Frequency sweeping events in cyclotron emission of energetic electrons in ECR discharge plasmas

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The complex dynamics have been observed in the spectra of the electron cyclotron emission of a nonequilibrium plasma created by powerful microwave radiation of gyrotron (37.5 GHz, 80 kW) under electron cyclotron resonance (ECR) conditions and confined in a tabletop mirror trap [1, 2]. The dynamic spectrum of the emission is a set of highly chirped radiation bursts with both increasing and decreasing frequencies which are repeated periodically. Such patterns are not described in the frame of a quasilinear approach which is standard for the description of a broadband plasma emission. From the other hand, the simultaneous observation of several chirping bursts in the same frequency range is typical for the formation of nonlinear phase-space structures in a proximity of the wave-particle resonances of a kinetically unstable plasma, also known as the "holes and clumps" mechanism [3]. Our data provide the experimental evidence for the spontaneous formation of self-consistent structures in the new frequency domain (a few GHz) linked to the electron cyclotron frequency in a laboratory mirror-confined plasma.

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References

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