A Study of the Relation between Type III Radio Storms and Solar Energetic Particle Events

Sachiko Akiyama*(1), Nat Gopalswamy(2), Seiji Yashiro(1), Pertti Mäkelä(1) and Hong Xie(1)
(1) The Catholic University of America, Washington DC 20064; e-mail: Sachiko.akiyama@nasa.gov
(2) NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA

Type III storms are observed as thousands of short-duration weak type III radio bursts continuing several days in the decametric to kilometric wavelength range. They are thought to be intermittent outflow of high energy particles into the interplanetary medium along open magnetic field lines located active regions (ARs). Though it is often difficult to identify the source AR of type III storms, several-hour disruptions of type III storms after intense coronal mass ejections (CMEs) help to identify the sources region. Recently Gopalswamy et al. [1] reported that type III storms could be one of the preconditioning factors contributing to acceleration of solar energetic particles (SEPs). They compared two fast CMEs with similar characteristics that differed only in the presence or absence of a type III storm and showed that the CME accompanied by a type III storm results in a larger SEP event.

We extend this study by expanding the sample size to 343 events. We use the CMEs from the CDAW Wind/WAVES type II burst list [2] and the CMEs are divided into two group based on their association with a type III storm: 134 with and 209 without type III storm. To avoid the possibility of the chance coincidence of the type III storm association, we require the type III storm is disrupted for at least 2 hours by the CME to ensure that their source region is the same. We examine their SEP association using the particle data from the GOES satellites. Minor SEP events (>1 pfu at >10 MeV proton) are considered as the SEP-associated CMEs. Figure 1 shows the SEP association rates (histogram) as a function of the source longitude for the CMEs with type III storms (red) and without type III storms (blue). The number of events in each longitude are annotated on each bar. Except for the E60-E30 bin, the SEP association rates are higher on the CMEs with type-III storms. The line graph is the median of >10 MeV peak intensity in each bin and shows that the SEP peak intensity is higher on the CME with type III storms on average. The presence of a type III storm in the CME source region seems to result in a larger SEP event, confirming the case study results in [1]. The interpretation is that the source region of the type III storms accelerates protons, which serve as seed particles for the CME-driven shock. This study points to the importance of source environment in causing additional variability in SEP events relevant for space weather research.

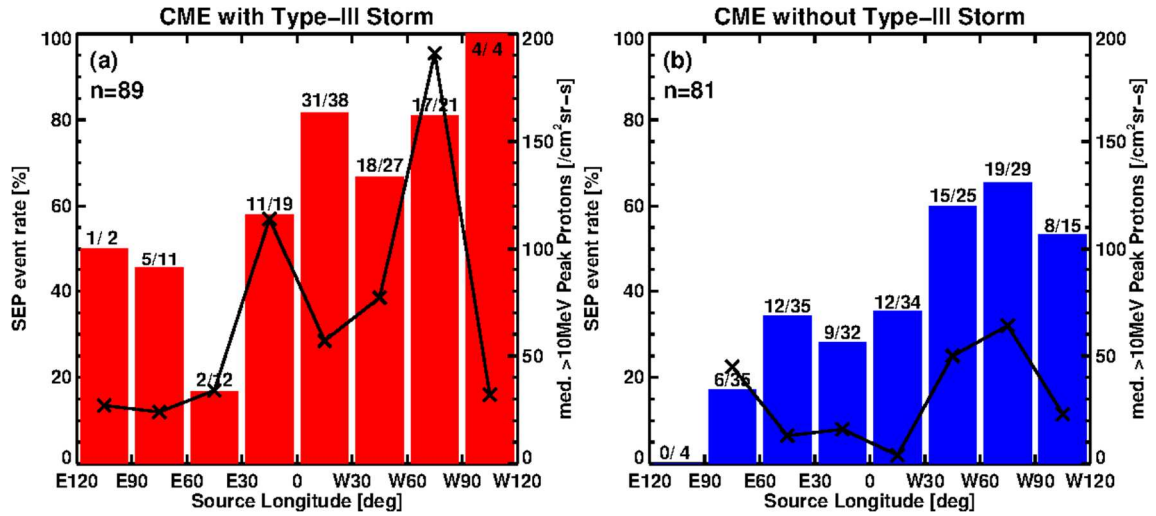

Figure 1. The rate of SEP events including minor events and median value of their GOES >10MeV peak intensity for each source longitude. The SEP event fractions are noted above the bars.

References

[1] N. Gopalswamy, S. Akiyama, P. Mäkelä, S. Yashiro, and H. Xie, "Can Type III Storms be a Source of Seed Particles to Shock Acceleration?", *Proc. 3rd URSI AT-AP-RASC, Gran Canaria, 29 May – 3 June 2022.*
[2] http://cdaw.gsfc.nasa.gov/CME_list/radio/waves_type2.html