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ヘリオトロンJにおける電子バーンスタイン放射計測システムの開発
Development of Electron Bernstein Emission Diagnostic System on Heliotron J

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Use of electron Bernstein Waves (EBWs) is attractive for heating/current drive, electron temperature diagnostic [1] and magnetic pitch angle profile measurement [2] at high densities not accessible to electron cyclotron waves. The EBWs have advantage of no density limit and high optical thickness even at low T_e. Electron Bernstein emission (EBE) has been studied for T_e measurement at high density regime in Heliotron J. Figure 1 shows a calculation result on O-X mode conversion efficiency using the TRAVIS code. The existing EC launcher antenna has an access window for the O-X conversion for 35 GHz frequency with 5 deg and 3 deg wide in the toroidal and poloidal directions, respectively. The density fluctuation may affect the O-X mode conversion efficiency, as shown in Fig. 2. The transmission efficiency is reduced even at optimum angle with an increase in density fluctuation amplitude, suggesting that high-density improved modes are preferable for the EBE diagnostic. A ray tracing code, KRAY, has been developed to calculate heating and emission profiles via O-X-B process, which solves the radiative transfer equations [3] in the 3-D magnetic field structure. The calculation shows that the power can be deposited at the core region [4].

A multi-channel radiometer system is being assembled and tested for the EBE measurement. Since the electron density in NBI plasmas is typically n_e<4×10^{19} m^{-3}, the frequency of Ka-band (26-40 GHz) is chosen to measure the radiation from core. As the radiometer is connected to the transmission line and steerable antenna of the existing ECH/ECCD system, it will be possible to perform angular scans of conversion efficiency that can also provide guidance to EBW heating and current drive. The designed EBE measurement system consists of a Gaussian optics antenna, a universal polarizer and a radiometer. Preliminary tests showed that the radiometer detected 35 GHz microwaves of 0.2 nW level intensity.

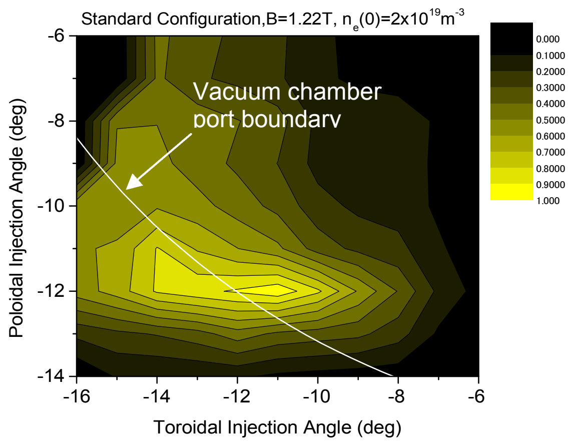

Fig. 1. O-X mode conversion window for the frequency of 35GHz in Heliotron J

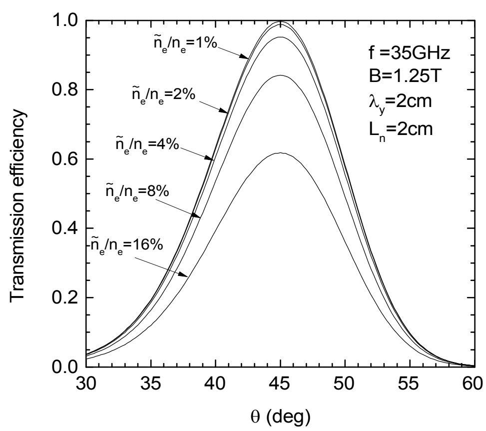

Fig. 2. Effect of density fluctuation on transmission efficiency. θ is the angle between the wave vector and the magnetic field.

References

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