Turkish Journal

of

Physics

Turkish Journal of Physics

Study of the Effectiveness of Various Solar wind Parameters in the Development of Geomagnetic Storms During Interplanetary Events

BADRUDDIN
Department of Physics, Aligarh Muslim University,
202002, Aligarh-INDIA

Abstract: We have selected some interplanetary events responsible for geomagnetic disturbances of varying magnitude, fairly different from one another. We then tried to find the heliospheric structure (e.g. shock/sheath and/or CME/magnetic cloud) responsible for individual disturbances. We have discussed and inter-compared these structures in their plasma and field parameters as well as in their geomagnetic effects. As a parameter for geomagnetic disturbance we have chosen index Dst, to compare it with variations in field and plasma to heliospheric response structures. We considered parameters such as total field strength, its north-south component, solar wind density, temperature and velocity. In addition, we have considered the magnetic field variance during the passage of interplanetary events. Field variance has been used (a) to study its role in influencing the level of geomagnetic activity, (b) as a measure of turbulence level during the passage of heliospheric events and (c) to identify the cause of a large northward/southward field in the sheath i.e. whether it is due to turbulence or not. All the heliospheric disturbances responsible for individual events, discussed in the paper, are due to coronal mass ejection -- some of them are magnetic clouds. Among the CMEs/magnetic clouds, some are associated with shock/sheath. A geomagnetic disturbance may start during the passage of a sheath and/or CME/magnetic cloud, as observed a event to event basis. During the passage of a sheath, the shock compression, turbulence, draping of magnetic field or shocked heliospheric current sheet may lead to large southwards fields and, whenever this happens, a large geomagnetic disturbance is likely to be observed. We suggest a method to distinguish between these four causes of southward field in the sheath. A geomagnetic disturbance is observed to start during the passage of a CME/magnetic cloud whenever magnetic field becomes large southward. From the variations in various plasma and field parameters during these disturbances, plasma density does not appear to be directly involved in the development of geomagnetic storms. The large variance (turbulence) in the magnetic field observed in the sheath is (sometimes) responsible for a large southward field that initiates the geomagnetic storm. The total field strength itself does not play an essential role in the development of geomagnetic storms unless accompanied by southward field of appreciable magnitude. However, southward component of the magnetic field plays a crucial role both in creating and in determining the magnitude of geomagnetic storms. Solar wind speed, from independent evaluation of the effectiveness of individual parameters, appears to be only a minor factor for the creation of storms. This conclusion, apparently poses some constraints on the generally accepted reconnection/merging models. However, in these models, the multiplicative combination of solar wind speed and the southward component of the field is an important physical quantity controlling geomagnetic activity, it is possible that dependence on velocity might not appear clearly when the southward field is small.

Key Words: Geomagnetic storms, interplanetary magnetic field, Coronal mass ejections, interplanetary shocks.

Turk. J. Phys., **26**, (2002), 391-402.
Full text: pdf
Other articles published in the same issue: Turk. J. Phys.,vol.26,iss.5.