§46. QUEST Plasma Measurement Using a Fast Video Camera

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QUEST is a medium sized spherical tokamak, of which mission is to study issues related to steady-state operation. It has a major radius of R = 0.68 m, minor radius of a = 0.40 m, diameters of the center stack and the outer wall of ~ 0.2 m and ~ 1.4 m, respectively and flat divertor plates at the vertical distance from the midplane, $Z = \pm$ 1 m. Microwave systems (8.2GHz, < 400 kW, and 2.45GHz, <50 kW) were prepared for plasma heating [1]. Figure 1 shows the top view of QUEST machine and the location of the fast camera (FX K5, NAC image technology).

Using a fast camera the filamentary structure was found in open magnetic field with RF heating [2,3]. This experiment is for current drive by RF. Therefore, it is very interesting to investigate that this filamentary structure was the same observed by other experimental machine such as NSTX, DIIID, Heliotron J, LHD, TJII, etc [e.g. 4]. For the present this phenomena in QUEST open field was termed as the blob-like structure. Figure 2 shows typical blob-like structure. The red-blue colored images are used to see the brightness easily by eyes.

Changing the poloidal magnetic field we confirmed the blob-like structure is along the magnetic field line (see Fig.2 upper column and lower column). In the simultaneous measurement with Langmuir probe the ion saturation current increased with the light emission of the probe location in the images. This result was the same as that of Heliotron J plasmas.

Also, ExB drift velocity calculated by the measured potential difference and the velocity of the bright region from the image was almost same value. Therefore, apart from the plasma production area the blob-like structure should be moved by ExB drift. In the plasma production area the probe measurement was difficult because of meltdown of probe tips. This is future problem to solve.

According to Nishino model [5] the filament structure was generated by perturbation of current density, which caused non-uniform heating on the magnetic field line. This model account for Ip energy confinement scaling. If the poloidal magnetic field was perturbed by PFC current perturbation, the perturbation of the vertical magnetic field was generated, and this perturbation produce toroidal current density. Therefore, the blob-like structure may be created by this toroidal current density. To confirm this interpretation we will plan to have experiments under various magnetic field condition and/or heating method.

In conclusion, the fast camera was very powerful tool to visualize and investigate the phenomena on the motion of the bright region in plasma even the magnetic field is open. Also, we are trying to see the fast plasma-wall interaction in QUEST.

1) Hanada, K. et al., Plasma and Fusion Res. **5** (2010) S1007
2) H. Q. Liu *et al.*, ITC19 Plasma and Fusion Research Special Issue (to be published).
3) H. Q. Liu *et al.*, the 7th APFA/APPTC Special Issue (JPFR Series) (to be published).
4) S. J. Zweben *et al.*, Nucl. Fusion **44**, (2004) 134
5) N. Nishino, Nucl. Fusion **46** (2006) S658

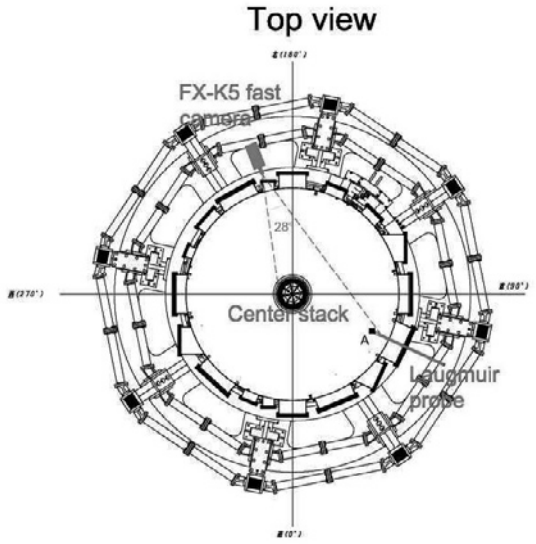

Fig.1 Top view of QUEST and camera location

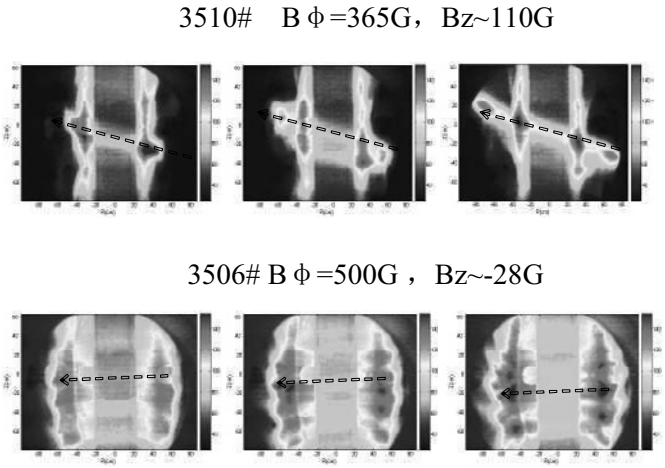

Fig. 2 Behavior of the blob-like structure
The projection angles of the blob-like structure in the images are parallel to the magnetic field line.