Volume-5, Issue-7, July - 2016 • ISSN No 2277 - 8160

Original Research Paper

Physics

Study of Severe Geomagnetic Storm: Solar Cycle 24

RADHA DEVI SINGH

Department of Physics, Govt. MVM College Bhopal M.P

ABSTRACT

According to present study in the whole period of ascending and descending phases of solar cycle 24,only one strongest geomagnetic storm occurred on 17 march 2015.we have seen that total 17 geomagnetic storms occurred during the span of 2008 to 2016 with disturbance time index (Dst<-100nT).It is observed that no sever (Dst< -200 nT)geomagnetic storm have been occurred during the rising phase of Solar Cycle 24.we found only two severe geomagnetic storm(Dst<-200nT) during time period of 2008 to May2016.As a result of Strongest storm the Dst decrease up to -223 nT has been investigated in number of ground based instruments. For this study we have investigated its properties in term of it's Solar Sources, relation with interplanetary and geomagnetic parameters. It is found that this storm was associated with the passage of interplanetary Coronal Mass Ejection

KEYWORDS : Geomagnetic Storm, Coronal Mass Ejection, Forbush Decrease

INTRODUCTION:

Geomagnetic storm are characterized by sudden worldwide variation in the intensity of the geomagnetic field as a consequence of the dynamic interaction between the interplanetary magnetic field embedded in the solar wind and the Earth's magnetosphere .The variation would be produced from shock waves, coronal mass ejection and flares (Rechardson 2013,Cane & Rechardson 1995). Comprehensive analysis of magnetic storm morphology have been made by Chapman 1935,Akasofu & Chapman 1972. The Dst index estimates the globally averaged change of the horizontal component of the Earth's magnetic field at the magnetic equator based on measurements from a few magnetometer stations. Dst is computed once per hour and reported in near-real-time.

It is well established geomagnetic activity as measured by indices such as Kp (Menvielle & Berthelier 1991) and Dst (Sugiura 1964) is principally driven by the plasma and magnetic field conditions in the solar wind that encounters the Earth (O'Brien & Mcpherron 2000). These studied have shown that at equatorial and mid-latitudes the decrease in Hz during a magnetic storm can approximately be represented by a uniform magnetic field parallel to the geomagnetic dipole axis and directed towards South. G. G.M. Le et. al (2013) analyzed the Solar cycle distribution of great geomagnetic storm (-300 nT<Dst<-200 nT).Their result show that about 73% of great geomagnetic storm occurred in the descending phase of the solar cycle and 83% of great geomagnetic storms occurred in the two years before the solar cycle and in the three years after it. The characteristic of sever geomagnetic storm in association with solar and interplanetary disturbances for current solar cycle 24, have been studied.

OBSERVATION AND DATA ANALYSIS:

*For the analyzed geomagnetic storms of solar cycle 24, we have used hourly data of disturbance time index (Dst). Dst is the best indicator of ring current intensity and a very sensitive index to measure the degree of solar disturbances. We have selected only those geomagnetic storms which magnitude less than -100 nt (Dst≤-100 nT). Interplanetary plasma parameters (solar wind V, plasma density N/Cm*3), interplanetary field parameters (magnetic field B, North-South component Bz), etc have been used from Omni web explorer (Omni web.gsfc.nasa.gov). From these data, we have investigated one Sever geomagnetic storm and it's associated magnetic indices (Kp, AP)data from WDC for geomagnetism, Kyoto for the time period of 2008 to May2016.Correlated CME data for this sever geomagnetic storm have been used from LASCO/SOHO data center.*

RESULT AND CONCLUSIONS:

The purpose of this work was to develop a catalog of Dst (-100 nT) from 2008 to 2016.We have observed that 17 intense geomagnetic storms (Dst≤-100 nT) , only two SEVER geomagnetic storm (Dst≤-200 nT) and no strongest geomagnetic storms (≤-300 nT) occurred during the said spam of current solar cycle 24. Figure 1 show the comparative distribution of Geomagnetic storms event (≤-100 nT) of solar cycle 22,23 and 24.It has been analyzed that Geomagnetic activity level during the rising phase of solar cycle 24 was lower than during any comparable solar cycle 22,23.

For the study of severe strongest Geomagnetic storms of solar cycle 24, we have seen that, this severe geomagnetic storm occurred on 17 March 2015 AT ~5:00 UT with the arrival of a partial Coronal Mass Ejection (CME) as shown in fig 2.On 15 March 2015 before 2 days of event S0HO/LASCO recorded a partial halo CME (at1:48:05) with speed 611 Km/s, which was associated with a long duration C9 flare. A number of moderate M-class flares, one X-class flare and a C9 solar flare. This severe geomagnetic storm began with sudden storm commencement (SSC). The initial phase is also referred to as a storm sudden commencement (SSC).An interplanetary (IP) Shock arrived at 4:00 UT on 17 march(solarham.net& Swpc.noaa.gov) .This IP shock at the Earth may have caused a sudden storm commencement (SSC) at onset time of saver storm on 17 march.

The equatorial storm index Dst at low latitudes, reached -223 nTat 22UT and indicate the peak of the geomagnetic on the Earth. The strength of this geomagnetic storm is measured also by the Kp and AP (magnetic activity indices) index. Kp's value was 2 at around 01UT 0n 17 March while after some hour it's value sharply increase up to 8 range, indicating a "SEVERE" geomagnetic storm. On 17 march 2015 Kp's were 2,5,-6,-5,+8,-8,-7,+8 and AP were 7,39,67,56,179,179,154,179 .Hourly values of solar wind velocity ,plasma density, IMF Bz, geomagnetic disturbance index Kp, and AP are plotted in Fig. 2 .

So we have concluded that Geomagnetic activity level during the rising phase of solar cycle 24 were lower than during any comparable solar cycle 22, 23. No severe geomagnetic storms (Dst≤-200 nT) were observed during the rising phase of solar cycle 24.Only one severe strongest geomagnetic storm on 17 March 2015 (maximum decrease of Dst<-223 nT) have been found during descending phase of solar cycle 24.This storm caused of partial coronal mass ejection and began with sudden storm commencement . Several space weather phenomena tend to be associated with or are caused by a geomagnetic storm.

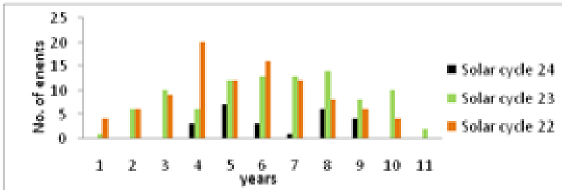

Fig.1:Shows the histogram of Yearly total number of Geomagnetic storms (Dst<-100 nT) distribution for the solar cycles 22, 23 and 24.

FIG.2.: Shows the hourly value of severe geomagnetic storm (Dst -223nT) and Geomagnetic indices Kp for the interval of 15-18 March 2015.

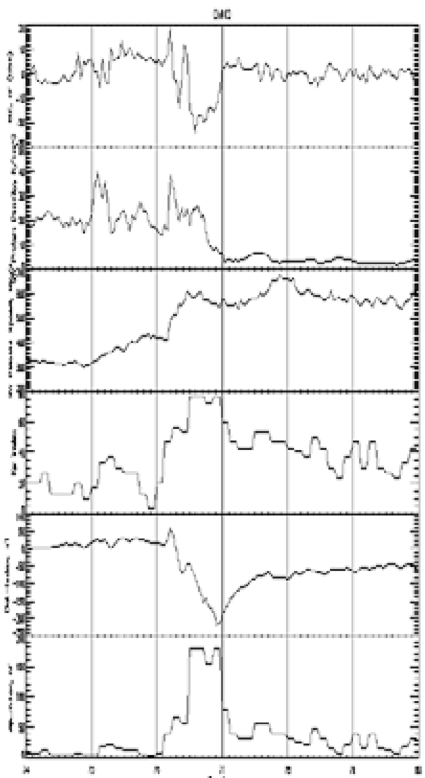

FIG.3.: Shows the hourly value of Dst -223nT, with Kp*10, Ap geomagnetic indices, Solar wind velocity, Proton density and Bz for the interval of 15-20 March 2015

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