Design of waveguide polarizer at 2.45 GHz.

Abstract

Electron cyclotron heating (ECH) plays a crucial role in spherical tokamaks, where it is employed to enhance the plasma temperature. However, due to the relatively low toroidal magnetic fields and the high plasma densities characteristic of these devices, over-dense plasmas are often produced. In such conditions, an electron cyclotron wave (ECW) of lower frequency cannot penetrate beyond the cut-off layer, preventing direct plasma heating.

To overcome this limitation, mode conversion becomes essential for heating over-dense plasmas. In the O-X-B mode conversion scenario, an ordinary (O) mode wave is launched obliquely into the plasma, where it first converts into an extraordinary (X) mode wave, and subsequently into an electron Bernstein (EB) wave. Unlike electromagnetic waves, the EB wave does not experience a density cut-off, allowing it to propagate deep into the plasma and heat it efficiently provided that the plasma exhibits an appropriate density gradient at the upper hybrid resonance layer.

The coupling efficiency between injected electromagnetic waves and EB waves is strongly influenced by the polarization of the injected wave [1]. Optimal coupling is achieved when the injected wave possesses the proper elliptical polarization, which depends on both the injection angle and the local density gradient at the upper hybrid resonance [2].

Any desired elliptical polarization can be derived from a circular TE11 mode by employing a combination of a half-wave section and a quarter-wave section of circular waveguide. The polarization transformation arises from differences in the axial wave numbers of an orthogonal pair of modified circular TE11 modes, which can be practically realized through the insertion of a Teflon plate inside the circular waveguide.

As part of the proposed work, the design of a circular TE11 -based waveguide polarizer will be undertaken.

Academic Project Requirements:

1) Required No. of student(s) for academic project: 1

2) Name of course with branch/discipline: M.Sc. Physics

3) Academic Project duration:

(a) Total academic project duration: 35 Weeks
(b) Student's presence at IPR for academic project work: 5 Full working Days per week

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