## §5. Orbit Effects on the ECRH Deposition Profile in Stellarator-devices[1]

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The particles trapped in the helical ripple tend to drift away from the starting magnetic surface in stellarators. Therefore, at low collisionalities, the ECRH-heated electrons can drift radially before being collisionally thermalized. And the absorbed power deposition profile will generally be broader than the peaked "birth profile" usually predicted by ray-tracing. Recent measurements suggesting the existence of a "broad component" in the ECRH deposition profile at W7-AS[2] have put a considerable interest in a quantitative analysis of this r. f.-driven transport.

In order to study the effects of radial drift motion of suprathermal electrons, a Monte Carlo simulation code is developed based on a technique similar to the adjoint equation for dynamic linearized problems. The linearized drift kinetic equation for the deviation from the Maxwellian background $f_1(\underline{x}, \underline{v})$,

$$\vec{v} \cdot \nabla f_1 + \vec{a} \cdot \nabla_v f_1 = C(f_1) + S_{ql}^0, \qquad (1)$$

is evaluated as,

$$f_1(\underline{x}, \underline{v}) = \int_0^{\infty} dt \int d\underline{x}' \int d\underline{v}' S_{ql}^0(\underline{x}', \underline{v}') g(\underline{x}, \underline{v}, t|\underline{x}', \underline{v}'), \qquad (2)$$

where $C(f_1)$ is the linear Coulomb collision operator and $S_{ql}^0$ is the wave induced flux in velocity space (quasi-linear diffusion term) which is assumed to be a given function. The time dependent Green function $g(\underline{x}, \underline{v}, t|\underline{x}', \underline{v}')$ is the solution of the drift kinetic equation, $\partial g/\partial t + \vec{v} \cdot \nabla g + \vec{a} \cdot \nabla_v g = C(g)$,with initial condition $g(\underline{x}, \underline{v}, t = 0|\underline{x}', \underline{v}') = \delta(\underline{x} - \underline{x}')\delta(\underline{v} - \underline{v}')$. The function $g$ is obtained using the Monte Carlo simulation in which the complex magnetic field configuration, the finite-$\beta$ effect, and the radial electric field can be included.

Figures 1 and 2 shows the normalized power deposition profiles with changing the configurations and densities (X-mode, 2nd-harmonic , $T$ = 1.5keV, and $Z_{eff}$ = 2.0). The quasi-linear diffusion term $S_{ql}^0$ is estimated through an analytical model of ECR heating. We can see a considerable broadening of the deposition profile due to the large orbit of suprathermal electrons, especially for "minimum $B$" configuration and for lower densities. These results are consistent with the experimental results[2].

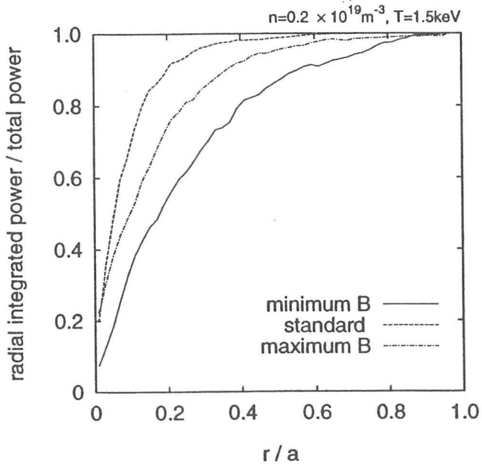


**Fig. 1:** *Normalized power deposition profiles for different configurations.* $[n_0 = 2.0 \times 10^{19} \mathrm{m}^{-3}$, $T = 1.5keV]$.

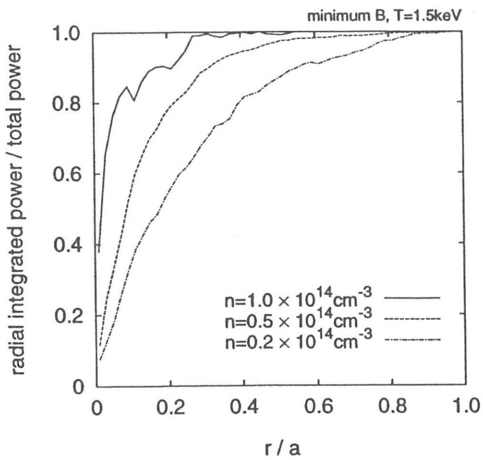


**Fig. 2:** *Same for different densities in the "minimum B" configuration.*

### References

1) Murakami, S., et al, *Proc. 1996 Int. Conf. Plasma Phys.* (Nagoya, JSPSNFR) Vol. 1 (1997) p 1014.
2) Romé, M., et al, Plasma Phys. Contr. Fusion **39** (1997) 117.