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トカマクにおけるSOL流へのリサイクリングの影響に関する
粒子シミュレーション

Particle Simulation of Recycling Effects on SOL Flow in Tokamak

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Plasma flow in a Scrape-Off Layer (SOL) has importance for particle control in fusion reactors. This flow in the direction of a divertor plate is expected to expel helium ashes and to retain impurities in the diverter region. In the outer SOL region of tokamaks, however, the flow in the opposite direction, from the plate to the outer midplane, has been confirmed experimentally [1]. As for SOL plasma flow, a lot of fluid simulations have been carried out, but hasn't given a full explanation of the mechanism yet. Therefore, kinetic simulation is required to improve the understanding of the physics.

PARASOL (PARticle Advanced simulation for SOL and divertor plasma) is a particle simulation code, and has been extended to two-dimensional (2D) axisymmetric toroidal system [2]. A tokamak plasma is confined in a vessel with rectangular poloidal cross-section. The ratio of upper and lower divertor coil currents affetcts divertor configurations; upper null (UN) and lower null (LN) configuration, as shown in Fig.1. The motion of electrons is approximated by the guiding-center motion while that of ions is fully followed. The electric field is determined self-consistently by the PIC method. The Coulomb collision is implemented by a binary collision model, and the anomalous transport across the magnetic filed is simulated with a Monte-Carlo random-walk model. Ion and electrons with same temperature are supplied from hot and cold particle source, and the former is put in the core region (H) and the latter in the divertor region (C1, C2, C3, C4), as shown in Fig.2.

In this study, the SOL plasma flow including the recycling effect has been studied with PARASOL 2D. The dependence on the ratio and the region of recycling has been examined for the case of UN and LN

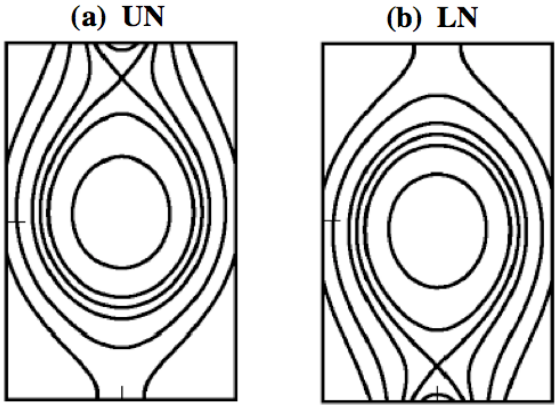

Fig. 1 Magnetic configuration for PARASOL simulation

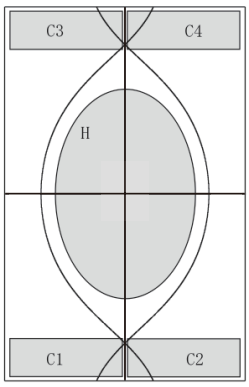

Fig. 2 hot and cold sources

[1] B. LaBombard et al., Nucl. Fusion **44** (2004) 1047
[2] T. Takizuka, T. Hosokawa, the 24th JSPF annual meeting 28aA17P