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PLASMA OF ECR DISCHARGE IN AN OPEN MAGNETIC TRAP AS A CYCLOTRON MASER: DYNAMIC REGIMES AND INFLUENCE ON CONFINEMENT *)

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This talk discusses the electron cyclotron resonance (ECR) interaction of electromagnetic waves and plasma confined in laboratory open magnetic traps. Such research typically involves ECR plasma heating, used to achieve high electron temperatures in open magnetic configurations of varying scales, from relatively compact process ion sources to large-scale plasma traps used in fusion research.

These applications have a long history but still remain relevant today, mainly due to progress in the development of high-power microwave sources such as gyrotrons, followed by a significant increase in microwave power load and thereby an increase in the number of nonequilibrium resonant electrons. The interaction of microwave waves with resonant electrons leads to a specific transfer of electrons in momentum space, which ends with them entering the loss cone and spilling out of the trap. Such electrons can also lead to the development of kinetic ECR instabilities in a wider frequency range than those used for resonant plasma heating. If this occurs, the suprathermal electrons act as an amplification medium for the intrinsic electromagnetic noise, while the thermal plasma and vacuum chamber provide a resonator for the unstable modes. In many cases, this mechanism determines the loss of excess energy stored in the accelerated electrons, thereby limiting the achievement of peak plasma parameters in applications. Recent advances in the theory of such a cyclotron maser offer approaches to control unwanted plasma turbulence caused by strong ECR heating [1-6].

The report discusses various dynamic regimes of radiation generation as a result of the development of ECR instabilities, the influence of these instabilities on the confinement of hot electrons and the main plasma in a trap.

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