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Design of a dual-band IR imaging system for surface temperature measurements on the tungsten divertor in EAST

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In 2018, EAST will be operated with a full tungsten (W) divertor in both the upper and lower divertors. Tungsten is a shiny refractory metal; as such, its emissivity in the infrared (IR) range is low. In addition film formation on the tungsten alters the emissivity, which makes precise surface temperature measurements difficult for conventional single-band IR cameras. To resolve this problem, a dual-band IR imaging system has been planned to install into EAST, to more accurately measure the surface temperature on the W divertor. The dual-band IR system has the advantage of being mostly independent of surface emissivity; using pyrometric techniques, the surface temperature is calibrated by the ratio of signals in two bands [1]. A commercial single-band mid-wavelength IR camera combined with a two-band IR adapter is designed with a field of view 5.5×2.2.The two-band IR adapter utilizes a dichroic beam splitter, which reflects 3.7–4.2μm wavelengths and transmits 4.3–4.8μm wavelength radiation, each with >90% efficiency and projects each IR channel image side-by-side on the camera's detector. The dual-band IR images system will be used to monitor the upper outer W divertor with an existing mirror, with a ~1mm spatial resolution. In addition, a mirror installed into Material and Plasma Evaluation System [2] is designed for the measurement of the surface temperature on the lower outer divertor.

[1] A.G. McLean et al., Rev. Sci. Instrum. 83, 053706 (2014)
[2] F. Ding et al., Journal of Nuclear Materials 455 (2014) 710–716

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Eligible for student paper award?

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