TH/4-2:The low-threshold parametric decay instabilities leading to anomalous absorption at ECRH in toroidal devices

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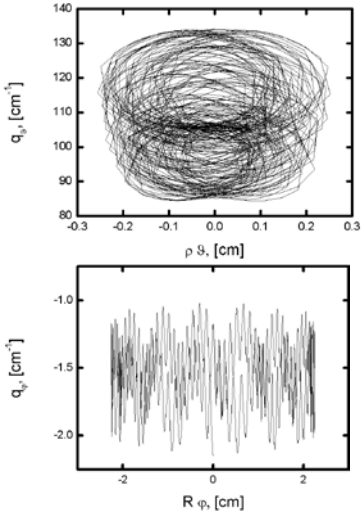
1. Low-threshold parametric excitation of the Upper Hybrid (UH) or Electron Bernstein Waves (EBW) 3D-trapped in the drift-wave eddies or blobs.

The 3D trapping of the UH or EB waves in the drift-wave eddies possessing density maximum and aligned with the magnetic field is demonstrated (see fig.1 showing the finite EBW's ray trajectory).

In the case of the 2nd harmonic X-mode ECRH the low threshold (50 kW for TCV conditions) parametric excitation of the trapped mode and heavily damped ion mode can explain fast ion tail production in TCV and TJ-II ECRH experiments.

In the case of the 1st harmonic O-mode ECRH the low-threshold absolute parametric decay instability can lead to anomalous microwave absorption in the UH resonance.



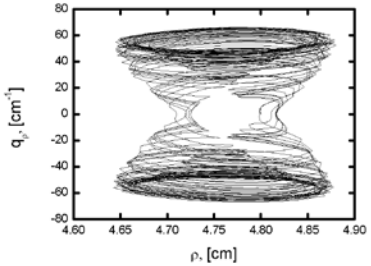


Fig. 1: The phase portrait along the EBW's ray trajectory for TCV conditions. The 3D trapping of the EBW's ray trajectory is shown.

2. Low-threshold parametric excitation of two Upper Hybrid (UH) plasmons in the 2nd harmonic X-mode ECRH experiment.

The 3D localization of both UH daughter waves due to local maximum of the density in the O-point of the magnetic island (fig.2) and finite-size of the pump wave beam (fig.3) is accompanied by the absolute parametric decay excitation. The power threshold is less than 100 kW. This PDI play a key role in anomalous backscattering in the ECRH experiments at TEXTOR.

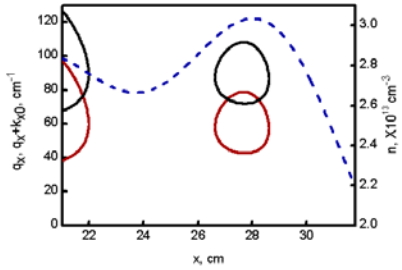


Fig.2: The UH waves are radially trapped in magnetic island (red and black 1D dispersion curves) in a vicinity of the local maximum of the density profile (blue curve). In the points where the solid and dashed curves intersect the decay conditions are fulfilled.

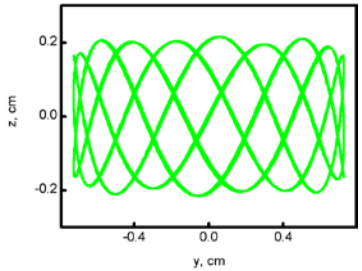


Fig.3: The UH wave ray trajectory on the magnetic surface for Textor conditions demonstrating its 2D trapping due to finite-size of the pump wave beam.