Study of neoclassical transport characteristics by Monte Carlo method in advanced stellarator

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Stellarator provides the steady-state MHD equilibrium by only external magnetic coils without plasma current. However, in the case of 3-D torus without any symmetry like conventional stellarators, the large neoclassical diffusion is expected in low-collisionality regime[1]. In order to overcome this, so-called advanced stellarators embedded with symmetry have been proposed. A quasi-axisymmetric stellarator (QAS) is one of those, having a magnetic configuration embedded with axisymmetry like tokamaks. As a first experiment device of QAS in the world, CFQS is being constructed now[2-4]. Figure 1 illustrates the CFQS plasma and magnetic coil system.

In this work, in order to study neoclassical diffusion properties in CFQS plasmas, we have been developing Monte Carlo Neoclassical Transport Simulation (MONTS) code. The effect of the radial electric field (E_r) on neoclassical transport in CFQS has been investigated by MONTS. Figure 2 shows the neoclassical diffusion coefficients at r/a=0.5 with various amplitudes of E_r in CFQS. The ambipolar E_r are evaluated assuming a typical temperature and density profiles of CFQS, which is obtained from ambipolar condition of particles' flux. Three roots of E_r can be evaluated, containing two of stable roots (ion and electron roots) and one of an unstable root.

We study the effect of β on neoclassical diffusion coefficient in CFQS by using MONTS. CFQS experiment will be performed in various QA configurations using toroidal field and/or poloidal field coils. Therefore, we also study the neoclassical transport in various magnetic configurations. In this paper, the neoclassical transport characteristics in CFQS will be reported.

References

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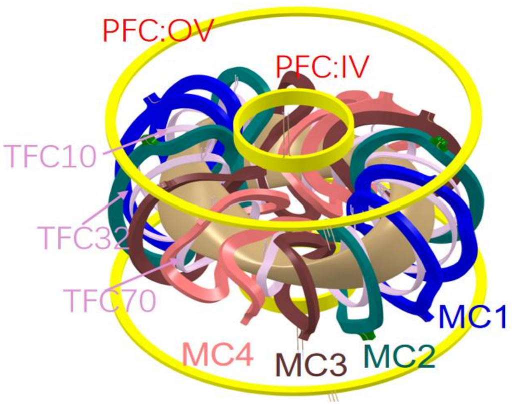

Figure 1. The CFQS plasma and magnetic coil system.

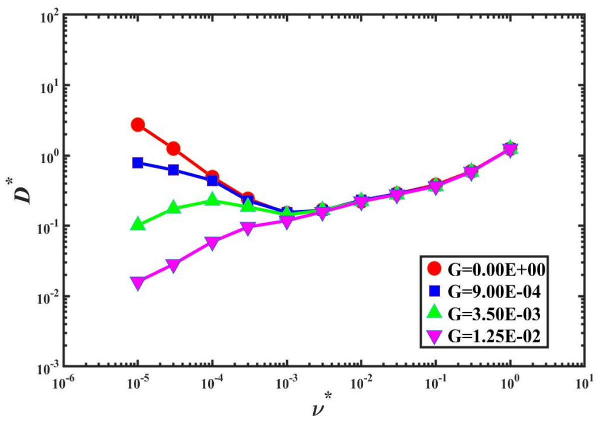

Figure 2. The diffusion coefficients at r/a=0.5 are shown with the radial electric field. We use the normalized radial electric field G[=(R_0/ιr)×E_r/νB].