§56. Hydrogen Recycling and Neutral Particle and Impurity Behavior in Spherical Torus Plasmas

Nakashima, Y. (PRC, Univ. Tsukuba),
Kobayashi, S. (IAE, Kyoto Univ.),
Sakamoto, M., Zushi, H. (RIAM, Kyushu Univ.),
Yonenaga, R., Hosoi, K., Ozawa, H., Takeda, H.,
Ishii, T. (Graduate School of Pure and Appl. Sci., Univ. Tsukuba,),
Shoji, M.

Investigation of behavior of neutral particle transport is important subject for evaluating particle and energy transport in torus plasmas. In particular, edge plasma – neutral interaction is much interesting subject from the viewpoint of long-lasting and steady state plasma production. QUEST is a medium sized spherical tokamak device whose chamber height is 2.8 m and radius is 1.4 m. The diameter of the CS is 0.4 m. The major (R) and minor radii of the plasma are 0.68 m and 0.4 m, respectively. Eight toroidal field (TF) coils produce the toroidal magnetic field, Bt ~0.25 T at R ~0.64 m. PF coils are used to create the vertical field, Bv. The magnetic field for plasma confinement is optimized by adjusting the TF and PF. The plasma discharge is sustained using hydrogen gas puffing and ECH by 8.2 GHz klystrons.

Figure 1 shows the photograph of the horizontal viewing port of QUEST vacuum chamber and the image fiber system with a medium-speed camera. This system consists of two-branched image fiber, CCD camera (HAS-220, DITECT INC.) and relay lens. The object side of the fiber is separated, which enables to observe the different image of the plasmas simultaneously. The frame speed of the medium-speed camera is 500 fps. An interference filter that transmits 75% of light at wavelengths from 650 nm to 690 nm is attached between the set of relay lens so that only Hα -light (656.3 nm) can be observed in the plasma. The camera is connected to a PC in the QUEST machine room. Two-dimensional images are captured during the QUEST experiment just after the PC in the machine room receives a trigger signal, which is synchronized with the start-up of the coil current. The time evolution of the light-emission from the QUEST plasma has been captured with the above camera system. Two-dimensional image of light–emission was measured mainly in RF produced plasmas.

In order to develop a transport analysis of neutrals and impurities, a standard configuration of plasma surface and plasma parameters are well clarified. Fig.2 shows the example of magnetic surface calculated in QUEST. In this model, the plasma is in the condition just before obtaining a divertor configuration.

We are preparing the application of the DEGAS code to QUEST in order to investigate the behavior of neutrals in the spherical torus plasma. Figure 3 shows a example of the mesh model. In this design, the shape of the plasma is simply modeled as a torus with the circular cross-section. After determination of optimized magnetic flux surface, detailed mesh structure will be made and the simulation analyses will be started.

1) H. Zushi, et al. 22th IAEA Fusion Energy Conf. EX/P4-12 (13-18 October 2008, Geneva, Switzerland).
2) Y. Higashizono et al. Proc. 7th General Scientific Assembly of the Asia Plasma and Fusion Association, (October 27-30 2009,Aomori, Japan).

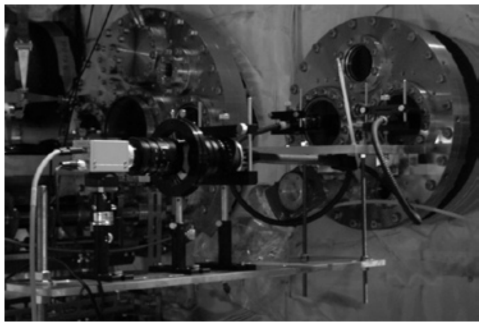

Fig. 1 Photograph of the medium-speed camera and imaging fiber system.

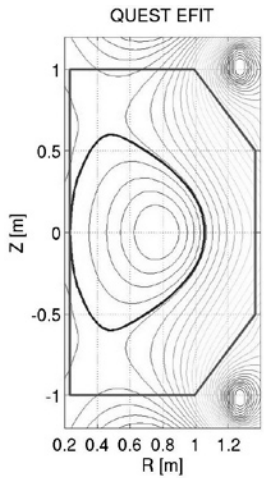

Fig. 2 Example of magnetic surface of QUEST

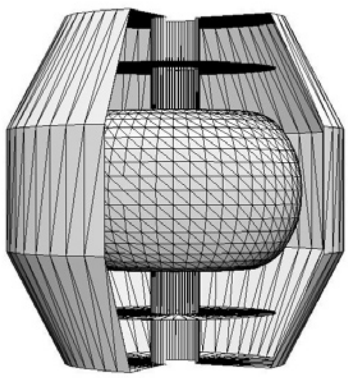

Fig. 3 Mesh model of the QUEST vacuum chamber and plasma for the DEGAS code.