Plasma density depletion caused by inhomogeneous stochastic electric fields

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We consider the time evolution of the initially homogeneous spatial distribution of the plasma density in a magnetic field due to the effect of inhomogeneous turbulent electric fields. These fields in homogeneous plasma can arise as a result of the development of instabilities when nonuniform electron flows pass through the plasma. The emerging ponderomotive force pushes particles out of the region with an increased level of oscillations, which leads here to a depletion of the plasma density and cavity formation. This situation can occur both in laboratory and space plasmas. In particular, in the plasma of the ionosphere and magnetosphere of the earth, satellites and sounding rockets often observe the so-called lower hybrid cavities, axially symmetrical regions elongated along the magnetic field which are characterized by an increased level of oscillations in the region of the lower hybrid frequency, as well as a depletion of the plasma density. The study of the evolution of the plasma density distribution due to inhomogeneous electrostatic turbulence is carried out using the one-dimensional Fokker-Planck equation. The evolution of the density of ions and electrons, which are homogeneous in the initial state, is considered separately. The drift velocity and the diffusion coefficient of ions and electrons in Fokker-Planck equation are determined from the equation of motion of the particles, as averaged over a long time, the rates of the quasi-linear drift and the displacement velocity of the squared root-mean-square displacement. It is assumed that the frequency range of oscillations is near the lower hybrid frequency, so that the gyrofrequency of electrons is much higher, and the gyrofrequency of ions is much less than the frequency of plasma oscillations i.e. electrons are magnetized while ions are unmagnetized. It has been found that the drift velocity and the diffusion coefficient of guiding electron centers significantly exceed the corresponding values for ions. For a given envelope of plasma oscillations, the shape of the cavity is determined when a steady state is established. It is also shown that the formation of a plasma density cavity occurs if the particle drift velocity exceeds their thermal velocity.