejected from the Sun**
- **Ulysses finds few reverse shocks (propagating toward the Sun) at low heliospheric latitudes, mostly forward shocks (propagating away from the Sun) observed. This result is in contrast to the abundance of reverse shocks seen at low latitudes by Ulysses in 1992-1993 portion of the solar cycle.**

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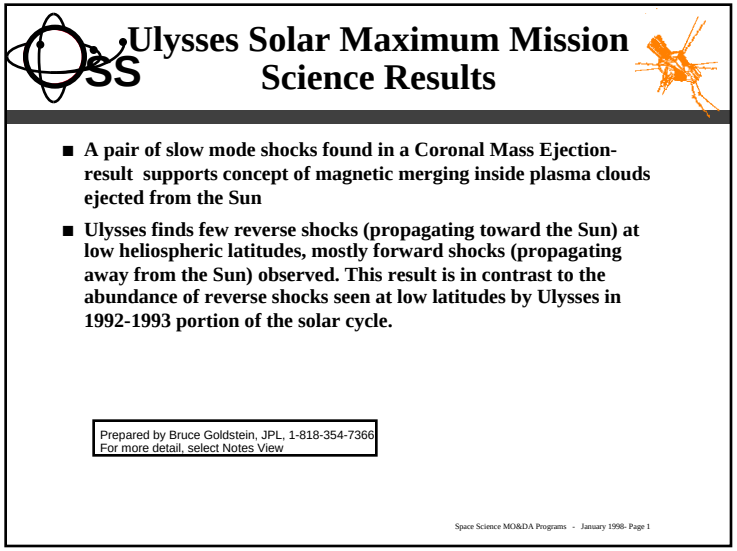
For more detail, select Notes View



Background information for viewgraph.

• Ulysses recently found a pair of slow mode shocks in a Coronal Mass Ejection (CME). CMEs are large clouds of gas expelled explosively from the Sun by a sudden release of magnetic forces (CMEs propagate through space to the Earth causing geomagnetic storms). Recent three-dimensional models of the CME formation suggest that the magnetic fields inside CMEs may be tangled like slinkies. When oppositely directed magnetic fields are forced against each other, the destruction of magnetic field can create a pair of unusual slow mode shocks in which the magnetic field strength decreases across the shock while temperature and density are increasing. The Ulysses result is the first and only example of how this magnetic merging process might be working inside CMEs.

From theoretical work and the Earth's magnetosphere, we know that magnetic merging occurs when magnetic field lines are drawn out to form the tail, with field lines in the tail being oppositely directed. Space missions to the Earth's distant magnetic tail have found pairs of shock waves at each of which the magnetic field decreases; in the region between the shocks the plasma is heated and accelerated by the annihilation of magnetic field. By analogy, the Ulysses observation of a pair of slow mode shocks inside a CME provides evidence for oppositely directed fields within the CME, and shows that heating of CME plasma can occur as the plasma travels away from the Sun.

• Ulysses finds for the 1997/98 low latitude crossing of the heliosphere that there are few reverse shocks (propagating toward the Sun) at low heliospheric latitudes, mostly forward shocks (propagating away from the Sun) are observed. This result is in contrast to the abundance of reverse shocks seen at low latitudes by Ulysses in 1992/93. Shocks within the solar wind during solar minimum are typically formed at compression regions between fast and slow speed solar wind streams, and propagate away from the region of compressed gas, both in the Sunward (reverse) and anti-Sunward (forward) directions. Such a pattern was observed near the ecliptic by Ulysses in 1992-1993. Explanations for the current results are under investigation.