High-temperature behavior of diffraction effects in blackbody calibrations: higher-order effects

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Since the early work by Blevin [1], it has been well known that diffraction effects in the calibration of blackbodies generate an error in measured power led by a term varying as $1/T$. Higher-order corrections are also of increasing importance in cases of (1.) low (source) temperature, and (2.) multi-staged optical systems. This talk will include presentation of results related to these two aspects. For low temperatures and in the case of a single intervening aperture consisting of the blackbody, cryogenic radiometer and aperture, diffraction corrections on total power involve a series expansion in terms of $1/T$ and the logarithm of T [2]. For cases with more than one aperture between the source and detector, other effects arise that mostly vary as $1/T^2$, but often with contributions scaling as $1/T^3$, $1/T^4$ or $1/T^5$. By use of a higher-order boundary diffraction wave formulation [3], these terms can be identified, and the larger terms can be computed efficiently in a method that automatically integrates over the Planck spectrum, eliminating the need to carry out calculations at multiple wavelengths before suchsintegration. This talk will emphasize the new, unpublished developments that have taken place most recently and apply the results of this work to a recent calibration at NIST.

[1] W. R. Blevin, Metrologia **6**, 39 (1970).

[2] E.L. Shirley, J. Opt. Soc. Am. A **33**, 1509 (2016).

[3] E.L. Shirley, J. Mod. Opt. **54**, 515 (2007).