§33. Analysis of NBI Particle Orbit and Beam Pressure in High Beta Plasma of LHD

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The high beta experiments in LHD have been performed with the low magnetic field ($\simeq 0.5$ T) and the low density plasma heated by the neutral beams (NB).[1]. It is pointed out that the proportion of the beam pressure to the total plasma pressure is large in such experiments. The precise identification of the beam pressure is one of the most important subjects on the equilibrium and stability studies in the high beta helical plasmas. The method to identify the beam pressure with accuracy, however, has been unestablished. Consequently, the purposes of the present study are to establish the high accuracy identification method of the beam pressure and to investigate the effects which the beam pressure has on the equilibrium and stability. Besides, the aim of this study is the precise analysis of the high-energy particle orbit in the high beta plasma of LHD.

The behavior of the high energy particles in the high beta LHD plasma has been analyzed with the use of the real coordinate system[2]m. Especially, the re-entering particles,[3−5] which repeatedly go out of and get into the core plasma region, are focused and the effects of these particles to the high beta plasmas are investigated. Based on this particle tracing code and the OFMC code, we have developed a new Monte Carlo code to investigate the distribution function of the high-energy particles in LHD. The distribution function including the contribution of the re-entering particles can be calculated since the real coordinate system is adopted. The particle loss due to the charge exchange reaction in the peripheral region is also included in our code. Figure 1 shows the pressure of the high-energy particles produced by the tangential NBs(BL1(counter) and BL2(co)).

We have investigated the particle orbit in the high beta plasma of LHD without the guiding center approximation. The orbit of the rotation center defined as the "real" center of the gyro-motion is compared with that of the guiding center. As shown in Fig.2, the rotation center deviates from the magnetic surface larger than the guiding center.

The non-linear MHD code with the use of Constrained Interpolated Profile (CIP) method have been developed.[6] After completion of this code, the equilibrium of LHD will be studied. We will also study the nonlinear stability/instability in LHD.

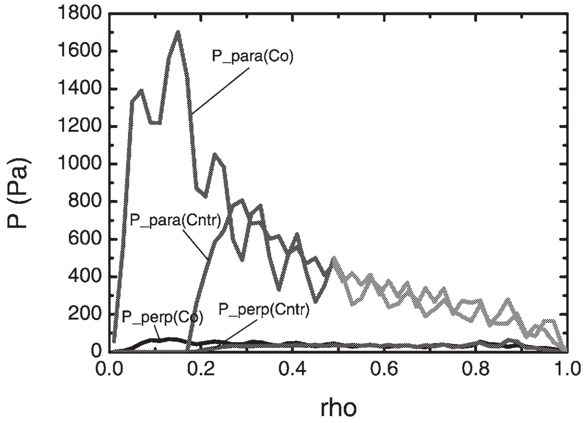

Figure 1: Pressure of the high-energy particles produced by the tangential NBs(BL1(counter) and BL2(co)).

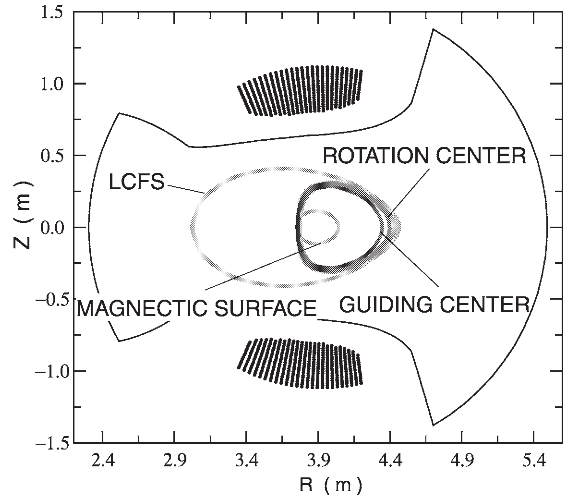

Figure 2: Poincare plots of rotation center and guiding center orbits. The LCFS and the magnetic surface, on which the starting point of the particle is set, are also shown.

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6) Matsumoto, Y., J. Plasma Phys. **72**, 1163 (2006).