

Design and Calibration of a Resistive Bolometer Array for KSTAR

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As part the Japan-Korea cooperation program in magnetic fusion research, bolometer diagnostics are being developed for the KSTAR experiment as a collaboration between the National Institute for Fusion Science and the National Fusion Research Center (Rep. of Korea). This collaboration involves the development of both resistive bolometer arrays and InfraRed imaging Video Bolometers (IRVB) for the KSTAR experiment. The resistive bolometers are expected to be installed in 2008 in preparation for the second experimental campaign on KSTAR.

The resistive bolometer arrays consist of 12 channels of gold foil (4 microns) resistive bolometers with kapton insulating layers 1. The 12 channel array consists of 3 bolometer heads with 4 channels per head as shown in Figure 1.

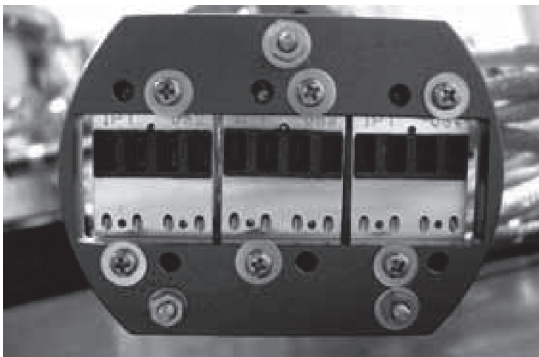


Figure 1. Photograph of 12 channel resistive bolometer array..

The resistive bolometers operate with a bridge circuit consisting of 4 resistive grids, two measuring and two reference grids. The power absorbed by the bolometer, P_{rad} , is given by the equation

$$P_{rad} = \frac{1}{K} \left(\tau_c \frac{\partial V_b}{\partial t} + V_b \right) \quad (1)$$

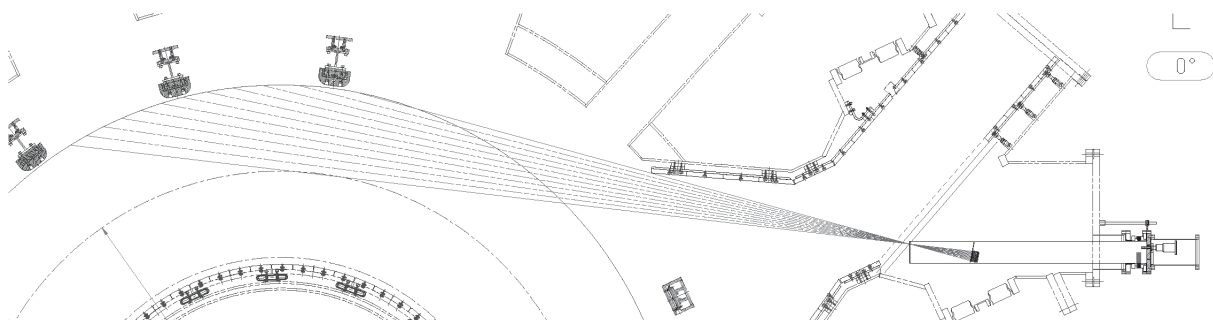


Figure 2. Position of resistive bolometer arrays and viewing chords (green) in drawing of top view of KSTAR at mid-plane.

where V_b is the bolometer bridge voltage, K is the sensitivity and τ_c is the cooling time. Calibration experiments were carried out in a test vacuum chamber at NIFS. By using a chopped helium neon laser as a known radiated power source the calibration coefficients K and τ_c are determined for each channel as shown in Table 1.

IPT 52	ch1	ch2	ch3	ch4
τ [ms]	160.70	159.23	154.82	152.06
K [V/W]	9.76	10.33	10.28	9.93
IPT 53	ch1	ch2	ch3	ch4
τ [ms]	148.19	151.27	149.34	150.37
K [V/W]	10.01	9.64	9.64	9.55
IPT 54	ch1	ch2	ch3	ch4
τ [ms]	149.43	153.28	157.64	157.85
K [V/W]	10.05	10.20	10.44	10.36

Table 1. Calibration results for 12 channel resistive bolometer array

A design was made for the array using a tangential port as shown in Figure 2. The array views tangentially and fans out in the major radial direction over half of the plasma cross-section. The data will be analyzed using a tomographic inversion to give a radial profile of the radiation power intensity of the circular cross-section plasma by assuming poloidal and toroidal symmetry. The spatial resolution of each viewing chord is 4.5 cm at the toroidal angle of tangency. The detectors are electrically isolated from the machine by a ceramic insulator and are equipped with a pneumatically actuated shutter using a rotary-motion vacuum feedthrough to protect the detectors during glow discharge cleaning.

Acknowledgement

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Reference

- 1) Mast, K. F. et al. : Rev. Sci. Instrum. **62** (1991) 744.