

S9. Infrared Imaging Video Bolometer with a Tangential View for LHD

Peterson, B.J., Ashikawa, N., Osakabe, M., Sudo, S.

A new type of imaging bolometer called the Infrared Imaging Video Bolometer (IRVB) has been developed, designed, installed in LHD and successfully operated during the third experimental campaign. This concept utilizes infrared imaging to measure the foil temperature as in the segmented mask infrared imaging bolometer (SIB)[1,2] but replaces the segmented foil mask with a single large foil in a frame as shown in Fig. 1 [3]. Using a numerical

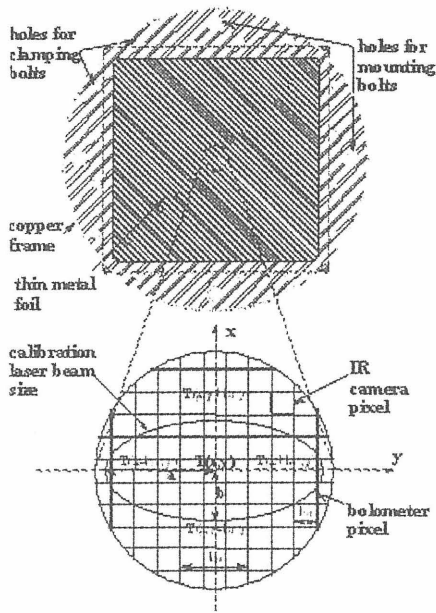


Fig. 1 Drawing of foil in frame construction of IRVB with detail of emissivity analysis geometry.

algorithm to solve for the diffusive contribution to the signal, the radiated power distribution on the foil is given by the temperature distribution evolution (with time step Δt) of the foil, the foil thickness, t_f , and the thermal characteristics (conductivity, k , and diffusivity, κ) of the foil using Eq. 1.

$$P_{rad}(x, y, t) = t_f k l^2 \left\{ \frac{[T(x, y, t) - T(x, y, t - \Delta t)] / \kappa \Delta t + [4T(x, y) - T(x, y + l) - T(x, y - l) - T(x + l, y) - T(x - l, y)]}{l} \right\} \quad (1)$$

This technique improves on the thermal sensitivity of the diagnostic by a factor of 5 compared to the SIB and also provides experimental flexibility by allowing the number of pixels to be varied depending on the

signal strength of the data.

A prototype of this diagnostic was constructed and installed in LHD at tangential port 6-T with a field of view as shown in Fig. 2. This diagnostic uses a 66 mm high by 90 mm wide by 0.001 mm thick gold foil for the detector.

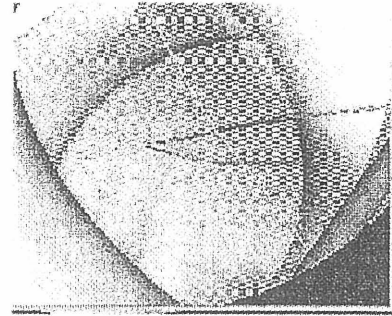


Fig. 2 CAD drawing of tangential field of view of IRVB from Port 6-T.

The gold foil is blackened on the IR camera side in order to increase the IR emissivity of the foil. Measurements were made in the 3rd experimental campaign during discharges using the inboard wall as a limiter which show the radiation localized near the scrape off location indicating high wall surface interaction as seen in Fig. 3.

References

- [1] G.A. Wurden, et al., Rev. Sci. Instrum. **68** (1997) 766.
- [2] G.A. Wurden, et al., Rev. Sci. Instrum. **70** (1999) 255.
- [3] B. J. Peterson, Submitted to Rev. Sci. Instrum.

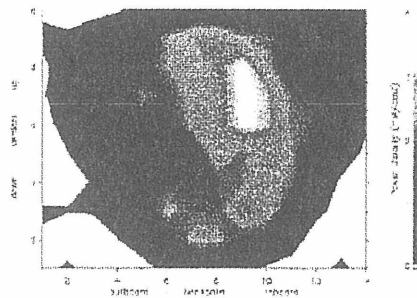


Fig. 3 Two dimensional emissivity profile from Port 6-T IRVB during wall scrape off discharge.