

Determination of the NIST Scale of Absolute Spectral Responsivity from 200 nm to 1800 nm

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Abstract

The National Institute of Standards and Technology (NIST), USA has provided calibrations of absolute spectral radiant power responsivity [A/W] from 200 nm to 1800 nm for optical detectors for over 20 years. The scale of absolute spectral radiant power responsivity is transferred to industry and research through a variety of detectors and facilities to provide the traceability for the nation's optical measurements. Although NIST has been providing calibrations for many years, the actual instrumentation and detectors have changed during this time. The latest realization of the spectral radiant power responsivity scale is described in this paper.

The absolute detector as the basis of this scale is a cryogenic radiometer, which is an electrical substitution radiometer operated at liquid helium temperatures. The cryogenic radiometer determines the optical power of a source based on electrical standards. Tunable lasers from the Spectral Irradiance and Radiance using Uniform Sources, SIRCUS, provide the calibration source for various transfer detectors. These detectors are then used with the monochromator-based Visible to Near Infrared Spectral Comparator Facility (VisSCF) and the UV Spectral Comparator Facility (UVSCF). Groups of calibrated photodiodes are used as working standards (WS) with the SCFs to disseminate the spectral radiant power responsivity scale to customers' detectors.

The processes of the scale realization and dissemination of this scale to industry is discussed. This paper describes the different steps and instrumentation, from the cryogenic radiometer to the customer's detector, used in the scale transfer. Along with listing the major sources of uncertainty, the issues and their resulting solutions to improve and lower measurement uncertainties will be discussed.