§57. Analysis of NBI Particle Orbit and Distribution Function in LHD

Matsumoto, Y. (Hokkaido Univ.)

It is one of the important subjects to analyze the high energy particle orbit produced by the plasma heating or the fusion reaction. Especially, in the helical devices, such as LHD, the confinement of the reflected particles reflected by the helical and/or the toroidal ripples has to be clarified. We developed the particle orbit analysis code in LHD, in which the real coordinate system is adopted to trace the particle outside the LCFS. In this code, the Littlejohn's guiding center equations are numerically solved to include the effect of the plasma current. The Monte Carlo code, MORH, is also developed base on the above mentioned particle orbit code[1, 2]. In the present study, the behavior and confinement of the high energy particles produced by the NB of LHD is analyzed by using these codes.

We classified the high energy particle orbits both in the high beta LHD plasma and the vacuum magnetic field. It is found that the there is no significant difference in the particle orbit classifications in the space relating to the starting points versus the initial pitch angles between two magnetic fields.

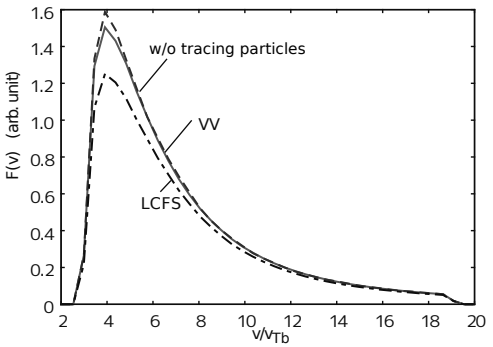
Using the MORH code, we analyzed the tangentially injected NB. Figure 1 shows the obtained distribution functions due to the tangentially injected NB. It is seen from Fig. 1 that there exists the effect of the re-entering particles around the thermal speed. The effect of the re-entering particles is independent of the pitch angle .

The perpendicularly injected NB is also analyzed by using the MORH code. The obtained distribution functions due to the perpendicularly injected NB are shown in Fig. 2. Figure 2 suggests that the effect of the re-entering particles is seen independent of the particle speed. When pitch angle becomes $\simeq 0.4\pi$ or 0.6π by the pitch angle scattering, the effect of the re-entering particles is large.

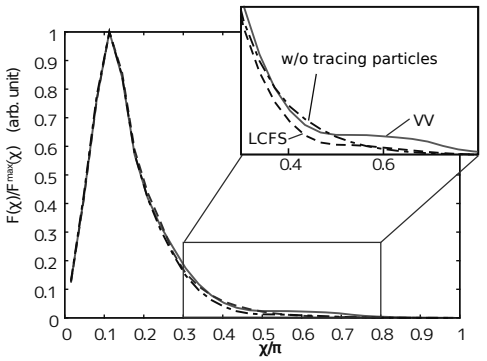
We developed the particle orbit tracing code and the Monte Carlo code, MORH. The confinement and behavior of the high energy orbit in LHD are studied. And the distribution functions of the high energy particles produced by NB are investigated The comparison between the calculation and the experience will be done.

1) R. Seki, Y. Matsumoto, Y. Suzuki, K. Y. Watanabe, K. Hamamatsu and M. Itagaki: J. Plasma Fusion. Res. **5**, 014(2010).

2) R. Seki, Y. Matsumoto, Y. Suzuki, K. Y. Watanabe, K. Hamamatsu and M. Itagaki: J. Plasma Fusion. Res. **5**, 027(2010).

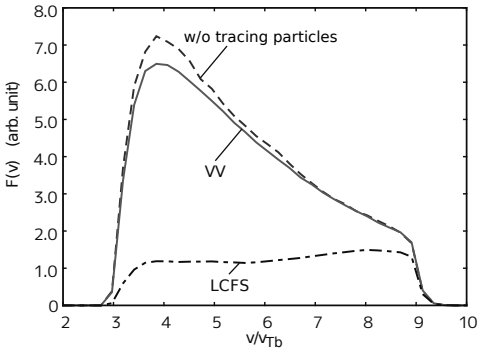


(a) Distribution funcion vs. speed

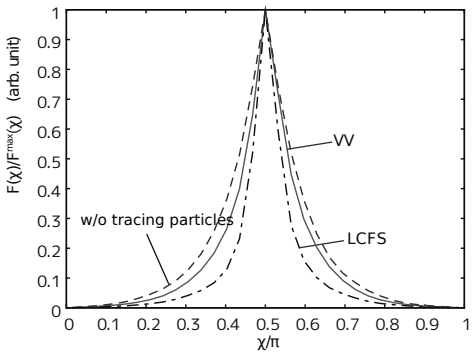


(b) Distribution funcion vs. pitch angle

Fig. 1: Distribution functions due to the tangentially injected NB.



(a) Distribution funcion vs. speed



(b) Distribution function vs.pitch angle

Fig. 2: Distribution functions due to the perpendicularly injected NB.