

# Full Halo Coronal Mass Ejection and Cosmic Ray Intensity

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**Abstract:** *In this work we have studied the effect of different types of full halo Coronal Mass Ejection on the cosmic ray intensity for the period of 1996-2004. It is found that the cosmic ray intensity depressed to minimum after three days of the onset of the symmetric and outlines asymmetric full halo CMEs and four days after the onset of brightness asymmetric full halo event of Coronal mass Ejection.*

**Keyword:** Coronal mass Ejection, Cosmic Rays Intensity, Solar Atmosphere, Full Halo Coronal Mass ejections, Geomagnetic Field

## 1. Introduction

Coronal mass ejections (CMEs) are plasma eruptions from the solar atmosphere involving closed field regions, which are expelled into the interplanetary medium. Typically  $10^{15}$ - $10^{16}$  g of plasma is expelled into interplanetary space with a kinetic energy of  $10^{31}$ - $10^{32}$  ergs. The phenomenon of coronal mass ejection first time reported in 1971, using the seventh orbiting solar observatory (OSO-7). The CMEs having angular width  $>180^\circ$  are considered as halo CME event (Howard et al.<sup>1</sup>, 1982). Full halo CMEs has an apparent width of  $360^\circ$  while partial halo CMEs has  $120^\circ \leq W \leq 360^\circ$ . Extensively observations from the Solar and Heliospheric Observatory (SOHO) mission, Large Angle Spherometric Coronagraphs (LASCO) have shown that full halo constitutes ~3.6% of all CMEs, while partial halo constitutes ~11% (Gopalswamy<sup>2</sup>, 2004). Full halo CMEs can be categorized as Symmetric (S) or Asymmetric with respect to the occulting disc coverage during observation of CME.

Asymmetric event can further be classified as Brightness Asymmetric and Outline Asymmetric event. (Cane et al.,<sup>3</sup>1996) reported a significant relationship between CMEs and cosmic ray intensity variations. In 2001 (Shrivastava<sup>4</sup>,2001) have reported that the Coronal mass ejections in association with B type solar flare might be the reason for the enhancement of geomagnetic field variation and CME indicate its better role in cosmic ray modulation. (Badruddin and Singh<sup>5</sup>,2005) studied the influence of halo and partial halo CMEs on cosmic ray intensity and modulators as compared to the other CMEs. Recently (Mishra et. al<sup>6</sup>, 2011) reported correlative analysis between cosmic ray intensity and interplanetary magnetic field during different types of halo CMEs. In this work we have studied the effect of

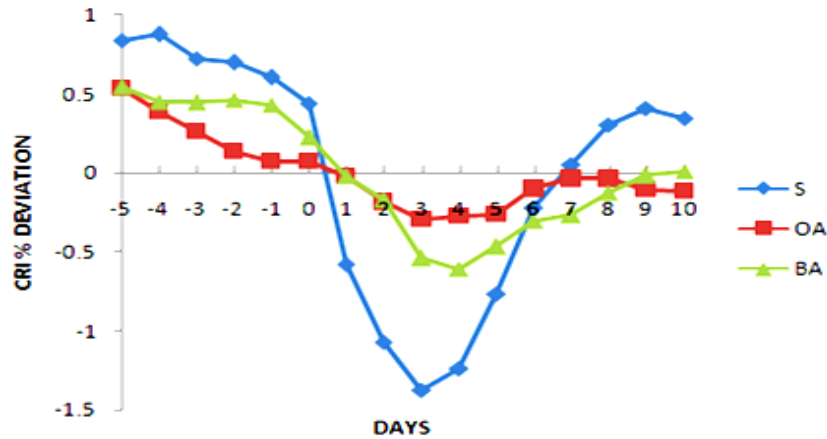
different types of halo Coronal mass ejections (CMEs) for the period of 1996-2004.

## 2. Data Analysis

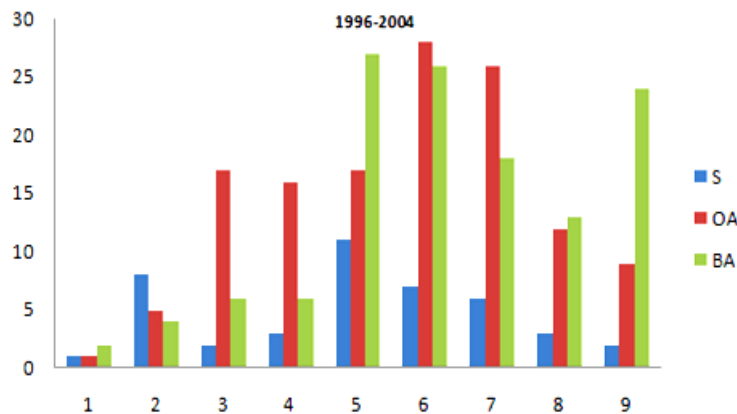
We have used the entire full halo CMEs data observed by SOHO/LASCO from 1996-2004 taken from SOHO/LASCO CME Catalog ([http://cdaw.gsfc.nasa.gov/CME\\_list](http://cdaw.gsfc.nasa.gov/CME_list)). The Chree analysis method of superposed epoch has been adopted to determine the average behavior of cosmic ray intensity. Zero day is taken as the onset day. Daily values of Oulu neutron monitor (Lat.65.05°N, Long.25.47°E and Rigidity $\geq 0.8$ GV) data have been taken for analysis.

## 3. Result And Discussion

In this study we have divided the full halo CMEs into three categories (1) symmetric full halo CMEs, (2) Brightness Asymmetric and (3) Outline Asymmetric full halo CMEs. The statistical significance of the results is obtained by using a chree analysis of superposed epoch method. Figure 1 depict that the symmetric full halo CMEs produces more depression in cosmic ray intensity than other two. It is also noted that the cosmic ray intensity depressed to minimum after three days of the onset of symmetric and outline asymmetric CMEs and four days of the onset of brightness asymmetric full halo CMEs. Figure 2 shows the frequency of occurrence of three types of CMEs. In this graph numbers from 1-9 on X-axis represents year from 1996-2004. It is clear from the figure that the frequency of symmetric full halo CMEs is high during solar minimum, while frequency of occurrence of outline asymmetric and brightness asymmetric full halo CMEs is high during solar maxima.



**Figure 1:** The results of Chree analysis of % deviation of daily values of Cosmic ray intensity of Oulu for -5 to +10 days with zero epoch day corresponds to the day of event for a period of 1996-2004.



**Figure 2:** Shows the frequency of occurrence three types of full halo event for the period of 1996-2004

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