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Solar origin of Major GMSs with (-50nT>Dst>-100nT)

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The effect of solar features on geospheric conditions leading to 45 Major geomagnetic storms with Disturbance storm time (Dst) index (-50nT>Dst>-100nT) have been investigated during the period 1996-2003.Statistically it is observed that that Hα, X-ray solar flares and APDFs have occurred with in lower Heliographic latitude (0-30) ^{0} N and (0-30) ^{0} S. Maximum number of Major type GMSs are associated with importance of SF of each Hα and X ray solar flares.Average width, speed and acceleration of CMEs were observed as 116.92, 578.06 km/s,2.22 km/s 73.33%, 26.66%, 40% and 80% Major type of GMSs are associated with Hα, X ray solar flares, APDFs and CMEs. It has been observed that solar features such as Hα, X ray Solar flare, Hα + X ray solar flares, APDFs have no better correlation with occurrence frequency of Major GMSs. But there is good correlation when the accumulated solar features (Hα solar flares, X ray solar flares, APDFs and CMEs) effects has been observed where CMEs events play a dominant role in the correlation factor with the occurrence of GMSs.

1. Introduction

The geospheric environment is highly affected by the Sun and its features such as, Solar flares, APDFs, Coronal Holes, Coronal Mass Ejection etc which are responsible for some large/small geomagnetic storms [1]. The disturbances in the geomagnetic fields are caused by fluctuations in the solar wind impinging on the Earth. The degree of the equatorial magnetic field deviation, the measure of the magnitude of GMSs is usually given by the Dst index. Dst is the hourly average of the deviations of the H (horizontal) component of the magnetic field measured by several ground stations in mid to low latitudes. Geomagnetic storms events are characterized by the Disturbance storm time (Dst) index measured in terms of nano Tesla (nT).A storm is said to be Intense if (Dst<-100nT), Major if (-50nT> Dst≥-100nT), Minor if (-20nT≥ Dst ≥-50nT).

2. Data Analysis

In the present data analysis, Major GMSs events with (-50nT> Dst≥-100nT) have been studied from the periods 1996-2003.Solar geophysical and interplanetary data and SOHO/LASCO CME Catalog are used to study the Major GMSs. On the basis of Solar Wind Velocity (V) Solar features have been investigated such that $1 \leq \Delta t \leq 5$ days prior to the occurrence of GMSs on the Earth. Here the time Δt taken by the Solar wind in reaching the Earth from the Sun depend upon V.

3. Results and Discussion

Forty-five Major GMSs events with (-50nT> Dst≥-100nT) have been investigated from the period 1996-2003. It is observed from the Figure1 and 2 that Hα, X-ray solar flares have occurred with in lower Heliographic latitude (0-30) ^{0} N and (0-30) ^{0} S are associated with maximum number of Major type GMSs. No Hα, X ray solar flares have occurred beyond 30^0 N and 30^0 S [2]. Flare events in the northern hemisphere are much more then the southern hemisphere similarly western hemisphere have large no of solar flare events then the eastern hemisphere. The ratio of the total number of flare events in the northern hemisphere to southern hemisphere is 1.25 and western to eastern hemisphere is 1.05. There are N-S and E-W asymmetries. This result is consistent with [5,6] however the distribution of Hα and X ray solar flares has been observed from 0^0 to 80^0 East and West. It is observed from the Figure3 that APDFs are observed in Heliolatitudes (0-30) ^{0} N and S and can be observed in between (0-90) ^{0} E and W Helio longitudes. It is observed from the Fig 4 that maximum number of Major type GMSs are associated with importance of SF of each Hα and X ray solar flares and also the importance of 2N cannot be ignored In many individual events the travel time between the explosion on the Sun and the maximum activity is lying between 54.86 to 129.44 hours [4]. Statistically its observed that 73.33%, 26.66%, 40% and 80% Major type of GMSs are associated with Hα, X ray solar flares, APDFs and CMEs. The association of Major GMSs with Hα, X ray solar flares, APDFs and CMEs have been plotted in Fig 5.Venn diagram. It is quite clear from the Venn diagram that Solar Flares and CMEs plays dominant role for creating GMSs [2]. The correlation coefficient between the yearly occurrence of GMSs and Solar features such as Hα, X-ray Solar flares, Hα+Xray Solar flares, APDFs and CMEs has been calculated and found to be 0.82,0.76,0.85,0.77 and 0.94. CMEs events play a dominant role in the correlation factor (0.94) with the occurrence frequency of Major GMSs. The correlation coefficient has been calculated as 0.92 when the accumulated Solar features like (Hα Solar flares, X ray Solar flares, APDFs and CMEs) effects has been observed.

4. Conclusion

1. Hα X-ray solar flares and APDFs have occurred with in lower helio graphic latitude (0-30) ^{0} N and (0-30) ^{0} S. No Hα and X ray solar flares have occurred beyond 30^0 N and 30^0 S.
2. Hα, X ray solar flares and APDFs are accompanied by CMEs.
3. Maximum numbers of Major-type GMS are associated with importance of SF of each Hα, and X ray solar flares. However importance of 2N cannot be ignored. 24.44% of total Major type GMSs during the entire period of consideration i.e. 1996-2003 has occurred during the year 2001.
4. 73.33%, 26.66%, 40%, 80% Major type GMSs are associated with each Hα-, X-ray- Solar flares, APDFs & CMEs.
5. In many individual events the travel time between the explosion on the sun and maximum activity is lying between 54.86 to 129.44 hrs causing Major type GMSs at Earth.
6. It has been observed solar features such as Hα, X ray Solar flare, Hα + X ray solar flares, APDFs have no better correlation with occurrence frequency of Major GMS. But there is good correlation when the accumulated solar features (Hα solar flares, X ray solar flares, APDFs and CMEs) effects has been observed where CMEs events play a dominant role in the correlation factor with the occurrence of GMS.

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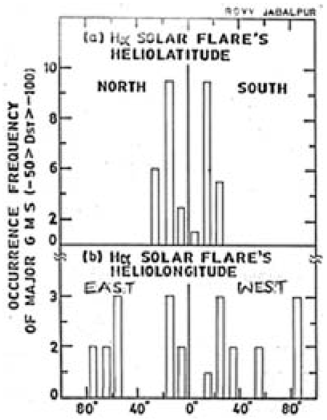

Figure 1. Occurrence frequency of Hα Solar Flares (a) Helio-latitude and (b) Helio- longitude associated with Major type GMSs during the period 1996-2003.

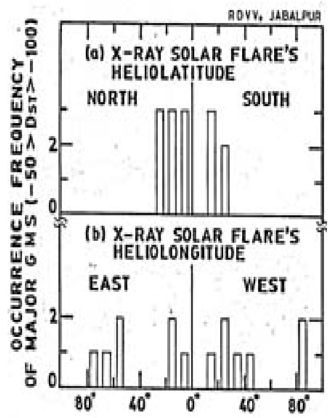

Figure 2. Occurrence frequency of X-ray Solar flares (a) Helio-latitude and (b) Helio-longitude associated with Major type GMSs during the period 1996-2003.

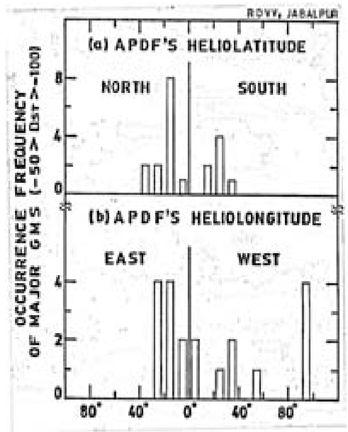

Figure 3. . Occurrence frequency of APDFs (a) Helio-latitude and (b) Helio-longitude associated with Major type GMSs during the period 1996-2003.

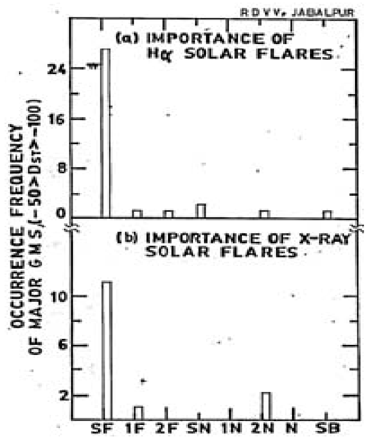

Figure 4. The Occurrence frequency of the importance of (a) Hα Solar flares and (b) X-ray Solar flares associated with Major type GMSs during the period 1996-2003.

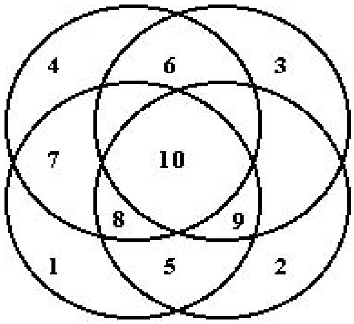

Figure5. Venn diagram representing Solar features of Major type GMSs during the period 1996-2003.

1. : Hα SOLAR FLARES (33)
2. : X-RAY SOLAR FLARES (12)
3. : APDFs (18)
4. : CMEs (36)
5. : Hα, X-RAY SOLAR FLARES (12)
6. : APDFs, CMEs (15)
7. : Hα, CMEs (19)
8. : Hα, X-RAY, CMEs (10)
9. : Hα, X-RAY, APDFs (7)
10 : Hα, X-RAY, APDFs, CHMIs (6)