§14. Development of Monte Carlo Simulation Code for ECR Heating in Non-axisymmetric Devices

Murakami, S., Nakajima, N., Okamoto, M.
Gasparino, U. (Max-Planck-Institut für
Plasmaphysik, Germany)

Although linear theory predicts a local absorption of ECR heating power, broader heating profiles and changes in the radial electric field, possibly due to enhanced electron flux, are observed in electron cyclotron heating of low density plasmas in both heliotrons and stellarators.

The drift motions across the magnetic surfaces related to the heating of ripple trapped electrons can play an important role in these phenomena. However, this drift motion effect has not been sufficiently analyzed in literatures due to the difficulty in solving the electron orbits and the radial electric field consistently. We have developed a Monte Carlo simulation code in which a complex magnetic field configuration, the finite-β effect, and the radial electric field are consistently included.

The analysis is based on a technique similar to the adjoint equation for dynamic linearized problems. In the linearized kinetic equation, the wave-induced flux in velocity space (quasilinear diffusion term) is assumed to be known (e.g., from ray-tracing calculations) and the steady-state distribution function is evaluated through a convolution with a characteristic time dependent "Green's function". The complex magnetic field configuration and finite-β effects on the electron motion are included using the Boozer coordinates based on the three-dimensional MHD equilibrium.

As a test of our Monte Carlo based simulation code we have compared our results with Fokker-Planck simulation results by eliminating the orbit effects. Figure 1 shows the contours of Green's function; Monte Carlo simulation (up) and Fokker-Planck simulation (down). We can see the good agreements between them. The time development of parallel momentum with the quasi-linear diffusion term depending $k_{\parallel}$ is shown in Fig. 2. The results also show a good agreement. We are now applying this code for study of orbit effects in non-axisymmetric configurations.
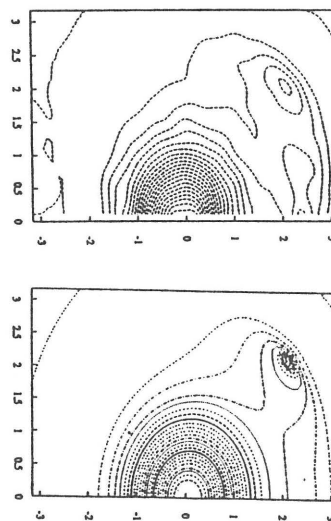

Fig. 1: *Comparison of Green's function; MC result (up) and F-P result (down).*
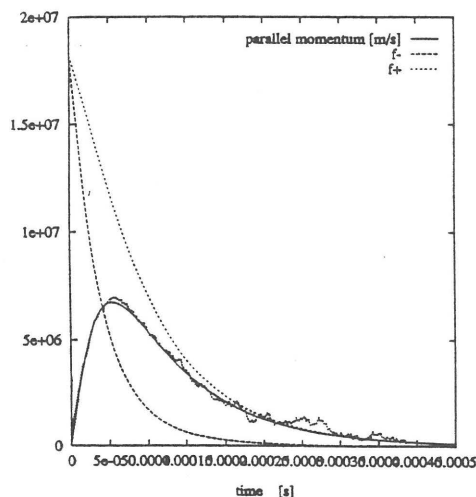

Fig. 2: *Time development of parallel momentum; MC result(dashed line) and F-P result (solid line).*

References

1) N. J. Fisch, Phys. Fluids **29** (1986) 172.

2) S. Murakami, et al., Nuclear Fusion **34** (1994) 913.