

§2. Developing of 3D Tomography Method with Multiple IRVB in LHD

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An IR imaging video bolometer (IRVB) is a powerful measurement instrument for 2D radiation profile measurement with a pin-hole projection principle. Four IRVBs are installed on LHD to measure the radiation. Figure 1 shows the installation locations for IRVBs on LHD. However, radiation phenomena mainly occur in the plasma edge region which has a 3 dimensional structure on heliotron devices such as LHD. 3D measurements which are planned in LHD using installed IRVBs and tomography techniques are necessary to understand radiation phenomena clearly. The topics listed below were studied in the last year.

1. Adjustment of each IRVB field of view using geometry matrices:

The tomography technique requires information from all plasma-voxels which are defined in the LHD plasma to reconstruct the 3 dimensional plasma radiation distributions with high accuracy from the 2D output of the IRVBs. With the previous fields of view of the IRVBs on LHD, many plasma-voxels could not be measured by any IRVBs. We adjusted the position of each IRVB to see all plasma-voxels by any of the IRVBs using the calculated geometry matrices which are the projection matrices to the detector of the IRVB from the plasma radiation region. By improving the fields of view, the 3 dimensional plasma radiation distributions will be reconstructed with higher accuracy.

2. Developing 3D visualization software using geometry matrices:

A visualization method to plot the 3 dimensional radiation structure and fields of view is also necessary for the 3D measurement. We developed a visualization program which provides 3 dimensional structures as a 3D CAD image. By this 3D CAD image, the turn of the sight line by periodic symmetry, which was assumed in the tomography technique, was investigated. Figure 2 shows the turn of the sight line for the IRVB channel. Blocking of the sight line by the LHD wall for each IRVB channels was also investigated.

3. Investigation of practical issues for 3D tomography calculation:

The 3D measurement has three candidates for the tomography technique. The first and second are ART and SIRT. These methods, which are linear calculation methods are powerful on an underdetermined system. The other one which is a non linear calculation method is called Hopfield. In the 3D measurement using a tomography technique, installation accuracy of the IRVB and computer resources are important in practice. We worked out the influence of the installation error on the reconstruction accuracy and the calculation capability on

our computer resources with the three candidates for the tomography technique.

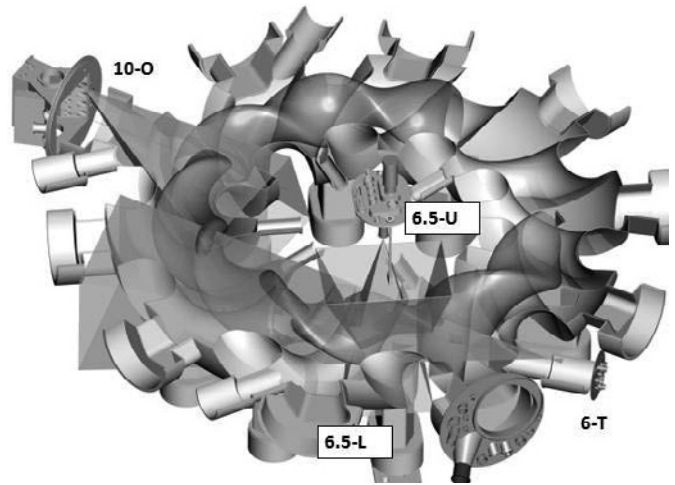


Figure 1 3D-CAD image of Installation locations for IRVBs on LHD

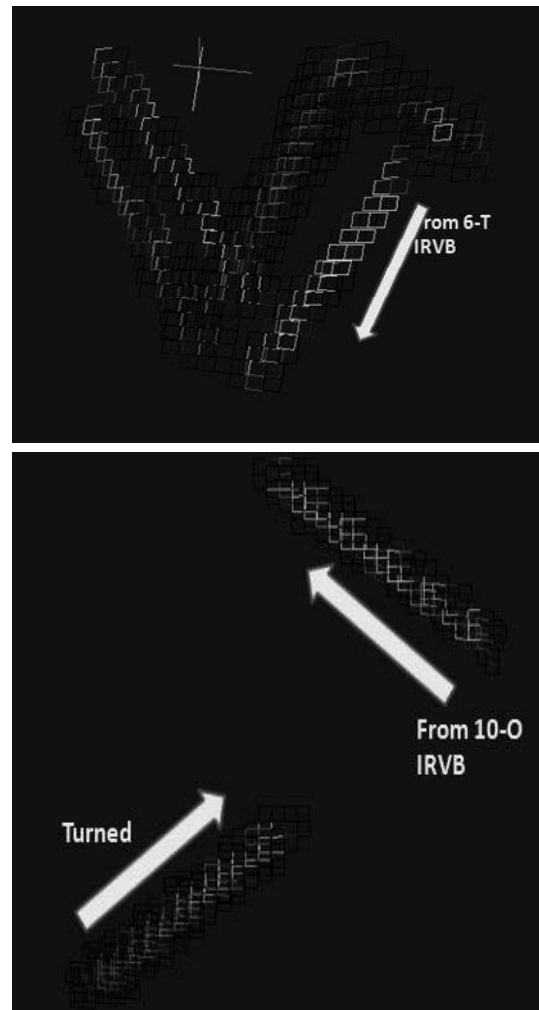


Figure 2 Visualized sight line of a channel of 6-T(upper) and 10-O(lower) IRVB on a field period (0-18degree).