§53. Formation of Divertor Configuration and Measurement of Divertor Plasmas on QUEST

Hanada, K., Sato, K.N., Zushi, H., Yoshida, N., Nakamura, K., Sakamoto, M., Idei, H., Hasegawa, M., Ishiguro, M., Liu, H., Tachikawa, H., Yamanaka, S., Yamada, T., Yoshinaga, T., Fujiyoshi, H., Hamamoto, K., Takahashi, H. (Kyushu Univ.),
Mitarai, O. (Tokai Univ.),
Nishino, N. (Hiroshima Univ.),
Maekawa, T., Tanaka, H. (Kyoto Univ.),
Takase, Y., Ejiri, A. (Univ. Tokyo),
Nakashima, Y. (Tsukuba Univ.),
Kikuchi, M. (JAEA),
Yoshinaga, T.

Formation of a single-null divertor configuration and and measurement of the plasmas was successfully obtained on QUEST. The duration of the divertor plasma reached at around 40s.

1. Introduction

Spherical tokamak (ST) is a candidate for cost-effective fusion reactor and the improvement of the plasma performance of ST has been tried in many institutes. It is important to obtain the academic basics to support high beta and steady state operation approaches. The QUEST (Q-shu University Experiment with Steady State Spherical Tokamak) project focuses on the steady state operation of ST which has the capability to attain high β rather than conventional tokamaks. A final target of the project is the steady state operation of ST with relatively high β under controlled plasma wall interaction (PWI).

2. Formation of divertor configuration and its maintenance

On QUEST, a divertor configuration has been successfully obtained, as shown in Fig. 1 The plasma was turned on by RF at 1.4s and then making a limiter configuration at around 2s. A PF4 current increase and a negative increase for PF35 could make an almost double-null divertor configuration. A vertical shift of 40mm was applied from the discharge of a pair of feedback coils (HCU and HCL) to create a horizontal magnetic field; eventually, a lower single null configuration was maintained from 2.8 to 4.0 s. A magnetic reconstruction of the flux surface in this discharge was performed yielding κ=1.5, δ=0.4, A=2.0 as shown in Fig. 2; here κ, δ, and A is elongation, triangularity, and aspect ratio, respectively. During the divertor configuration, we detected a significant variation in ion saturation current profile measured with probe pins aligned along major radius on the top divertor plate. Depending on the configuration, particle and heat fluxes around divertor region were found to have been modified by the arrangement of magnetic field lines.

Duration of the divertor plasmas was limited by out-gassing from outer limiters made of Molybdenum due to direct attack of energetic electrons produced by RF and the plasmas could be maintained for around 40s.

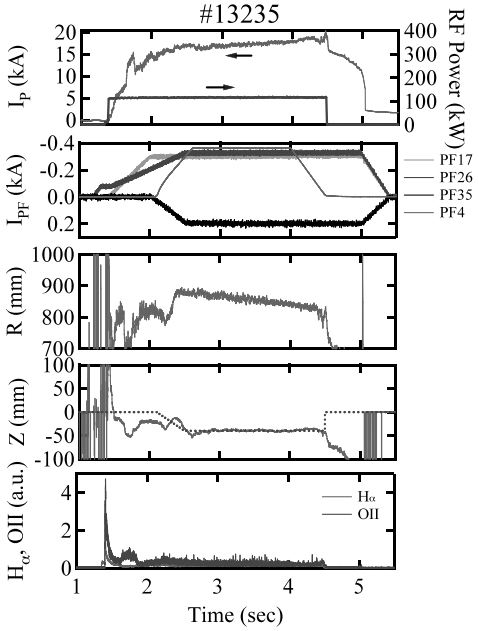

Fig. 1 Typical waveforms in a divertor configuration discharge are plotted. From top to bottom, panels display plasma current and injected RF power; currents applied to PF17, PF26, PF35, PF4 coils [1-3] dial position of the plasma; real vertical position (solid line) and destination (dotted line) of the plasma; and signals of H_α and OII line radiation.

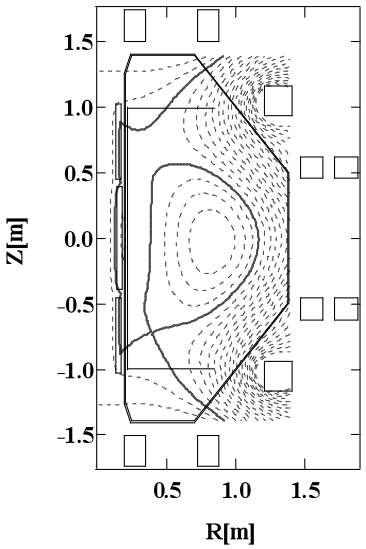

Fig. 2 Reconstructed magnetic surface structure in #13235 at 3.5s. The reconstruction was executed by parabolic current fitting (PCF) methods [1,3]. A lower single null configuration was achieved.

[1] K.Hanada *et al.*, Plasma science and technology, Vol. 13, No.3, pp. 307.
[2] K.Hanada *et al.*, Proc. of 6th IAEA-TM on steady state operation of tokamaks, Vienna, Dec. 6-8, 2010, (2010).
[3] K.Hanada *et al.*, IEEJ, Vol. 132 / No. 7 / Sec. A, pp. 490-498.