

1997/III A

OBSERVATIONS OF THE EARTH'S OUTER RADIATION BELT DURING MAGNETIC STORMS

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One of the prominent features of the trapped electron fluxes measured with Radiation Environment Monitor, REM from PSI aboard the UK satellite STRV-1b is their strong variations during magnetic storms.

MAGNETIC STORMS

During periods of high geomagnetic activity the magnetic field at middle and low latitudes on the earth's surface tend to show characteristic deviations from the quiet time state. The horizontal component of the magnetic field, H , first slightly increases for a few hours (initial phase) then strongly decreases within typically a day (main phase) to recover to its initial value within a few days (recovery phase). This phenomenon is known as magnetic storm. The development of a storm is measured by an index called disturbance storm time, Dst, which is defined as the world-wide average of the deviation of the equatorial H component from a quiet day [1]. The middle panel of the figure shows Dst versus time for a storm in March 1995. Magnetic storms are triggered by the arrival of enhanced solar wind dynamic pressure at the earth (lowest panel). The initial increase of Dst at the beginning of a storm is caused by the compression of the magnetosphere due to the solar wind shock. The decrease and increase of Dst during the main and recovery phase of the storm however are caused by the variation of the so-called ring current. The ring current consists primarily of 10-200 keV ions, mostly protons, which encircle the earth in a distance of 3 to 6 earth radii. This current induces a southward magnetic field and lowers the magnetic field magnitude in the inner magnetosphere. During the storm main phase the ring current increases. It is partly supplied by plasma particles, which resist in the tail region of the magnetosphere. Due to an enhanced convection electric field, which is generated by the flow of the solar wind particles across open field lines in the Polar Regions, the plasma particles are accelerated and transported to the vicinity of the earth where they can become trapped. During the recovery phase the ring current slowly decays again (charge exchange, wave-particle interactions) which leads to the recovery of Dst.

THE EARTH'S OUTER RADIATION BELT

Simultaneously with the storm time related magnetic field changes large variations of the electron flux trapped in the earth's magnetic field are observed. Measurements with the Radiation Environment Monitor, REM, from PSI aboard the UK satellite STRV-1b [2] since summer 1994 show that the >1 MeV electron flux typically decreases during the storm main phase and increases again during the storm recovery phase, often exceeding the level observed before the storm [3]. This is shown in the upper two where the REM electron count rates are plotted versus the distance from earth, L for different periods of the storm (a-e) which are marked in the middle panel. During the storm main phase (a-c) the peak count rate decreased by a factor 50 and slightly increased again during the first part of the recovery phase (c-d). The peak

position had moved inward. Until that time the count rate profile had changed rather smoothly which suggests that an entire population of particles has been modified.

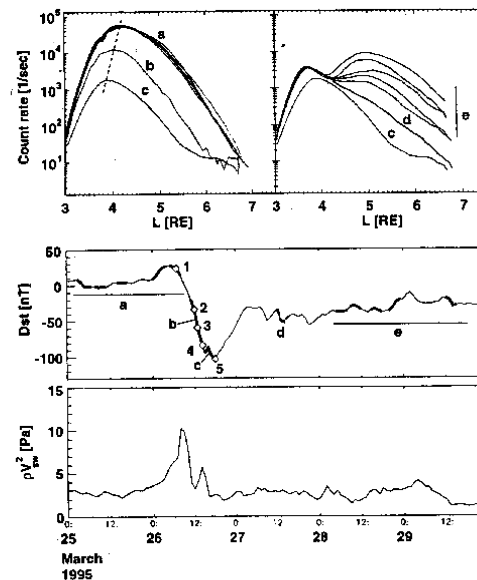


Fig. 1: REM electron count rates versus distance from earth (uppermost panels), Dst (middle panel) versus time, and solar wind dynamic pressure versus time (lowermost panel) during the March 1995 magnetic storm. The different sets of radial count rate profiles (a-e) correspond in time with the periods marked in the middle panel.

During the later part of the recovery phase (e) the count rates strongly increased. The rate profile is considerably different compared to the old one, suggesting new particles to be involved. As electron flux variations coincide with Dst variations it is obvious to consider the magnetic field to have an effect on the trapped electrons. The investigation of this effect is described in the following report.

REFERENCES

- [1] W.D. Gonzalez et al., J. Geophys. Res. **99**, 5771 (1994).
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