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Resonant power absorption in helicon plasma sources: Theory[1]
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It is very common for helicon discharges to produce plasmas with a strong density gradient across the confining magnetic field. Such a nonuniform plasma can create a radial potential well for non-axisymmetric whistlers, allowing radially localized helicon (RLH) modes. This work presents new evidence that RLH modes play a significant role in helicon plasma sources. Experimentally, the mode has been identified by its resonant response to a low power rf-generator with variable frequency. The 2D plasma density profile was measured and then used to calculate the corresponding eigenfrequency and RLH mode structure for the experimental parameters. The calculations were performed using a 2D field solver for a single resonant azimuthal harmonic (m=1) under the assumption that the density profile is axisymmetric. The resulting mode frequency matches the driving frequency of the rf-antenna. The calculated power deposition into the plasma is comparable to the experimental value for a relevant electron collision frequency. It is noteworthy that the RLH mode, rather than the electrostatic modes, is responsible for the rf-power absorption in most of the plasma volume for the measured density profile.

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