Dissemination of the Redefined Kelvin

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We present an ongoing research project which involves cooperative scientific activities by 14 international partners, including both National Metrological Institutes (NMIs) and academies, with the main objective to demonstrate the dissemination of thermodynamic temperature, using different primary thermometry approaches, taking advantage of the recent redefinition of the kelvin.

Covering the overall range between 4 K and 300 K, three thermodynamic methods − namely Dielectric Constant Gas Thermometry (DCGT), Refractive Index Gas Thermometry (RIGT) and Acoustic Gas Thermometry (AGT) − will be used to calibrate capsule-type resistance thermometers of various kinds (Pt, PtCo, RhFe) with target standard uncertainties of 0.25 mK at 25 K and 0.6 mK at 300 K. These sensors will serve as transfer standards to test the consistency of thermodynamic calibrations within a blind international comparison, the first of this kind. Additional activities of the project include:

- the independent calibration of the same transfer standards on the International Temperature Scale of 1990 (ITS-90) to develop a coherent framework for temperature dissemination from NMIs to users, whether it is by thermodynamic temperature or the defined scale (ITS-90), and to assess the respective measurement uncertainties and the level of equivalence between these alternative dissemination approaches;
- the extension, by four different NMIs, of the useful working range of the AGT primary method, initially up to 700 K with a standard target uncertainty of 7 mK and, in perspective, at even higher temperature;
- the development of thermodynamic temperature standards based on AGT in the range between 234 K and 303 K by two NMIs currently without primary thermometry capabilities.

As a whole, the project's outcomes are expected to mark a significant advance towards the realization and dissemination of thermodynamic temperature using multiple primary thermometry approaches, as opposed to using internationally agreed and periodically updated defined scales. The interest for this long-term objective spans beyond thermometry and definitely includes the much wider community involved in the accurate measurement and modelling of the thermophysical properties of gaseous, liquid and solid substances.