1st Asia-Pacific Conference on Plasma Physics, 18-23, 09.2017, Chengdu, China

Observation of hollow SXR emissivity distribution in a low-*A* RFP

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The measurements of bremsstrahlung soft X-ray (SXR) radiation are useful passive methods for diagnosing high-temperature plasmas, because these emissivity distributions correspond to plasma density, temperature and impurities. Therefore, these measurements are often adopted for studies of both equilibrium and fluctuation structures in combination with computer tomography (CT) techniques. Tangential SXR imaging has been applied to high-temperature toroidal plasma experiments for the study of fluctuations either in the core or at the edge [1]. Moreover, fast successive imaging measurement has been a useful tool to understand many aspects of plasma research involving dynamic plasma formation processes, plasma equilibrium, magnetic reconnection, or plasma instabilities [2]. Two-dimensional (2-D) high-speed SXR imaging diagnostics were developed to identify the emission structures associated with MHD instabilities and impurities in an reversed field pinch (RFP) [3].

The RFP is one of the magnetic confinement systems of torus. In a low-aspect-ratio (low-*A*) RFP machine RELAX [4] (R = 0.51 m/a = 0.25 m (A = 2)), operational regimes have been investigated over a wide range of discharge parameters [5]. In deep reversal discharge (F ~ -1.5), oscillated plasma current like as discrete relaxation events has been observed. In such oscillated discharge, hollow SXR emissivity distribution has been observed with a high-speed tangential SXR camera. The experimental set-up of the tangential SXR camera in RELAX is shown in Fig. 1. Figure 2 (a) shows hollow SXR emissivity distribution obtained with tangential SXR camera. SXR images blink with 20kHz, this oscillation seems to synchronize with plasma current oscillation. Such oscillating hollow image is observed not only in SXR but also in visible light. If we assume light source distribution around the m=0 surface, calculated image agree with experimental image shown as Fig. 2 (b).

There are two possible hypotheses about the appearance of the hollow structure of SXR image. One is a heating by poloidal current sheet due to dynamo event. In deep reversal discharge, discrete relaxation events causes poloidal current sheet around the m=0 surface [6]. The other one is impurity influx from wall. Periodically changing equilibrium due to discrete relaxation events may enhance a plasma-wall interaction and impurity influx. Detailed analyses will be presented.

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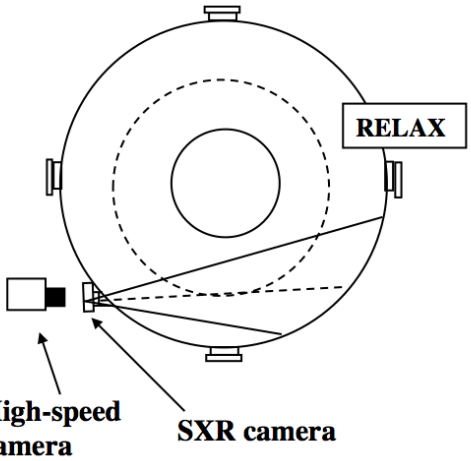

Figure 1 : Schematic of experimental set-up of the tangential SXR camera in RELAX.

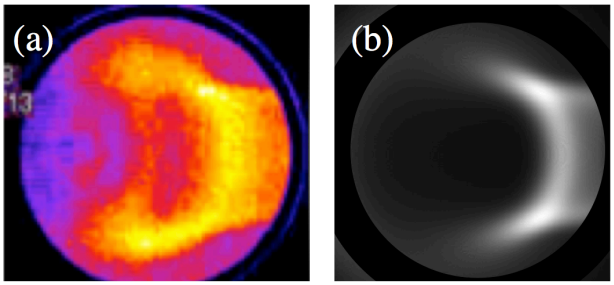

Figure 2 : (a) Hollow SXR distribution experimentally obtained with tangential SXR camera. (b) Calculated image under assuming light source distribution around the m=0 surface.