The measurement of bremsstrahlung soft X-ray (SXR) radiation is one of the useful passive methods for diagnosing high-temperature plasmas, because contours of the SXR emissivity correspond to magnetic surfaces of the plasmas. Tangential SXR imaging has been applied to high-temperature toroidal plasma experiments for the study of pressure fluctuations either in the core or at the edge\textsuperscript{1).} The reversed field pinch (RFP) is a high-temperature and high-beta toroidal plasma. In the RFP, studies on the behavior of magnetic islands due to the tearing modes are quite important, because the RFP configuration is self-organized and sustained by nonlinear interaction of the tearing modes, which lead to magnetic chaos. One of the important issues of this study is the development of three dimensional (3-D) SXR measurement system, which will be applied for physics study on 3-D helical equilibrium on LHD.

Consecutive imaging measurement has been a useful tool for understanding the plasma dynamics and instabilities. We are therefore developing an SXR imaging system consisting of a SXR pin-hole camera and a high-speed CMOS camera (Photoron FASTCAM SA-4 500K-M1AS) for the study of time evolution of 3-D structure. A schematic drawing of the developing imaging system is illustrated in Fig. 1. Plural unit is located tangential view of the plasma to have a view of nearly the entire plasma diameter and most of the vertical extent of the plasma. This SXR imaging system utilizes a microchannel plate (MCP) to record a higher-resolution distribution of two-dimensional (2-D) luminosity on a phosphor plate. The projected images strongly depend on the equilibrium magnetic field. As the $A$ of RFP is lowered, the safety factor $q$ on axis increases and $n$ of dominant internally resonant mode is to be lower. In this sense, the core of a low-$A$ RFP is favorable for this kind of tangential measurement.

In a low-$A$ RFP machine RELAX\textsuperscript{2),} ($R = 0.51 \, \text{m} / a = 0.25 \, \text{m} (A = 2)$), a quasi-periodic transition to quasi-single helicity (QSH) state has been observed\textsuperscript{3).} In this experiment, we have taken a series of tangential images of the plasma with 10 $\mu$ sec time intervals, to identify time evolution of SXR emissivity structure in the QSH state in RELAX. 2-D luminosity distributions corresponding to integrated SXR emissivity are measured with the high-speed camera with $320 \times 192$ pixels array and 12-bit of dynamic range. Raw images of SXR emission contain both the equilibrium and fluctuating component. To clearly illustrate the fluctuating component, we have applied the subtraction technique; we have obtained differential signals of two consecutive images. Figure 2 shows an example of the results. A simple helical structure has been observed clearly in the central part of the tangential viewing area. An equilibrium reconstruction has shown that the minor radial location of the $m=1/n=4$ resonant surface is consistent with the experimental observation; The simple helix is located at $0.10-0.14$ m in a poloidal cross-section.

We successfully obtained time evolution of SXR images from tangential port.

Fig. 1: Arrangement of the SXR pin-hole camera and the high-speed camera. Solid lines and a dashed line represent the limits of the visual field and the line sight of the center of the visual field, respectively.

Fig. 2: Above two images are raw data. Below one is a result of subtraction.