§8. Suprathermal Electron Effects on Ambipolar Flux in W7-AS

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Recently, a stronger positive radial electric field, E_r, ($\geq$40kV/m) has been measured in the central plasma region in W7-AS[1, 2]. The experimental heat diffusivity becomes much lower than the neoclassical one for $E_r \approx 0$, leading to highly peaked central electron temperatures (up to 4keV). The experimental findings strongly suggest a connection between the " electron root" feature and the ECRH driven flux mainly due to the drift motion of ripple-trapped suprathermal electrons. In this paper we study the kinetic effect by suprathermal electrons on ambipolar flux in W7-AS using a newly developed 5D Monte Carlo simulation code[3,4] in relation with the " electron root" experiments.

The " electron root" feature was only observed in low density discharges with high power ($\geq$ 400kW) X-mode 2nd-harmonic ECRH and, up to now, could not be driven by O-mode 1st-harmonic. Figure 1 shows the simulations of the radial profile of the ECRH driven electron flux for the two polarizations. It is found that, in the central plasma region, the ECRH driven flux for the X-mode case is about 2 times higher than that for O-mode. This is related to the different absorption mechanism for the two polarizations. The X-mode is mainly absorbed by deeply trapped particles (maximum of absorption by resonant electrons with $v_{//} \approx 0$), while the absorption for perpendicularly injected O-mode, requiring finite values of $v_{//}$, is shifted towards the passing particle region.

Figure 2 shows the comparison of the ECRH driven flux and the ambipolar neoclassical fluxes obtained by the DKES code. The full and dashed lines show the X-mode ECRH driven flux for the case without and with a strong positive E_r, respectively. The circles refers to the DKES results. We can see that the ECRH driven flux is comparable to the ambipolar neoclassical thermal one with the ion root and dominates at higher E_r. The validity of standard neoclassical theory in case of strong E_r is analyzed in Ref. [2].

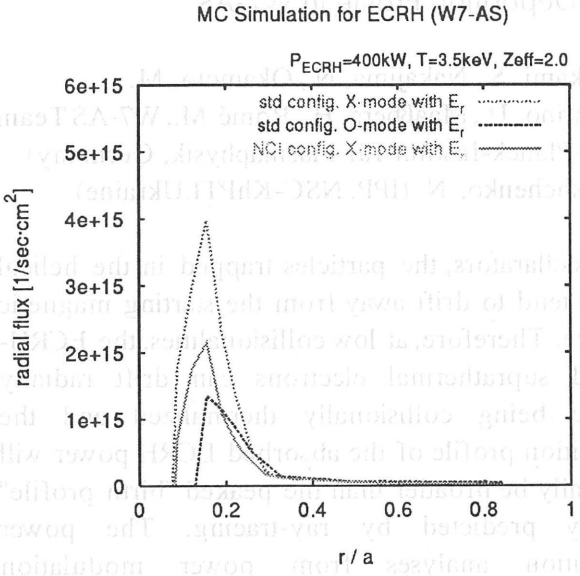

Fig. 1 Comparison of the radial profile of ECRH driven electron flux for X- and O-mode cases.

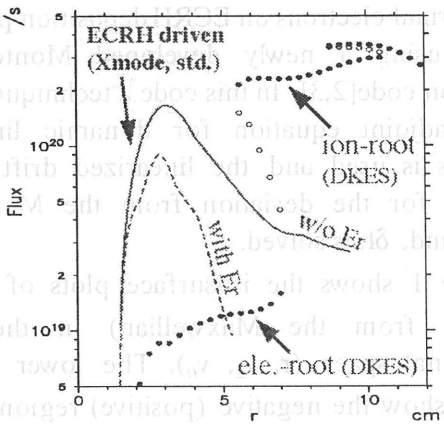

Fig. 2 Comparisons of the simulation results of the ECRH driven fluxes with DKES results (standard neoclassical theory).

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