§45. Analysis and Simulation on Experiments using RF/mm-Waves

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In analysis of Electron Cyclotron Heating and Current Drive (ECH and ECCD) experiments on the TRIAM-1M tokamak, the deposited power profile was analyzed with a TASK/WR code [1]. The driven current profile in the fundamental X-mode off-axis ECCD scenario on the tokamak was evaluated using a Fokker-Plank TASK/FP code, together with the TASK/WR codes. The three electron temperature model was adopted for the previous TASK/WR analysis, taking the high energetic electrons in the lower hybrid current drive plasma into consideration. Here, one higher electron temperature component (T_{e0} ~3keV) was assumed. Figure 1 shows the perpendicular refractive index $N_\perp$ and deposition profiles evaluated for the fundamental X-mode ECCD. Before the ray was reflected by the R-cutoff, all incident power was absorbed due to the Doppler-shift effect. The parallel refractive index $N_{//}$ was 0.32. The evaluated driven current was 30 kA at the 100kW ECCD injection. Figure 2 shows the current profile driven by the ECCD injection. The Fokker Plank code was able to be used with the ray tracing code, and will be applied to the driven current analysis on the QUEST tokamak.

In the QUEST experiment, Electron Bernstein Wave Heating and Current Dive (EBWH and EBWCD) is a main heating and current drive method to sustain the steady-state plasma. The establishment of steady-state current drive method is a key issue to study PWI phenomena in the steady-state QUEST plasmas. In order to evaluate the power deposition in the EBWH/EBWCD, a new ray-tracing code has been developed. In the EBWH and EBWCD, some mode conversions from the electron cyclotron (electromagnetic) wave to the electron Bernstein (electrostatic) wave are required. Figure 3(a) shows a ray trajectory in the O-X-B(Bernstein) mode conversion scenario. The incident O-mode wave was reflected at the O-cutoff, and propagated as the X-mode wave. The X-mode wave met an upper hybrid resonance, and converted to the B-mode wave. Figure 3(b) shows the profile of absorbed fraction of the propagating

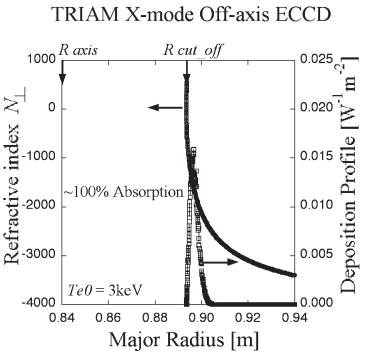

Fig. 1: Perpendicular refractive index $N_\perp$ and deposition profiles evaluated for the fundamental X-mode ECCD.

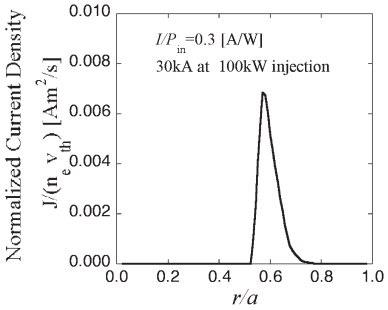

Fig. 2: Current profile driven by the fundamental X-mode ECCD.

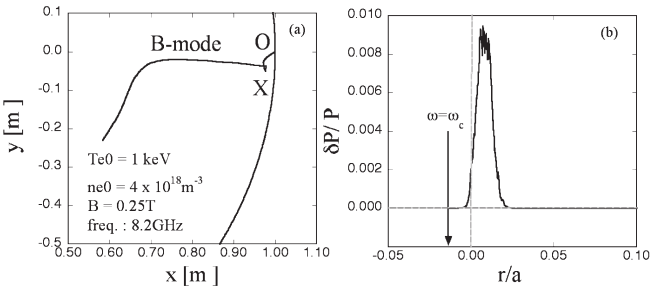

Fig. 3: (a)Ray trajectory and (b) absorbed power fraction profile in the O-X-B(Bernstein) mode conversion scenario.

B-mode wave. Since the B-mode wave was absorbed before the ray reached the cold resonance due to the Doppler effect, which indicated the effective EBCD. The Fokker-Plank analysis will be done with the ray tracing code.

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Reference

[1] Idei, H., *et al.*, Nuclear Fusion, **46**, 489 (2006).