Evolution of the Electron Zebra Stripes in the Earth's Inner Magnetosphere

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The electrons with 10's-100's of keV energies exhibit repeated peaks and valleys in the electron flux intensities when mapped on a Energy versus L-value spectra. It appears like a distinct band in the electron flux that resembles the zebra-like patterns and hence named as "zebra stripes". In the present studies, we analysed the spatio-temporal growth of the electron zebra stripes that appeared during the intense geomagnetic storm of September 8, 2017. An advection simulation is employed for the electrons, under the time-dependent electric and magnetic fields obtained from the global magnetohydrodynamics (MHD) simulation and the electron zebra stripes were reproduced on the computers. We back-traced the bounce-averaged electron trajectories and understand the evolutionary characteristics of the electrons comprising of the peaks and the valleys. The ionospheric electric fields have a significant influence on the electron motion in the radial direction. The enhancement of the westward electric field in the premidnight to postdawn region transports the electrons earthward and leads to the formation of the peaks, while the electrons comprising of the valleys have not experienced such earthward transport. The origin of the westward electric field has its roots in the Region 1 field aligned current (FAC) in the polar ionosphere. The electric field penetrates deep into the lower latitudes, and propagates into the inner magnetosphere. In addition, the non-uniform ionospheric conductivity at the equatorward edge of the auroral oval distorts the electrical potential patterns, and extend the westward electric field region to the dawn. Our study highlights the coupling of the solar wind and the deep inner magnetosphere for the formation of electron zebra stripes.