Determination of surface temperature distributions from spectrally resolved luminance distributions for infrared thermography in tokamaks

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Infrared (IR) thermography is widely used to insure a safe operation of tokamaks. Generally a single wavelength measurement is selected to determine the surface temperature. At Tore Supra it was found that luminance measurements in the Near IR yield often higher temperatures than measurements in the mid IR range. The proposed explanation is that a small fraction of the observed surface has a significantly higher temperature than the rest. We investigate the possibility to deduce from a spectrally resolved luminance measurement the temperature distribution that has caused it. Presently we are able to determine 5 independent parameters of the temperature distribution from simulated luminance distributions in the spectral range of 1 – 4 µm. These parameters can e.g. be 3 discrete characteristic temperatures and their relative occurrence, knowing that the sum of the occurrences is 1, corresponding to the complete surface. But equally well it can be 2 independent gaussian temperature distributions for both of which the centre temperature and width are free parameters and (the occurrence being a free parameter for one of them). Both approaches allow excellent least square fits to the luminance data and both types of results show significant correlation with the initial temperature distributions used to construct the simulated luminance spectrum. Such a situation of being able to determine by the data analysis significant information about the property to measure but not to be able to pin down the result in a fully determined quantitative way is more often encountered in the field of tokamak data analysis. The presentation is based to one part on simulated data to explore the theoretical possibilities of the analysis and in a second part the state of work on real data from Tore Supra measured with such a spectrally resolving thermography instrument.