EGS Abstract 2002

The Sun's Open Magnetic Flux and its Solar Cycle Variation

E.J Smith and A. Balogh

One of the more important scientific findings from the Ulysses mission during solar minimum was the relative constancy of the flux of open magnetic fields as measured by the radial field component, B_R, multiplied by the radial distance,r, squared. This measure, averaged over successive solar rotations, was found to be independent of both heliolatitude and time. Since the sun's dipole magnetic field is strongest and relatively unchanging near solar minimum, this result indicated that excess magnetic pressure at high latitude was causing the non-radial flow of the solar wind from the polar caps near the sun. The recent Ulysses observations from pole- to -pole reveal that the open flux is still independent of time and latitude during solar maximum. Furthermore, the amount of open flux is essentially the same as at solar minimum. This invariance is surprising in view of the dramatic changes that take place in the sun's magnetic field between minimum and maximum. The polar cap fields weaken and vanish while strong toroidal fields become dominant at low latitudes. In addition, the magnetic poles associated with the heliospheric sector structure and the solar wind sources shift to low latitudes. Another aspect that seems paradoxical is the large increase in the average magnitude of the heliospheric field near solar maximum that has been seen the last two cycles, even though $B_R r^2$,as measured in the ecliptic, remained invariant (Wang et al. 2001). On the other hand, the constancy of open flux is consistent with a recent model developed by Fisk and Schwadron (2001) which implies that reconnection occurs predominantly between fields that are already open. The Ulysses results obtained during minimum and maximum will be presented and their important implications will be explored in this talk.