§7. Suprathermal Electron Effects on ECRH Deposition Profile in W7-AS

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In stellarators, the particles trapped in the helical ripple tend to drift away from the starting magnetic surface. Therefore, at low collisionalities, the ECRH-heated suprathermal electrons can drift radially before being collisionally thermalized and the deposition profile of the absorbed ECRH power will generally be broader than the peaked "birth profile" usually predicted by ray-tracing. The power deposition analyses from power modulation experiments at W7-AS have shown the existence of a "broad component" in the deposition profile[1].

In this paper we study the kinetic effect by suprathermal electrons on ECRH deposition profile in W7-AS using a newly developed Monte Carlo simulation code[2,3]. In this code a technique similar to the adjoint equation for dynamic linearized problems is used and the linearized drift kinetic equation for the deviation from the Maxwellian background, δf, is solved.

Figure 1 shows the isosurface plots of δf (the deviation from the Maxwellian) in the three dimensional space (r, $v_\perp$, $v_{//}$). The lower (upper) surfaces show the negative (positive) regions of δf, respectively. ECRH tends to push resonant electrons towards higher perpendicular energies, consequently a depletion (with respect to the Maxwellian) tends to appear at lower energies and a tail at higher energies. Interestingly, we can see a ``nose-like structure" at the upper surface. This is related to the radial (convective) transport of the trapped energetic particles. This confirms that trapped suprathermal electrons are mainly responsible for radial transport.

Using the obtained distribution δf, we can evaluate the ECRH deposition profile. Figure 2 shows the comparison of the experimental and numerical results for X-mode 2nd-harmonic ECRH in the standard configuration [n_0=1.0× 10^{19} cm^{-3}]. We can see a relatively good agreement between the experimental and numerical results. This confirms the importance of radial convection of suprathermal electrons in the ECRH deposition profile broadening .

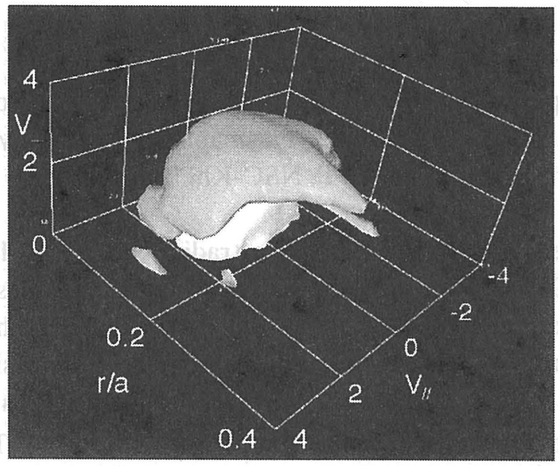

Fig. 1 Isosurface plots of the distribution δf (the deviation from the Maxwellian driven by ECRH).

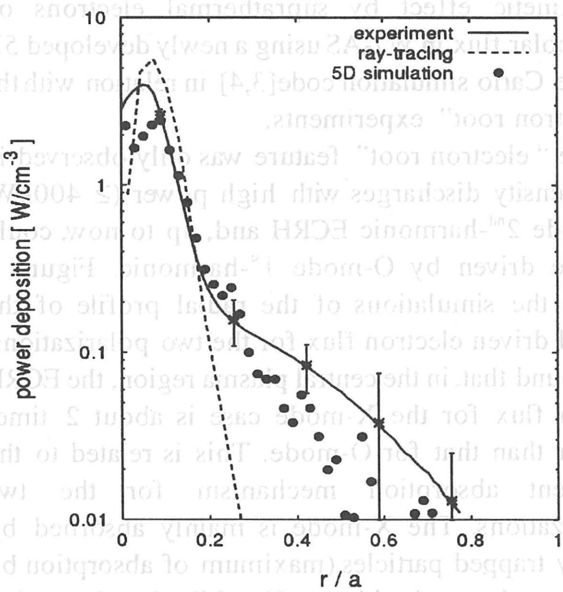

Fig. 2 Comparisons of the simulation results of ECRH deposition profile (filled circle) with the ray-tracing (dashed line) and experimental ones (solid line) [n_0=1.0× 10^{19} cm^{-3}].

REFERENCES

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