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# 仮想ダイバータモデルを用いた径方向プラズマ拡散の効果に関する非接触ダイバータプラズマのシミュレーション研究

# Simulation Study of Detached Divertor Plasmas by Using a Virtual Divertor Model Concerning the Effect of Radial Plasma Diffusion

東郷訓[1], 滝塚知典[2], 中村誠[3], 星野一生[3], 伊庭野健造[2], ランティーロン[1], 小川雄一[1]
TOGO Satoshi[1], TAKIZUKA Tomonori[2], NAKAMURA Makoto[3], HOSHINO Kazuo[3], IBANO Kenzo[2], LANG Tee Long[1], OGAWA Yuichi[1]

[1]東大新領域, [2]阪大工, [3]原子力機構
[1]GSFS Univ. Tokyo, [2]GSE Osaka Univ., [3]JAEA

Development of the control method of the detached divertor plasmas is crucial and the physical mechanism of them is studied worldwide. In the simulation studies, they often try to reproduce the behavior of the ion saturation current measured in experiments as a function of the midplane plasma density. Simulation results, however, do not satisfactorily agree with the experimental ones especially for roll-over which means the reduction of the ion saturation current and is the sign of the onset of the detached divertor plasma [1].

As the candidates to reduce the ion saturation currents, radial plasma diffusion is considered to be important in addition to the volume recombination. Simulation studies of Particle-in-Cell (PIC) code with binary collision model showed that supersonic flows can be driven by the strong gradient of plasma density at the private region and indicated that smoother roll-over can be accomplished [2]. The effect of radial plasma diffusion on the roll-over was studied by using a code package [3]. In such code packages, however, flow velocities cannot be self-consistently determined only by the upstream conditions but the Mach number at the sheath entrance in front of the divertor plates is required to be given as a boundary condition.

In our simulation code, by introducing the anisotropic ion temperatures directly into the plasma fluid model, the parallel momentum transport is described by the first-order differential equation so that the flow velocities are determined only by the upstream conditions [4]. In order to model the effects of divertor plate and sheath, we use a virtual divertor model which sets an artificial region beyond the sheath entrance with artificial sinks of particle, momentum and energy [4].

We conducted simulations by setting parameters of medium-size tokamaks. We successfully obtained supersonic flows in no-neutral conditions which agree well with the results of PIC code [2] and the theoretical curves (Fig. 1). With neutrals, we compared the behavior of the particle flux to the divertor plates with radial plasma diffusion to that without it in Fig. 2. By radial plasma diffusion, the high recycling regime appears which is observed in experiments but supersonic flow does not appear. In the presentation, we will discuss these results in detail including the effect of radial heat diffusion.

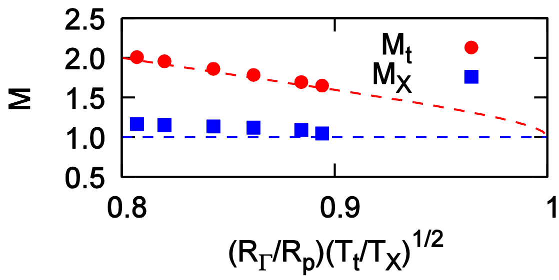


Fig.1 Mach numbers at the sheath entrance $M_t$ (circles) and X-point $M_X$ (squares). The dashed lines are theoretical curves. The notation $R$ is amplification factor for the particle ($\Gamma$) and momentum ($p$) fluxes. The sum of parallel ion temperature and electron temperature is denoted by $T$.

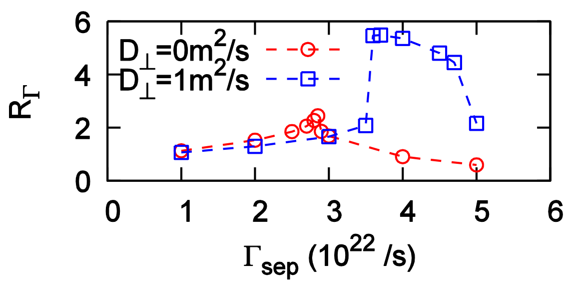


Fig.2 Particle flux amplification factor $R_\Gamma$ as a function of the particle flux from the core plasma $\Gamma_{sep}$ without (circles) and with (squares) the radial plasma diffusion.

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