Ion heating in the F2-region of the ionosphere in the presence of small-scale inhomogeneity

Zhizhko G.O., Vlasov V.G.

Irkutsk State Technical University, Irkutsk, Russia

Auroral electron beams unstable on the Cherenkov resonance are stabilised by large-scale inhomogeneity of the plasma density during all their way from the acceleration region to the E-region of the ionosphere. The generation of plasma waves by beam is possible only in the region of small plasma density gradients, that always is the area of the F2-region maximum or the area of small-scale density inhomogeneity. Collective dissipation of the electron beam energy occurs in the local region with the length about several tens of kilometres. This leads to the intensive heating of the electrons (up to temperatures about 10000 K) with longitudinal gradients about 1000 K/km. Simultaneously the ion heating occurs where the heating mechanism depends on the altitude of the small-scale density inhomogeneity. Calculations have shown that there are two extreme cases: 1) small-scale density inhomogeneity occurs at the altitudes of 300-400 km, and at the same time the altitude of the F2-region maximum is about 200 km; 2) small-scale density inhomogeneity occurs at the altitudes of more than 1000 km. At the first case the most effective heating mechanism is the frictional ion heating. The intensive electron heating results in the increase of the plasma pressure and gives rise to the ion upflows with velocity about 1 km/s and flux about 10^9 cm^{-2} s^{-1}. These flows can result in the ion frictional heating. At the same time ion temperatures reach the values about 4000-5000 K. At the second case the most effective heating mechanism is the ion heating due to induced dispersion of the high-frequency waves on the ions. Thus, the small-scale density inhomogeneity can be the heating region for both electrons and ions of the auroral ionosphere.

This work was supported by the Russian Fundation for Basic Research under grant 00-05-64064.