28E09P

低アスペクト比逆磁場ピンチプラズマにおける輸送解析
Diffusive Transport Analysis in Low Aspect Ratio Reversed Field Pinch

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To evaluate confinement properties of the low aspect ratio reversed field pinch (RFP) plasma, diffusive transport analysis including the neoclassical and turbulent transport models is studied. As for the conventional RFP plasma with larger aspect ratio, resistive magnetohydrodynamic transport analyses by using the theoretical model or three-dimensional numerical simulations based on the cylindrical approximation have been performed and shown to be nearly consistent with experimental results such as the confinement scaling in the standard ohmically driven RFP [1,2]. In the present RFP, it is considered that resistive diffusion in the relaxation process causes the anomalous transport of energy and particles. However, of transport phenomena in the steady state RFP without dynamo effect, the energy confinement time τ_E might be determined by anomalous transport due to micro-instabilities like in tokamaks. Mechanism of the turbulent transport due to micro-instabilities such as ITG modes is not understood well in the RFP.

Recently, linear gyro-kinetic calculations are applied to the RFP configuration to investigate the occurrence of ITG instabilities [3]. This analysis reports ITG modes are in general stable in RFP plasmas in the area of experimental parameters, and required gradients could be reached only in correspondence to the temperature slopes arising at the boundary of the helical structure in QSH states. Numerical calculations in [3], however, are based on geometry and parameters of the present experimental device. Also some geometric simplifications are imposed.

In this study, we focus on the low aspect ratio configuration with shaped magnetic surface and neoclassical effects. It is expected to use the gyro-fluid model for the turbulent transport model. In diffusive transport analysis, we apply TASK code [4] to the RFP configuration. As preliminary calculations of the modified TASK code, equilibrium and transport analyses of the low aspect ratio RFP were performed using the neoclassical and basic turbulent transport models [5]. It is necessary to examine more parameter dependences and also implement other transport models for more detailed analyses.

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