§ 12. Sensitivity and Calibration of LHD IRVBs

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In recent years a new type of imaging bolometer known as the Infrared Imaging Video Bolometer (IRVB) has been under development at NIFS which uses an IR camera to measure the temperature of a thin foil exposed to radiation from the plasma [1,2]. Recently a calibration technique has been developed which permits characterization of the local thermal properties of the foil [2]. Also as part of this work an expression for the noise equivalent power was derived, which is given in simplified form as:

$$\eta_{IRVB} = \frac{\sqrt{10}kt_f\sigma_{IR}}{\sqrt{N}}\sqrt{1 + \frac{A^2}{5\kappa^2\Delta t_{IR}^2}} \quad (1)$$

in terms of the thermal diffusivity, κ, the thermal conductivity, k, and the thickness of the foil, t_f, the area of the bolometer pixel, A, the temperature the error in the IR camera measurement, σ_{IR}, the time resolution of the IR camera, Δt_{IR}, and the number of IR pixels per bolometer pixel, N. Three IRVBs have been installed in LHD as shown in Fig. 1 and whose parameters are listed in Table1.

References

[1] Peterson, B.J., *Rev. Sci. Instrum.* **71** (2000) 3696, Japan Patent # 3390913 (2003).
[2] Peterson, B. J. et al., *Rev. Sci. Instrum.* **74** (2003) 2040.

Device /Port	IR Camera		IRVB						Signal level, S (mW/cm²)	SA/ η
	Make/ Model	σ (mK)	Slit/ pixel size A (mm²)	Foil Metal/ t_f (μm)	E_{ph}[4] (keV)	Δt (ms)	Ch # ($N^{0.5}$)	η/A (μW/ cm²)		
LHD/ 6T	AGEMA /THV900	120	8 x 8/ 7 x 7	Au/ 1	<5.6	67	11x7 (10)	70	0.5-5	8-80
LHD/ 6.5U	FLIR/ SC500	150	20x24 /8 x 8	Au/ 1	<5.6	17	9 x 9 (8)	400	5-50	12-120
LHD/ 5O	FLIR/ SC500	120	8 x 8/ 7 x 7	Au/ 1	<5.6	17	11x11 (14)	180	2-20	11-110

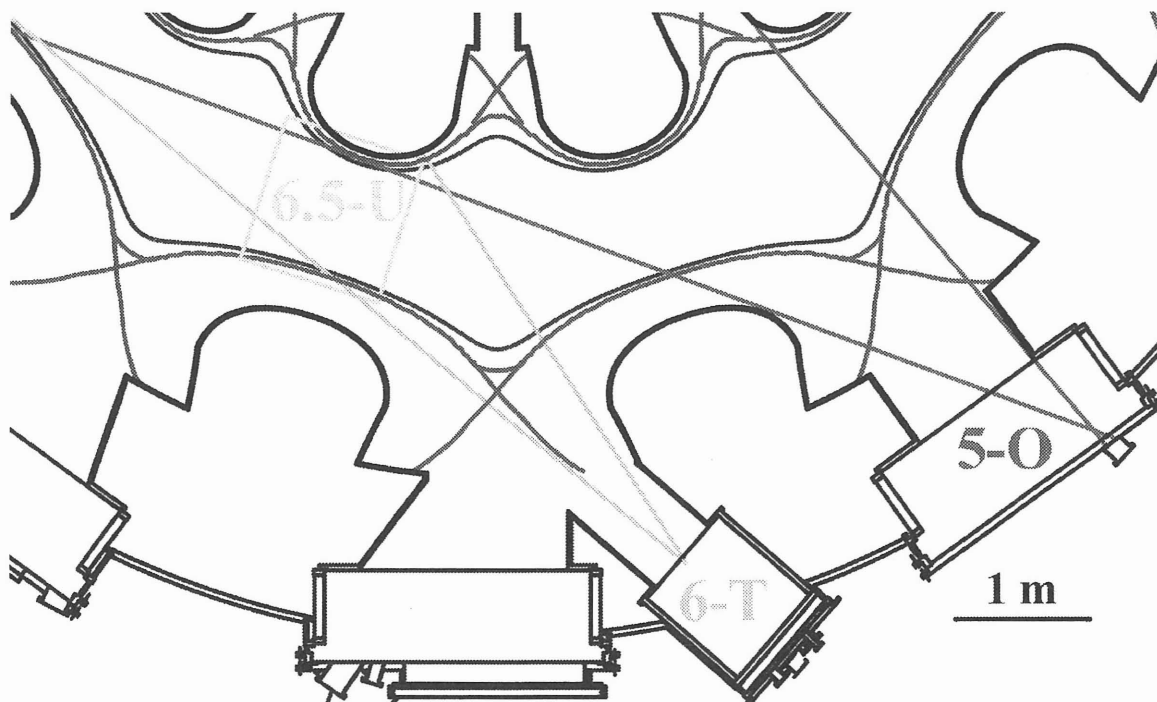Table 1. Parameters for IRVBs installed in LHD.

Fig. 1. Top view of LHD at mid-plane showing fields of view for three imaging bolometers (top view, tangential view and semi-tangential view) with last closed flux surface and ergodic edge.