§38. Observation of Low Mode Number MHD Activities by the Tangentially Viewing 2D VUV Camera on LHD

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In LHD, resistive/ideal interchange modes are unstable due to the existence of a magnetic hill in the peripheral region in the high beta plasma [1]. Spatial structures of the interchange modes are studied by a tangentially viewing 2D imaging system in order to understand the mechanism of the enhanced transport by the MHD instabilities.

A high speed vacuum ultraviolet (VUV) telescope system has been developed to investigate the edge MHD activities in the Large Helical Device (LHD) [2]. This diagnostic has been transferred from the perpendicular port (10-O) to the tangential port (6T) in 2010. A Zr filter, which can cut off the visible and low energy VUV photons, has been installed in front of the MCP. The framing rate of the camera can be up to 10k frames per second in 128×128 pixels. However, the frame rate of the camera is limited below 2k frames/s so far, because the total amount of the photon which enters the camera is small. The spatial resolution of this telescope system is about 2.5 cm and its focal length is about 7 m. The viewing filed of the camera at 6T port is shown in Fig. 1.

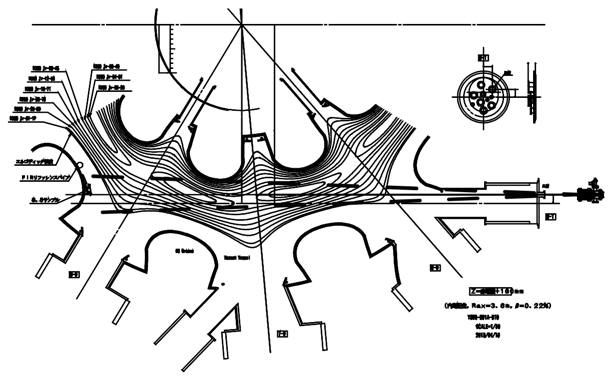

Fig. 1 Dashed lines indicate the viewing field of the tangentially viewing VUV telescope system.

MHD activities with low frequency (750 Hz) are triggered with the decrease of the heating power due to the breaking of the NBI. This activity is caught by the VUV camera system (Fig. 2). The line integrated density, the impurity emission of CIV and CVI increase together with the edge fluctuation is excited. Tangential images with MHD activity are decomposed by the SVD method; the first three spatial components (U0~U2) are shown in Fig. 3. The static component (U0) are similar with a simulated image with a profile peaked both in the center and the edge region; the emission region is suitable for the detection of the m/n =1/1 modes. Two oscillating image (U1 and U2) are compared with the image having a mode structure localized at the 1/q = 1 rational surface. When the parameters, e.g., the location, the width and the phase of the modes, are optimized, the measured image is quite similar to the simulated image. Spatial structure of the edge MHD mode is thus directly measured with this system.

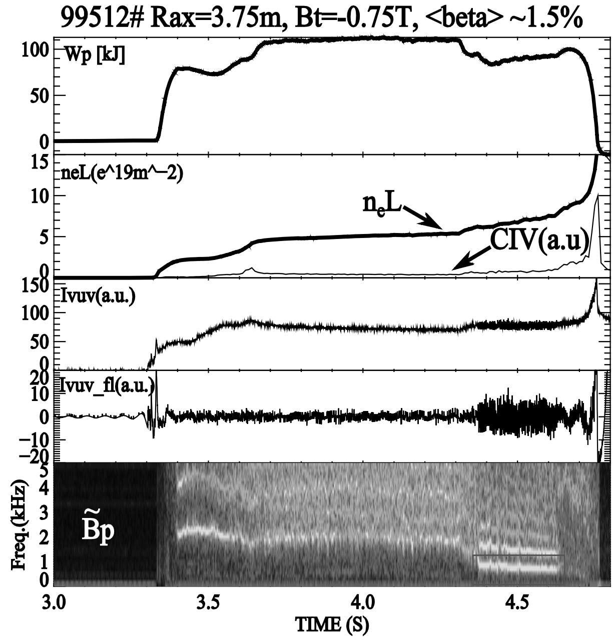

Fig. 2 Time evolutions of the plasma parameter and the impurity emission. Large amplitude fluctuations are observed by the VUV camera

We will investigate the deformation of the edge MHD mode by the externally applied magnetic field. Also, in order to study the fluctuations with a higher frequency, upgrade of the telescope system having larger mirrors is being prepared.

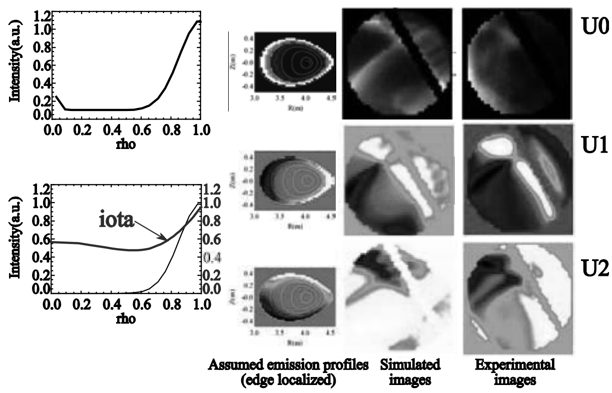

Fig. 3 Comparison between simulated images and experimental images

1) K.Y. Watanabe. et al, Nucl. Fusion 45 (2005) 1247.
2) M. Takeuchi. et al, Plasma Fusion Res. 5 (2010) S1037.