Naturally enhanced plasma line generated by auroral secondary electrons: modelling results

Tima SERGIENKO [(1)], Nickolay IVCHENKO [(2)], and Ingemar HÄGGSTRÖM [(3)]

(1) Swedish Institute of Space Physics, Kiruna, Sweden

(2) School of Electrical Engineering, Royal Institute of Technology, Stockholm, Sweden

(3) EISCAT Scientific Association, Kiruna, Sweden

Strong incoherent scatter radar(ISR) echoes localized in the narrow altitude ranges near the ionosphere F region peak were observed recently by various incoherent scatter radars. These echoes are distinctly associated with dynamic auroral precipitation. The main peculiarities of the signal, such as simultaneous enhancement of ion-acoustic and plasma lines, zero peak in the ion line, were attributed to the signature of strong Langmuir turbulence. Auroral electrons accelerated at the high altitudes are usually considered to be directly responsible for high-frequency plasma turbulence in the auroral ionosphere. The characteristic energy of the auroral electron beam are typically higher than 1 keV, but the ISR observations show that the electrons, that can directly exchange energy with Langmuir waves, should have energy of an order of several eV. The electron beam with such a low energy can be formed by secondary electrons produced due to collisional interaction of the auroral electrons with the background atmosphere. It is well established that the dip in the ~2-4 eV region in the secondary electron spectra is formed due to vibrational excitation of the molecular nitrogen. For pure isotropic pitch angle distribution this dip can not result in beam formation. However, in the real ionosphere the magnetic mirror force and exponential decreasing of the atmospheric density can potentially form anisotropic distribution function of the secondary electrons and as a consequence the low energy electron beam. In this study we apply the Monte-Carlo simulation of auroral electron transport into the Earth' atmosphere in order to calculate the secondary electron spectra with very high pitch angle resolution that is needed to obtain correct one-dimension distribution function. In this report we present the results of investigation of influence of the auroral electron energy, the atmosphere composition, the background electron density on the secondary electron spectra.