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The University of Wisconsin Space Science and Engineering Center Absolute Radiance Interferometer

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Obtaining accurate measurements of infrared radiance from satellite instruments in space can contribute greatly to our understanding of climate change and the earth system. The long-wave forcing of the climate, the climate's response, and the long-wave feedbacks involved in that response bear characteristic signatures in a time series of thermal infrared spectra. Such a time series can provide powerful constraints for climate models by improving the representation of feedbacks. Signal detection above natural variability for decadal climate signatures requires an uncertainty better than 0.1 K (k=3) in radiance temperature. Realizing such low uncertainty on a space-based instrument is a challenge.

The University of Wisconsin Space Science and Engineering Center (UW-SSEC), with funding support from the NASA Instrument Incubator Program, has undertaken an effort to advance the technological development of instrumentation for the measurement of absolute spectrally resolved infrared radiances (3.3–50 μm) with high accuracy (<0.1 K). The UW-SSEC is building the Absolute Radiance Interferometer (ARI), a demonstration test-bed which includes a Fourier transform spectrometer (FTS), a calibration system, and a validation system, to demonstrate the feasibility of thermal infrared instrumentation for a climate benchmark mission.

The FTS approach is well suited for the combined requirement of high accuracy and broad spectral coverage at high spectral resolution. The FTS implementation requires a small number of detectors, and provides a very well defined instrument line shape (ILS) that can be easily monitored and measured. The challenge in instrument development for a climate benchmark measurement mission is to achieve high accuracy with a design that can be flight qualified, has a long design life, and is reasonably small, simple, and affordable. Because of the inherent large differences in the sampling and noise requirements for benchmark climate measurement compared with those for weather research or operations, the required simplicity in design is achievable.

A summary of the design, radiometric performance and measurement results of the Absolute Radiance Interferometer will be presented.