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The big geomagnetic storm of 17 March 2015: measurements from the EPT/PROBA-V as well as their interpretation

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Since May 2013, the Electron Proton Telescope (EPT) orbits at 820 km altitude on a polar LEO track (Cyamukungo et al. 2014; Pierrard et al. 2014). The fluxes of trapped electrons ranging from 0.5 MeV to 20 MeV are measured by the EPT in 7 energy channels. We present and discuss here the observations collected during the period of the 17 March 2015 geomagnetic storm (Dst: -231 nT).

After the southward turning of the IMF, during the main phase of this large geomagnetic storm, an important dropout was observed at low altitudes in all energy channels of the EPT, for all drift shells of the outer Radiation Belt (L > 4). Penetration of relativistic electrons down to L = 2, into the inner Radiation Belt, was then also observed in the SAA at low altitudes (820 km). This strong injection event filled up the slot region between the inner and outer Radiation Belts, for a period lasting a few days.

The (L-t) maps of the fluxes measured indicate that the outer belt electron fluxes finally became significantly larger after the geomagnetic storm than before this event. It was also observed simultaneously by the MAGEIS/VAP-B detector along the highly excentric equatorial orbit of the Van Allen Probes B. Similar post-storm enhancements of energetic electrons fluxes in the outer radiation belt have often been observed and reported earlier, but never simultaneously (i) at low altitudes (along a LEO alike that of EPT/PROBA-V) and (ii) at large radial distances in the equatorial region (along a GTO orbit alike that of MAGEIS/VAP-B). The time variations of the energy spectra, made at both altitudes along the same drift shells, have been compared to each other during the different phases of this geomagnetic storm.

We show how Betatron deceleration and the uplift of mirror points (during the storm main phase), and Betatron acceleration and downward motion of mirror points (during the recovery phase) can explain the observed flux variations (i.e. the flux dropouts followed by the flux enhancements). Both at low altitude and at high altitude, these flux variations are due to Betatron deceleration and acceleration (the Dst-effect) induced by the initial built up of the Ring Current intensity, and subsequently by its decay, during the slower recovery phase.

We also pointed out how the effects of a concomitant interaction of outer belt electrons with whistler and ULF waves, during main phases and recovery phases can account for observed post-storm flux enhancements (or decreases) of outer belt electron population, often observed after geomagnetic storm events.

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