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Two-dimensional view of the proton precipitation related to geomagnetic pulsations Pc1

A.G. Yahnin (1), T.A. Yahnina (1), H.U. Frey (2)

(1) Polar Geophysical Institute, Apatity, Russia, (2) Space Sciences Laboratory, University of California, Berkeley, California, USA (yahnin@pgi.kolasc.net.ru)

Low-orbiting satellite observations of proton fluxes revealed a specific energetic (E>10-30 keV) proton precipitation pattern as being the counterpart to EMIC waves seen on the ground as geomagnetic pulsations Pc1. This isolated and localized (with latitudinal width as small as 1 degree) precipitation pattern is situated equatorward of the isotropy boundary of energetic protons. The longitudinal extend of the localized precipitation of energetic protons (LPEP) can not be determined undoubtedly from low-orbiting satellite data only. Recent observations from the IMAGE spacecraft revealed a new type of proton auroras, namely, the sub-auroral morning proton spots (SAMPS). Comparison of simultaneous IMAGE and low-orbiting NOAA observations demonstrated that SAMPS and LPEP represent, respectively, the two- and one-dimensional image of the same precipitation pattern. The fact that SAMPS are the particle signature of the ion-cyclotron instability producing both the EMIC waves and ion scattering into the loss cone is confirmed by consideration of the proton aurora data from IMAGE and ground-based observations of Pc1 at the subauroral station Lovozero. A dozen events were selected when SAMPS were nearly conjugate to the ground station. All these SAMPS were associated with Pc1 observed on the ground. Moreover, in most cases the pulsations started and ended in accord with the appearance and decay of the proton aurora spot. Thus, the SAMPS observations indicate the localized nature of the region of the intense ion-cyclotron interaction responsible for Pc1.