Dissemination of the redefined kelvin

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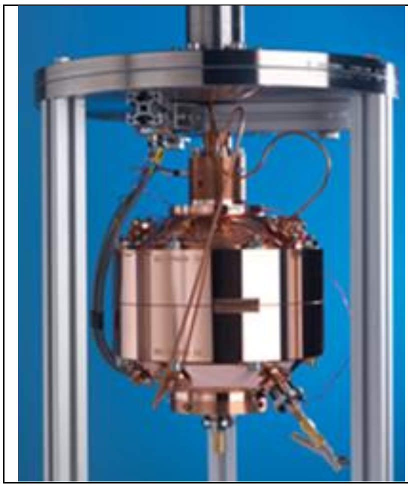
In May 2019 four of the base units of the international system of units (SI) were redefined in terms of fundamental constants. The kelvin, previously defined in terms of the triple point of water, was redefined in terms of a fixed value of the Boltzmann constant, *k*.

That redefinition initiated extensive research activity whose long-term objective was to replace the current defined temperature scales (the International Temperature Scale of 1990 and the Provisional Low Temperature Scale of 2000) with primary thermometry approaches for realisation and dissemination of thermodynamic temperature. These could include Acoustic Gas Thermometry, Dielectric Constant Gas Thermometry and Refractive-index Gas Thermometry. Already it has been shown that such a change is possible at temperatures >1235 K (silver freezing point) and <25 K (neon triple point) in a recently completed project Realising the redefined kelvin (Real-K) [Machin, G., *et al Measurement* **201** 111725 (2022)].



$$u_0^{\,2} = \gamma_0 kT / m$$

$$\gamma_0 = c_{p0} / c_{V0}$$

Figure 1: Illustration of acoustic gas thermometry (AGT). Left: Photograph of the NPL quasi-spherical acoustic resonator. Right: The basic equation of AGT; *u*, the speed of sound in the gas (often He or Ar), *k,* the Boltzmann constant, *T,* the thermodynamic temperature, *m,* the atomic mass of the gas and γ, the ratio of ideal specific heats.

Here we introduce the aims and objectives of the Real-K successor project, Disseminating the redefined kelvin (DireK-T). This three-year project begins in September 2023 as part of the new European Metrology Partnership (www.euramet.org) and brings together fourteen national metrology institutes worldwide. Its overall aims are to:

1. Demonstrate practical thermodynamic temperature dissemination from 4 K to 25 K and from 25 K to 300 K using independent thermodynamic methods.

2. Develop a coherent documented framework to ensure consistency of temperature dissemination from National Measurement Institutes to users from 4 K to 300 K.

3. Establish capability for dissemination of thermodynamic temperature from 300 K to 700 K and measure low uncertainty values of T-T_{90}.

As temperature is one of the most measured parameters in industry and science, the shift away from the defined scales to provide dissemination to thermodynamic temperature could well have profound long-term implications for temperature measurement and traceability.