Acceleration and losses of relativistic electrons throughout Earth's inner magnetosphere and magnetotail: New insights from multipoint observations

Drew L. Turner[1], Mike Shumko[1], Ian Cohen[1], and Sasha Ukhorksiy[1]
(1) Johns Hopkins Applied Physics Laboratory; drew.turner@jhuapl.edu

Study of the acceleration and loss of relativistic electrons (>100 keV) in Earth's magnetosphere continues to offer new insights on the complexity and intricacy of particle acceleration in space plasmas. Here, we present new research and results from a combination of observatories spanning Earth's inner magnetosphere and magnetotail. NASA's Magnetospheric Multiscale (MMS) and Van Allen Probes (RBSP) missions, each of which provides multipoint observations, deliver details of the in situ plasma, wave, and relativistic electrons from low-magnetic-latitudes throughout the inner magnetosphere (both missions) and extending out into the mid-magnetotail (MMS only). When those missions are paired with observations of relativistic electrons within the atmospheric loss cones, provided by the Electron Losses and Fields Investigation (ELFIN) CubeSats (also 2-point observations themselves) in low-Earth orbit (LEO), entirely new insights are gained on the rapidity and extent of relativistic electron acceleration, not only in the radiation belts but also, confoundingly, extending deep into Earth's magnetotail. Here, we detail some of these new insights, including the complicated relationship between relativistic electrons and whistler-mode chorus waves, the latter of which can be responsible for both rapid acceleration yet also pitch-angle scattering and losses of relativistic electrons. From the combination of MMS + RBSP + ELFIN, we develop a new understanding of how electron acceleration exists sporadically in the magnetotail, and at times, much of the plasma sheet is alight in high intensity levels of relativistic electrons. While those electrons scatter quickly into the atmospheric loss cones, they might also contribute at least in some part as a source of outer radiation belt electrons, albeit somewhat energy limited due to the magnetic geometry of Earth's extended magnetotail and plasma sheet.