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Solar Variation and Super Geomagnetic Storm Event during March 10-31, 2015

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Abstract*: *CMEs and solar flares are important solar ejections which are the cause of storm in Heliosphere. These ejections are producing a change in Earth magnetic field. In this paper we have studied heliospheric disturbance of solar cycle 24 during period from 10 March to 31 March 2015. We observed that a huge explosion of magnetic field and plasma from the Sun's corona on 15 March 2015 and associated solar flares have disturbed space weather towards earth causes strongest geomagnetic storm on 17 March 2015. We found that Dst value reached to its minimum is -223 nT and a FDs during the period on 17 March 2015.

Keywords : Coronal mass ejection, Solar cycle, Forbush decrease and Geomagnetic storm.

I. INTRODUCTION

In the past of astrophysics CMEs are a very recent parameter which is used from year 1970. In recent research, by many researchers observed that the solar cycle 24 is weakest than cycles 22 and 23. The solar cycle 24 could produced intense geomagnetic storm and solar energetic particle (SEP) events are associated with solar phenomenon. Earth directed CMEs are the main factor of generating major geomagnetic storm. Space weather predictions of various agencies are given the disturbance arrival on the Earth. The Earth directed CMEs that containing southward magnetic field component is capable to start geomagnetic storms. Gosling et al. (1990) studied the cause's geomagnetic storms have generated that by mostly caused by CMEs phenomena. Hence, best tool of CMEs and shock arrival time at the Earth is desired for prediction of space weather conditions. CME takes the time, arrival to the Earth about minimum in hour and maximum in 1 to 6 days. Various propagation models of CMEs and shock are using for space weather variation forecast. Gopalswamy et al. (2001) presented a model that space speed of CMEs in interplanetary medium with solar wind decreases about 1 astronomical unit. A similar CMEs propagation model that considers explicitly the effect of the drag force by the solar wind on the CMEs has been suggested (Vrsnak and Gopalswamy, 2002; Borgazzi et al., 2009). Studies using various methods to track the CMEs propagation have found evidence in support of the drag force model (Byrne et al., 2010; Mostl et al., 2014).

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Owens and Cargill (2004); Colaninno et al. (2013) predicted a model for arrival of storm towards Earth about 12 hours. Gopalswamy et al. (2001) may be compared to given this model. Hess and Zhang (2015) presented a drag model that is able gave the arrival of CME ejecta about 1.4 to 3.3 hours at Earth.

II. DATA COLLECTION SOURCES

This paper taken hourly data of magnetic field (B), solar wind velocity (v), Disturbance storm time (Dst) data from OMNI web of NASA similarly data of Cosmic rays intensity (in hours) from Moscow ground based neutron monitor having cut-off rigidity (Rc = 2.42Gev) and location on the Earth is latitude 55.47N, longitude 37.32E during the period from 10 March to 31 March of year 2015 in days. For CMEs data we have used CME catlog of NASA. Large outflow of magnetic field and plasma from the Sun to interplanetary space could produce storm.

III. RESULT AND DISCUSSION

The CMEs is one of the main transient features of the Sun. CMEs just changes into ICMEs when inter in heliospheric space. The figure 1 shows the images of solar output variation from 10 March to 15 March 2015. On 15 March 2015 these Earth-directed CMEs explosions inter into interplanetary space disrupted the space weather. Interplanetary magnetic field (B) and interplanetary force field (VB) shows similar activity and good positive correlation during the same period of time which have shown in figure 2 and 5. Interplanetary field lines change the track of charged particles in heliosphere. Table shows the SOHO/LASCO HALO-CMEs (Coronal mass ejections) their associated solar flare events during period from 10 March to 31 March of year 2015. Solar flares have high energy particles and radiation that are dangerous for human. The magnetic field lines of Earth are protected from the effects of charged particles solar flares and other solar activity which occurred by the Sun also. The most dangerous phenomena of the Sun is X class flares storm which is very dangerous. The dangerous x class flares strictly prevented by field line of Earth. The flares storm created a disturbance at Earth surrounding that is ionosphere resulting destroy telecommunication. Along with energetic ultraviolet radiation, they heat the Earth's outer atmosphere, causing it to expand. This kind disturbance changes the dragging of satellites around Earth. Also, both intense radio emission from flares and these changes in the atmosphere can degrade the precision of global positioning system (GPS) measurements.

The small number of very high energy particles that does reach the surface does not significantly increase the level of radiation that people experience every day. The most disturbing event of this planet on human activity is known as geomagnetic storms are associated with solar flares and plasma. Halo-CMEs sometimes occurred with and sometime are not. The interplanetary magnetic field and interplanetary force play an important role in heliosphere have shown in figure 2. The interplanetary magnetic field and interplanetary force shows the similarity during time scale 10-31 March 2015. Therefore it have good positive correlation has shown in figure 5. The expansion of solar ejection in solar space could produce solar wind. The expansion solar wind approximately 450 Km/second in space from the Sun containing more charged particles that are electrons and protons and others particles. The Solar wind propagation movement firstly through the solar coronal holes, which are predominantly occurred near the Sun's pole. In figure 3 shows the flow of solar wind speed during the period from 10-15 March 2015. The effect of solar wind influence on our planet occurred during active region of Sun that is sunspot maxima at this stage solar wind is strong and may produced storm corresponding to flares and CMEs of the Sun. When these halo-CMEs and their associated solar flares from 15-17 March 2015 reached near the Earth's magnetosphere they modulated the Galactic cosmic rays that coming from interstellar medium. Therefore, a Forbush decrease occurred during on 17 March 2015. Heliospheric disturbance by the Sun when interact with galactic cosmic rays it modulate the galactic cosmic rays and a remaining partial galactic cosmic rays that are neutron particles reaches on the Earth's magnetosphere. We know that Galactic cosmic rays are charged particles which have 91% of protons and remaining 9% have other elements. On 17 March 2015 same day halo-CMEs and solar flares strike on the Earth's magnetosphere therefore Disturbance storm time (Dst) decreased to its minimum -223 nT and cosmic ray decrease during same period have shown in the figure 4.

Date	CMEs Speed (Km/s)	CMEs associated solar flares
10 March 2015	1055	M 5.7
15 March 2015	725	C 9.4
24 March 2015	1800	None

Table 1 - List of halo - CMEs and Solar Flares Events during the period from 10 March to 24 March 2015.

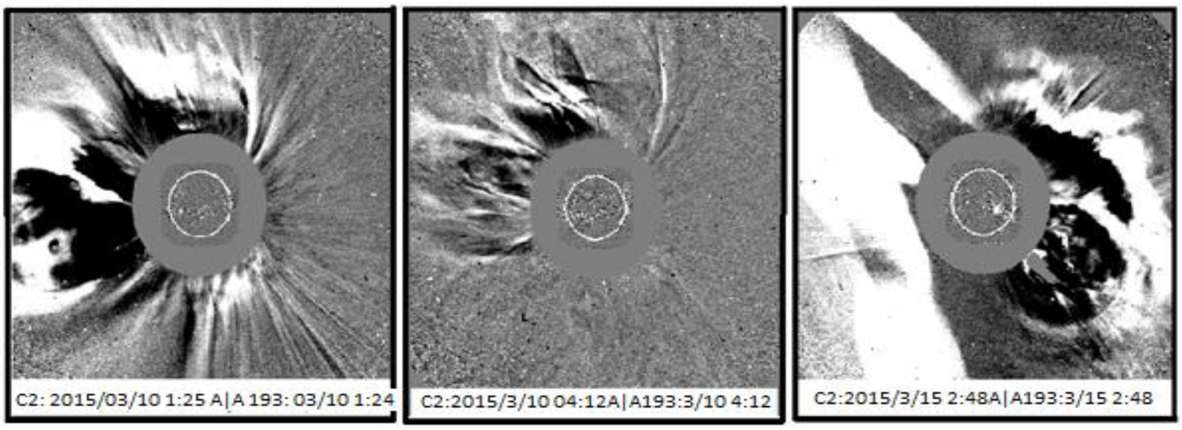


Figure 1: Image recorded by (SOHO/LASCO) Coronagraph C2 on March 10 and 15, 2015.

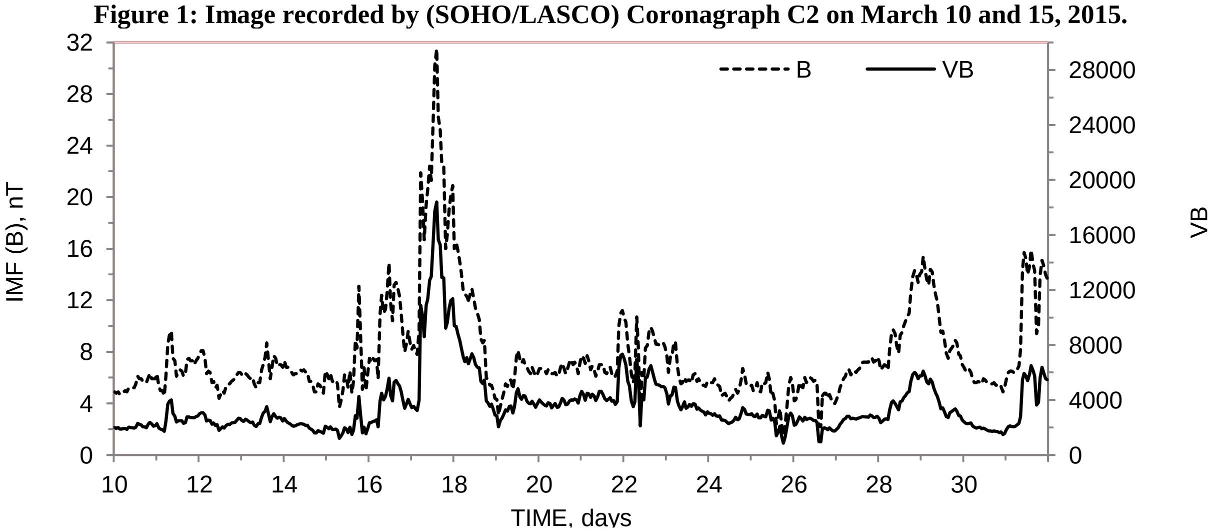
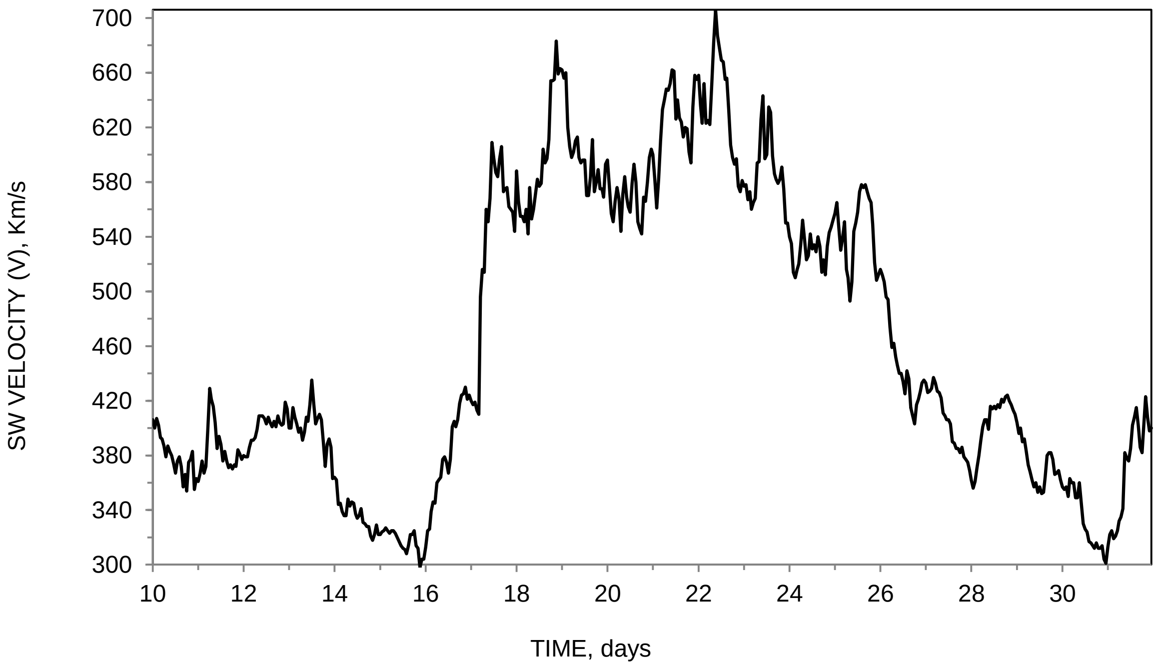
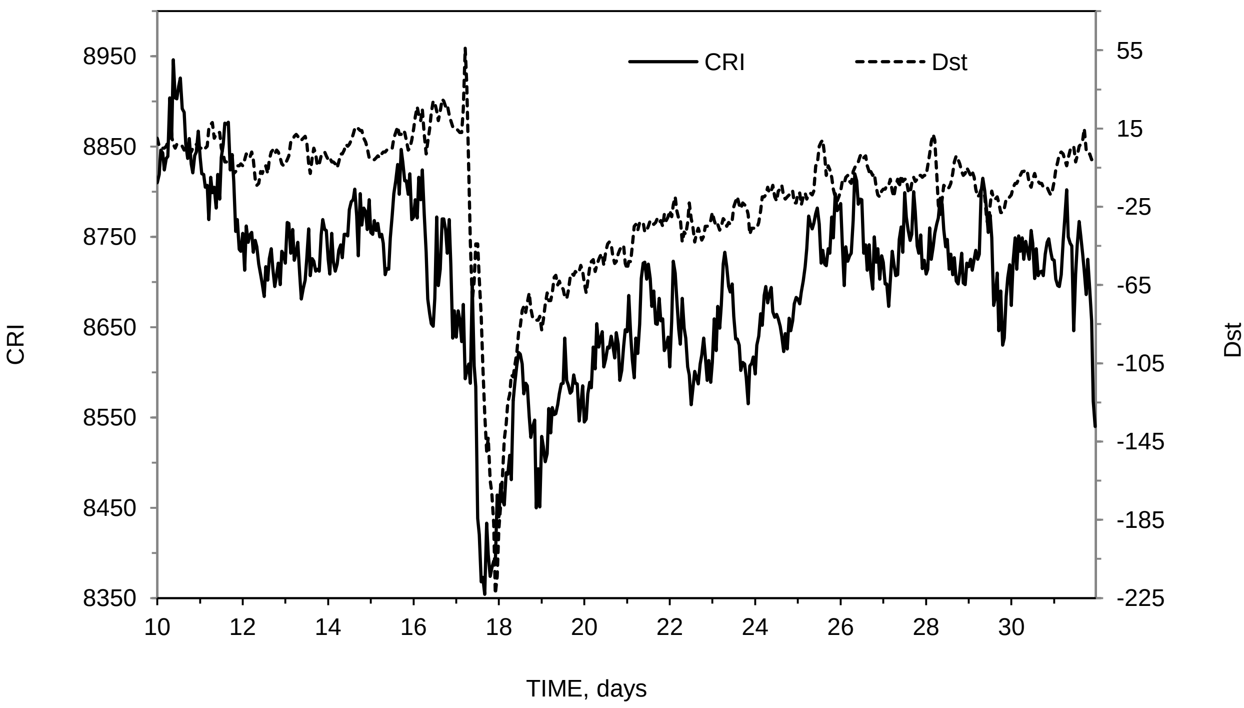


Figure 2: Time profile of IMF (B) and (VB) during the period from 10 March to 31 March 2015.



Figures 3: Time profile of solar wind speed (V) during the period from 10 March to 31 March 2015.



Figures 4: Time profile of Cosmic ray intensity (CRI) and Disturbance storm time (Dst) during the period from 10 March to 31 March 2015.

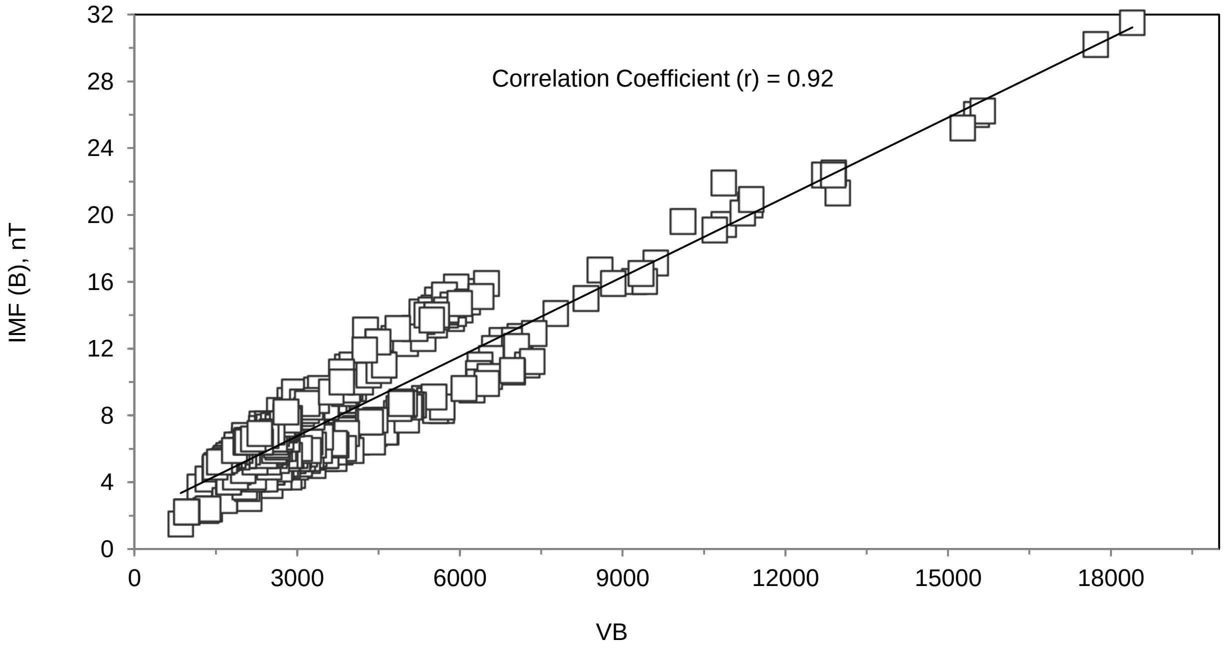


Figure 5: Cross plot between IMF (B) and VB during the period from 10 to 31 March 2015.

IV. CONCLUSION

When halo-CMEs and their associated solar flares strikes on Earth's atmosphere on 17 March 2015 it causes temporary disturbances of the planet's magnetic field called geomagnetic storms. These storms could be disturbed our power grids, radio communications and GPS navigation etc. So we should worry that an extreme CME on 15 March 2015 could cause a very powerful geomagnetic storm on 17 March 2015, resulting in global catastrophe and endanger able our lives. Its mean the Sun's violent activity and many unexpected and unpredictable events taking place on its surface suggest that we should prepare for worst.

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