Nonmaxwellian spectra of the SXR radiation in conditions of the ECR plasma heating at the L-2M stellarator

A.I. Meshcheryakov, I.Yu. Vaphin and D.G. Vasil’kov

Prokhorov General Physics Institute of the Russian Academy of Sciences, Moscow, Russia

Recently, the experiments on plasma heating and confinement with the high power density ECR radiation were performed, $P_{ECRH}/V_P = (2.0 \text{-} 2.5) \text{ MW/m}^3$. Under these conditions we were interested in the shape of the distribution function of electrons over energies.

In these experiments, plasma was produced and heated by two gyrotrons having the total power of $P = 350 \text{ - } 400 \text{ kW}$. The magnetic field at the center of the plasma column was $B_0 = 1.34 \text{T}$ which corresponded to the location of the resonance zone in the center of the plasma. The integral electron density over the central chord was $n_e = 2.0 \times 10^{19} \text{ m}^{-3}$.

The SXR spectrum was measured by the spectrometer having the high output count rate of $V = 2 \times 10^5 \text{ photons per second}$ which was recently put into operation at the L-2M stellarator. The measured spectrum had a slope which corresponds to the temperature of thermal electrons of $T_{e1} = 0.8 \text{ keV}$ and it also has an epithermal “tail” with the temperature of $T_{e2} = 2.0 \text{ keV}$. The breaking point of the spectrum corresponds to energy of $E = 5 \text{ keV}$ ($E/ T_{e1} = 7$). 2D modeling of the ECR heating (without taking relativistic effects into account) shows that the distribution function of electrons over energies is a non-Maxwellian function having the breaking point at the energy of about 10 $T_e$.

The presence of an epithermal “tail” in the distribution function of electrons over energies can result in the enhanced transport of electrons from the central area of plasma, i.e. it can be as a hypothesis for a possible explanation of the “pump-out” effect observed in the L-2M stellarator.