24aE01P

LHDにおける共鳴摂動磁場の粒子輸送への影響と定常実験への適用

Effects of resonant magnetic perturbation on particle transport and its application for the steady state operation in LHD

田中謙治 [1],笠原寛史 [1],武村勇輝 [1],成嶋吉朗 [1],藤井恵介 [2],後藤基志 [1],秋山毅志 [1],徳沢季彦 [1],
山田一博 [1],安原亮 [1],武藤敬 [1],村岡克紀 [3]

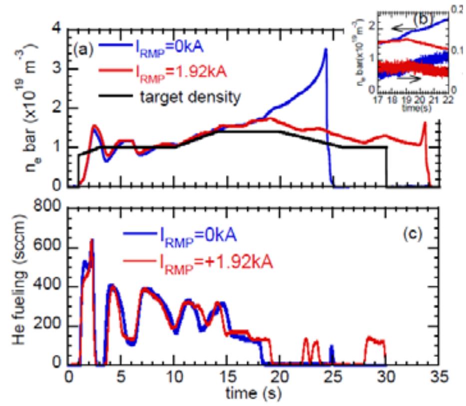
[1] 核融合研, [2] 京大工, [3] プラズワイヤー
[1]NIFS, [2] Kyoto Univ., [3]Plasmawire Co. Ltd

In the Large Helical Device (LHD), the control of the particle transport by using m/n=1/1 resonant magnetic perturbations (RMP) toward steady state operations was successfully demonstrated. Figure 1 shows one example of comparisons of discharge behavior with and without RMP. This plasma was sustained by the combination of ECRH and ICRF. The electron density was attempted to control in order to follow the target density by the feedback control of external gas fueling. Until t=18sec, in both cases, electron density followed the target density. After t=18sec, in the discharge with RMP, density reduced following target signal. However, in the discharge without RMP, density did not reduce and continued to increase. Finally plasma was terminated by the radiation collapse.

In the past study, it is shown that diffusion coefficient (D) at ρ=0.4-1.0 decreases and convection velocity (V) at ρ=0.4-0.7 increases outwardly with increase of the collisionality [1]. Figure 1 suggests that the collisionality dependence is different with and without RMP. In order to understand effects of the RMP on collisionality dependence of D and V, systematic study of density modulation experiments were carried out. The collisionality was scanned by changing NBI heating power.

Figure 2 shows comparison of collisionality dependence of D and V. The scanned region includes collisionality regime of discharges in Fig.1. As shown in Fig.2, D is larger with RMP than without RMP in the most of the collisionality regime. In particular, D (ρ=0.4-0.7) with RMP becomes higher than D (ρ=0.7-1.0) without RMP as collisionality increases. While, V(ρ=0.4-0.7) and V (ρ=0.7-1.0) are more inwardly directed with RMP and at higher collisionality, the difference of V becomes smaller. The observed different characteristics of D and V can cause different controllability with and without RMP.

[1] K. Tanaka et al, Fusion Sci. and Tech. 58, 70 (2010)



Fi.1 Time histories of (a) line averaged densities, (b) their expanded views shown together with respective radiation intensities, (c) helium fueling rates

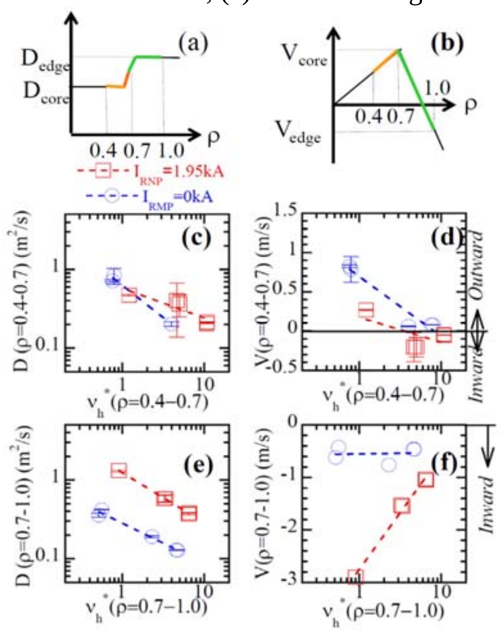


Fig.2 (a) models of D and V (c)-(f) collisionality dependence of D and V. $ν_h^*$=1 is the boundary between 1/ν and plateau regime