§13. Comparison of Synthetic and Bolometric Images in LHD

Peterson, B.J., Kobayashi, M., Mukai, K.,
Drapiko, E.A. (Kurchatov Inst., Moscow, Russia),
Pandya, S.N., Sano, R. (Grad. Univ. Advanced Studies)

The imaging bolometer (IRVB) has been developed to study impurity radiation in LHD [1, 2]. This diagnostic is based a large (7 cm x 9 cm), thin (2.5 μm) Pt foil mounted in a frame which from its front side absorbs plasma radiation collimated by a pinhole camera. The temperature rise of the foil due to the absorbed radiation is measured from the back side by an IR camera which views the foil through a vacuum IR window from outside the vacuum vessel. By solving the two-dimensional (2D) heat diffusion equation on the foil the radiated power on the foil is calculated. In this way this diagnostic provides an image of the plasma radiation which can be compared with the results of the EMC3-EIRENE impurity transport model [3, 4].

This comparison is made by using a synthetic diagnostic. The synthetic diagnostic takes the three-dimensional carbon radiation intensity from the edge plasma calculated by EMC3-EIRENE and transforms it using the geometry matrix, T_{ij}, to the image corresponding to the IRVB image according to Equation 1.

$$P_i = \sum_j \frac{\Omega_{ij}}{4\pi} V_{ij} S_j = \sum_j T_{ij} S_j \qquad (1)$$

where P_i is the radiation measured by the ith IRVB detector, Ω_{ij} is the solid angle of the ith detector with respect to the jth plasma subvolume, V_{ij} is the intersecting volume between the field of view of the ith detector and the jth plasma subvolume and S_j is the radiation power density from the jth plasma subvolume as calculated by EMC3-EIRENE, Then the synthetic image and the bolometer image can be directly compared.

In Figure 1 a computer aided drawing (CAD) of the field of view of the IRVB at port 10-O of LHD is shown. This IRVB has a semi-tangetial view looking towards the 9-I port. In Figure 2 the corresponding synthetic image for the IRVB at the 10-O port is shown which is derived from the radiated power density from carbon as calculated with EMC3-EIRENE. In Figure 3 the corresponding IRVB data is shown. The helical divertor x-point trajectories are shown in Figures 2 and 3 in light blue. Comparison of the IRVB and synthetic images shows similar features.

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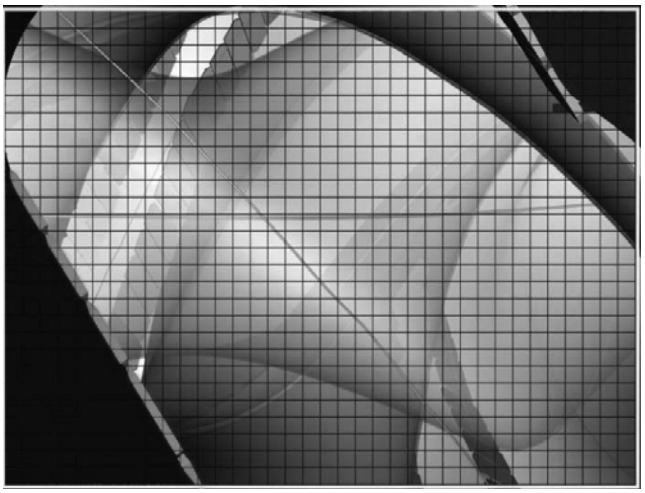

Fig. 1: CAD of FoV of IRVB at port 10-O in LHD.

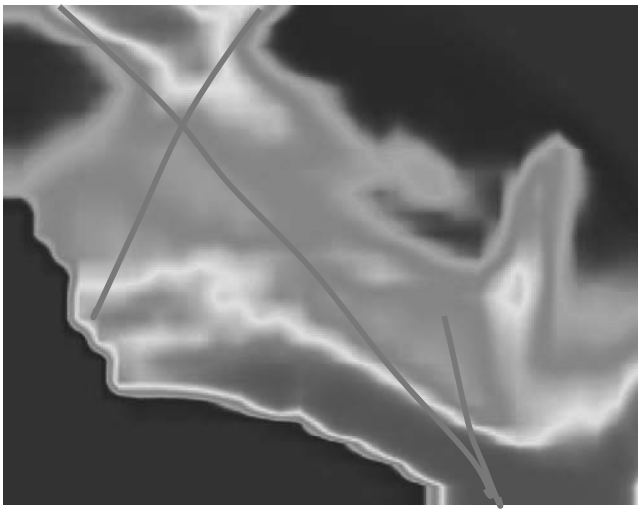

Fig. 2: Synthetic image of radiated power at LHD port 10-O IRVB derived from results of EMC-3 EIRENE code for island assisted detached plasma in LHD.

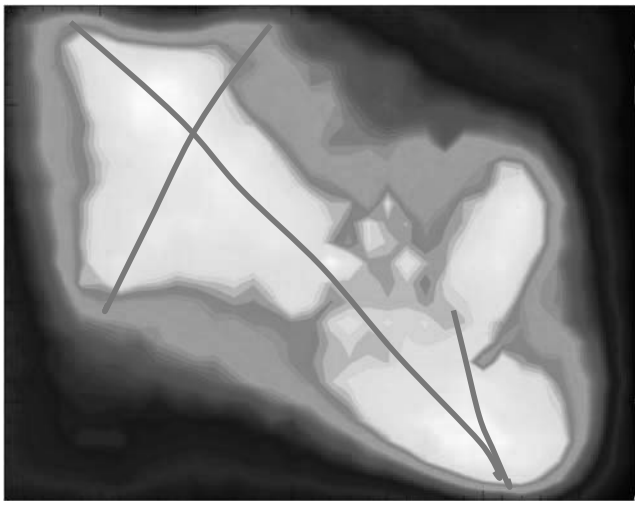

Fig. 3: Bolometric image of radiated power at LHD port 10-O IRVB during island assisted detached plasma in LHD.