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In the context of the EMPIR research project "Realizing the Redefined Kelvin" (Real-K)[1] [1], we have implemented absolute acoustic gas thermometry [2] between 10 K and 25 K to evaluate the performance of this method for the direct thermodynamic calibration of capsule-type resistance thermometers on the thermodynamic temperature scale. Our implementation of acoustic thermometry is based on speed of sound measurements in He at a single pressure, chosen in the range between 65 kPa and 125 kPa, at each temperature calibration point, with non-ideality corrections relying on the accurate ab initio calculations of the thermophysical properties of He.

From the acoustic calibration of RhFe and Pt capsules, previously calibrated on ITS-90, we determine ($T-T_{90}$) differences between the thermodynamic temperature T and its approximation T_{90} by the International Temperature Scale of 1990 (ITS-90), finding them in remarkable agreement with the 2022 consensus estimate [3] of these differences within the small combined uncertainties.

We discuss the advantages of acoustic thermodynamic calibration compared to ITS-90 calibration both in terms of achievable uncertainty and practicality of use.

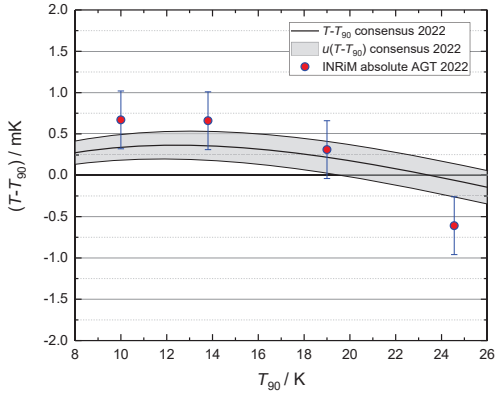

Fig. 1 Differences ($T-T_{90}$) determined using absolute acoustic gas thermometry between 10 K and 25 K.

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