

Upgraded Bolometer System on JET for Improved Radiation Measurements

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The radiation pattern is a particularly important quantity in tokamak experiments. On JET it was poorly resolved in space and magnitude in the divertor region where most required. Now two new bolometric cameras with horizontal and vertical views of the main plasma cross-section including the divertor region have been installed, providing a substantial upgrade in capabilities: more viewing chords, higher energy range, higher sensitivity, lower noise and therefore lower detectable signals. Both cameras collect the radiation along 24 chords, 8 of which in each case pass through the divertor region with 8 cm separation between the chords. In addition, three new divertor bolometers with 12 lines-of-sight in total, optimised views and other improvements have been installed.

The detectors are miniaturised metal foil detectors, of the same design as those on ASDEX-U: an 0.008mm-thick gold-absorbing layer on a 0.02mm-thick mica substrate and a gold meander on the rear side with a typical resistance of 1.2kOhm. The measured sensitivity of the bolometers varies over 3 -5V/W in the absorption range 2.5eV-8keV with a cooling time constant of about 0.2s. A 40Vpp sinusoidal voltage at 50kHz is applied to each bridge of the bolometer separately and the electronics amplifies the output (up to a factor of 5000) with a maximum bandwidth of 2kHz. The bolometer system is characterised by a low detection limit ($< 0.002\text{mW/cm}^2$) with a bandwidth of 200Hz.

The bolometers are absolutely calibrated regularly in situ using an electrical technique, which is today a standard calibration procedure. Uniquely on JET, in order to verify the electrical calibration, the bolometers were optically irradiated with an absolutely calibrated UV light source coupled with an interference filter at $\lambda=365\text{nm}$. In the wavelength range 200-480nm the absorption coefficient of gold is fairly constant at about 0.62. It was found that for all bolometers the sensitivity measured with the in situ electrical method matches within 7% the result using the light source calibration.

Because of the finite detector bounding aperture sizes, the three-dimensional geometrical properties of the detection systems must be taken into account for two-dimensional tomography. Details of these calculations and the measurements of the detection-system properties will be presented.

Tomographic reconstructions of high density divertor plasmas will be presented to illustrate the capability of the new diagnostic.