IRS2012-164
International Radiation Symposium 2012
Dahlem Cube, Berlin, Germany, 06 – 10 August 2012

Development of the novel in-flight blackbody calibration source for space-born radiometers to improve climatic measurements within thermal IR band

A. Burdakin (1), A. Panfilov (2), V. Sapritsky (3), and E. Us (4)

(1) All-Russian Research Institute for Opto-Physical Measurements (VNIIOFI), Moscow, Russian Federation (burdakin-m4@mail.ru), (2) All-Russian Research Institute for Opto-Physical Measurements (VNIIOFI), Moscow, Russian Federation (panfilov-m4@mail.ru), (3) All-Russian Research Institute for Opto-Physical Measurements (VNIIOFI), Moscow, Russian Federation (vsapritsky@gmail.com), (4) All-Russian Research Institute for Opto-Physical Measurements (VNIIOFI), Moscow, Russian Federation (us-m4@mail.ru)

Decades-long continuous time series of climate data will have to be obtained by simultaneous using instruments onboard platforms belonging to different participants. An example of such a full-scale integration is the Global Earth Observation System of Systems (GEOSS), which would hopefully allow us to avoid in the future the temporal and spatial gaps that exist in the current data. To meet growing needs for the long term high quality climate data records delivered by various Earth observation systems one has to ensure the uniformity of radiometric measurements within GEOSS. The most stringent requirements for long term stability and consistency of national radiometric scales are imposed by climatology within thermal IR (TIR) band within the dynamic range of temperature measurements with Earth observation systems: 0.01÷0.04 K per decade. This task can be solved through the development of the novel satellite-borne onboard fixed-point blackbody calibration source that incorporates the melt/freeze phase transition phenomenon. In the capacity of the space-borne fixed-point blackbody's phase-change substances there have been proposed a certain eutectic alloys and single-component metals having melt/freeze temperatures within the proper temperature range $\sim$ 210÷350 K. Satellite-borne onboard fixed-point devices should be small, light, and consume little power. So, the phase-change substances applicable for this purpose should demonstrate high metrological characteristics as fixed points realized in small-size cells. On the basis of the respective investigations Ga and the eutectic alloys Ga-In, Ga-Sn, and Ga-Zn have been selected as most likely candidates. Currently preparations for space experiment with the said substances on the ISS aimed at melt/freeze phase transition in-depth study upon the zero-gravity effect are in progress. Simultaneously the onboard fixed-point blackbody source for in-flight monitoring stability of space-borne radiometers characteristics within TIR is under development. In compliance with our concept of such a device optimal design, the space-borne fixed-point blackbody prototype has radiative cavity surrounded by the phase-change substance (Ga). Preliminary results of the prototype testing are very promising in terms of attaining at the next stage of work the required stability of the space-borne fixed-point blackbody radiation power. Currently preparations for space experiment with the prototype on the satellite "Foton-M" №4 are in progress. This experiment is aimed at examination of the space-borne fixed-point blackbody actual design under zero-gravity conditions. In the final analysis, the work as a whole is aimed at ensuring traceability of satellite-based climatologic measurements within TIR to the SI units. In our opinion, this task can be solved through calibration at the pre-flight stage and in-flight update calibration for the remainder of the instrument lifetime by means of the prospective satellite-borne onboard fixed-point blackbody calibration source.