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ITER-like wide-angle infrared thermography and visible observation diagnostic using reflective optics

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Control of the Plasma-Wall Interaction during transient events will be a critical issue in ITER. There is increasing concern that disruptions and ELM interactions with the main chamber plasma-facing components in tokamaks could be large enough in ITER to cause material erosion or melting. This is particularly the case with ITER's planned all-Beryllium first wall. Measurements of heat fluxes to the wall during transient events are urgently required in today's large tokamaks in order to anticipate likely problems in ITER
A new infrared thermography diagnostic has been designed [1] and installed in JET during the 2004-2005 Shutdown. This system is a unique ITER-like diagnostic able to provide a wide angle view in the visible and in the infrared range for thermography on the main chamber and divertor. This diagnostic is essential for the analysis of the power and energy fluxes deposition during transient events and for safety operation with real time protection during steady state phase.
The optical components are mainly reflective (aspheric mirrors), being the only kind which can sustain high neutron radiation. The diagnostic is able to measure temperature with a large dynamic range from room temperature up to a maximum temperature of 3000°C. The enhanced dynamic range is achieved by using IR camera working in the 3-5 µm range and with a multi-exposure time. Spatial resolution is about 6mm at a distance of 3m and time resolution of 100µs is achievable by reducing the image size to 128x8 pixels, and by using a 40 MHz pixel clock. The camera is remotely controlled and data transfer is achieved through optical fibre.
Manufacturing process and tests of the optical components, in particular for the aspheric mirrors, will be presented. Quality control and testing procedures for the acceptance criteria will be described and the results will be presented. Mock-up of the internal PFC located at different positions in the JET vessel has been realized and the measurements allowed providing a 3D reconstruction of the infrared images.
First infrared and visible images, mapping the heat load deposition in the divertor and in the main chamber during steady state and transient events will be presented. It will be shown that that the new IR diagnostic is an essential tool in the route of characterising (ELMs, heat flux and power deposition) and developing advanced regime compatible with the constraints imposed by the new wall.
[1] E. Gauthier et al, Proceeding of EPS 2005.