Surface temperature measurement of in-vessel components and its real-time validation

A. Herrmann, B. Sieglin, M. Faitsch, ASDEX Upgrade team

Max-Planck-Institut für Plasmaphysik, Boltzmannstr. 2, D-85748 Garching, Germany

e-mail: albrecht.herrmann@ipp.mpg.de

Systems to measure the temperature of in-vessel components are foreseen with a high priority for ITER. The highest priority is given to systems for machine protection. Other systems are planned for physics investigation. Machine protection is only as good as reliable the supervision systems and the measured data are. Formal requirements of ITER, like spatial and temporal resolution as well as dynamic range and resolution can be considered during the design of the protection system. To consider effects of higher order such as background radiation, target morphology, deposited layers and plasma radiation is more difficult and nearly impossible to consider during the calibration process. Engineering restrictions like surface or interface temperature limits are the driving part for machine protection systems. The range that can be used for machine operation depends on the uncertainties of the temperature measurement. If this is large, the machine limits have to be reduced to avoid operation above the engineering limits.

Assuming a reliable calibration of a system in terms of photon flux for diode based detectors or power for micro-bolometers there are two origins for ‘wrong’ temperature measurements. (i) The measured photon flux is the superposition of temperature signal and a parasitic photon flux due to plasma radiation. The main tool to discriminate between both sources is its wavelength dependence. (ii) The measured photon flux is due to the temperature of the measuring object, but this temperature is not the relevant temperature for machine safety requirements due to surface effects. Here the wavelength dependence and the temporal evolution allow detecting ‘wrong’ temperature measurements.

This paper discusses routes for real-time temperature validation and the underlying effects, considering the experiences from ASDEX Upgrade.