§ 21. High-speed Two-dimensional Spectroscopy of Divertor Plasma

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Camera system

Fast cameras are used at many fusion experimental devices. They are very useful to take the images of the light emissions from plasma periphery and to monitor plasma behavior. In LHD, Fastcam ultima-SE (Photron inc.) is used for high-speed two-dimensional imager and fast monitor. The measurement system is easy to install and take off. To avoid the electro-magnetic noise and the magnetic effect of coils, the system consist of three parts: a camera head, a controller and a personal computer.

Results and discussions

Figures 1(a) and (b) show the images of a gas puff jet injection (w/o pellet injection, #39937, #40048) from upper port (7.5-U): fast camera was installed at lower port (7.5-L). This gas puff system (super sonic molecular beam source) was described in Annual report of NIFS [p82] last year. In Fig. 1, the patterns of Hα emissions by gas puffing fluctuated while the gas flow was almost steady state. However, we cannot identify these fluctuations are true plasma fluctuations near the edge or the fluctuations of gas flow due to the mechanical structure of gas puff system. Typical fluctuation frequency was shorter than the frames interval in measure (22μsec). These patterns are similar to be that of neutral gas flow. Moreover, the difference between Fig.1 and 2 is that Hα emissions profile. This indicates the gas flow patterns were changed by some reasons. When the gas fuelling was large, many filaments were seen clearly. The filaments are thought to be truly plasma fluctuations, however, it cannot be distinguished the intrinsic plasma fluctuation and the fluctuation induced by gas puffing now. From these images the neutral gas seems to affect the MHD activity of the peripheral plasma, however the mechanics are not fully understood. Usually the filaments are not seen clearly in LHD plasma. It is because the neutral gas pressure is low at plasma periphery. The results suggest the GPI (gas puff image) experiments are likely to measure the filaments and the fluctuation of the plasma edge.

Summary and next step

The gas puff jet injections into LHD plasma were measured successfully by this fast camera. Also, Hα filaments and/or fluctuations near the divertor region are observed at gas puff jet injection and/or pellet injection shots. The fuelling mechanism is one of the important problems to achieve nuclear fusion. We are developing MHD simulation code included in neutral gas effects to solve these phenomena very soon.

Upgrade plan of the remote camera system

Remote iris and focus system using ultrasonic motors (Olympus inc.) are developing to set the camera status for various plasma conditions.

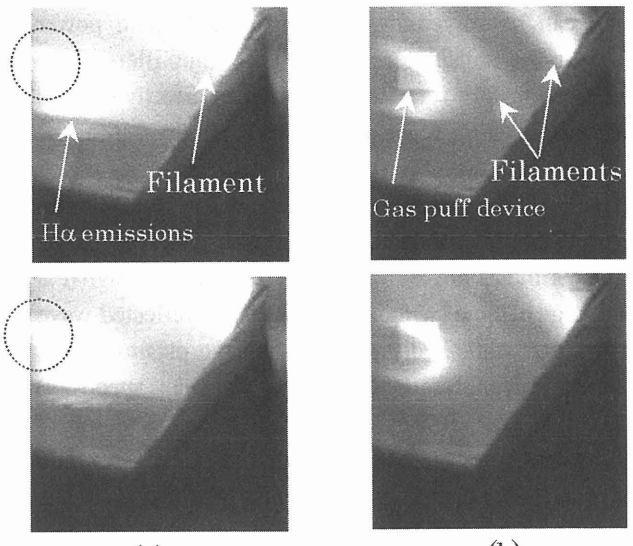

Fig.1 Hα emissions due to gas puff jet injection, (a) #39937 and (b) #40048. The white square on the upper left was gas puff device. There are quite difference of Hα emissions profiles.
(a) the fluctuation can be seen in a dashed line circle.
(b) Hα emission profile looks like a circle.
Timing of each figure: (a) upper 1.792519sec, lower 1.792667sec, (b) upper 0.662222sec, lower 0.66237sec