THERMAL BARRIER FORMATION FOR PLASMA ELECTRONS AND IONS IN KIND OF CONNECTED DIP AND HUMP OF ELECTRIC POTENTIAL NEAR ECR POINTS IN CYLINDRICAL TRAP

V.I.Maslov, N.A.Azarenkov*, S.V.Barchuk, V.I.Lapshin, V.N.Tretyakov*, M.Y.Yu**
NSC Kharkov Institute of Physics and Technology, Kharkov 61108, Ukraine
**Karazin Kharkov National University, Kharkov, 61108, Ukraine*
***Theoretical Physics I, Ruhr University, D-44780 Bochum, Germany*

In [1] the thermal barrier formation for plasma particles near point of local electron cyclotron resonance (ECR) in monotonically inhomogeneous magnetic field along system axis for plasma flow has been observed experimentally. In this paper the mechanism of this large amplitude barrier formation for plasma electrons and ions has been proposed and investigated theoretically.

In a neighbourhood of ECR point transversal electron velocity increases strongly. At motion of electrons along an inhomogeneous magnetic field transversal electron velocity decreases and longitudinal electron velocity increases. The increase of longitudinal velocity results that electrons in the area, where they penetrate, will derivate negative volume charge. This charge is a dip of an electric potential, from which the electrons are reflected. The increase of longitudinal velocity in a neighbourhood of ECR point results also that a nonequilibrium state occurs. In other words, electron current velocity concerning to ions appears. The reflection of electrons from dip of an electric potential results in growth of its amplitude. The dip is excited on a slow ion modes with very small velocity.

Quasistationary properties of a dip are described in neglect by a non-equilibrium. Taking into account the non-equilibrium state results in excitation of the dip, in other words to growth of its amplitude.

As the large part of electrons of plasma flow is reflected from the electrical potential dip, and the ions pass through dip freely, a volume charge of ions there is formed, in which field ions are reflected. This volume charge forms large amplitude hump of the electrical potential. The flow of ions excites this hump of an electrical potential. The hump of the electrical potential is almost nonmobile in the space.

References

Kaneko T., Miyahara Y., Hatakeyama R., Sato N. J. Phys. Soc. Jap. 69 (2000) 2060.