Student: Richard Tyler Simmons
Mentor: Dr. Hong Zhao

Ultrarelativistic Electron Flux Enhancement in the Van Allen Belts

The Van Allen Belts are torus-shaped regions of energetic particles that surround the Earth. These belts of particles are highly affected by solar wind conditions such as solar wind proton density, interplanetary magnetic field, and solar wind speed. Understanding the effects of solar wind structures on the radiation belt particles is of both scientific interests and practical needs as energetic particles can cause single-event upsets and deep dielectric charging in spacecraft electronics and are also harmful to humans in space. The effects of solar wind on the ultrarelativistic electrons (>~3 MeV) in the radiation belts received limited attention in the past due to sparse measurements of differential fluxes. Nowadays, the Van Allen Probes measurements of ultrarelativistic electrons with high energy resolution provide an unprecedented opportunity to study the influence of solar wind on this population. Coronal mass ejections (CME) and corotating interaction regions (CIR) are two primary types of solar activity that cause geomagnetic storms on Earth, and thus affect the Van Allen Belts. In this study, the relationship between geomagnetic storms with different solar wind drivers and ultrarelativistic electron flux variations was inspected using data from the Van Allen Probes. Using solar wind data from Aug 2012 to Nov 2018, 27 CME-driven storms and 28 CIR-driven storms were identified. Superposed epoch analysis was performed on ultrarelativistic electron fluxes during CME/CIR-driven storms, respectively, using data from Relativistic Electron Proton Telescope (REPT) on the Van Allen Probes. The preliminary results show deeper and faster flux enhancements of ultrarelativistic electrons in CME-driven storms compared to CIR-driven storms, which is consistent with previous studies on the electrons with lower energies. These results also show that for CME-driven events, there is a clear electron flux enhancement in the 7.7 MeV and 6.3 MeV electron energy channels. For CIR-driven events, there is a less dramatic increase. Significant electron flux enhancement occurs approximately two days after the arrival of CIR, and approximately one day after a CME arrival for 3 MeV to 6 MeV electrons. Further analysis of the enhancement events and non-enhancement events of ultrarelativistic electrons during CME/CIR-driven storms using the REPT data along with normalization techniques provide insight into how these CIR/CME affect flux enhancements of ultrarelativistic electrons with different energies in the radiation belts.