Realizing the redefined kelvin: Extending the life of the ITS-90

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Tenth International Temperature Symposium
Anaheim, CA USA
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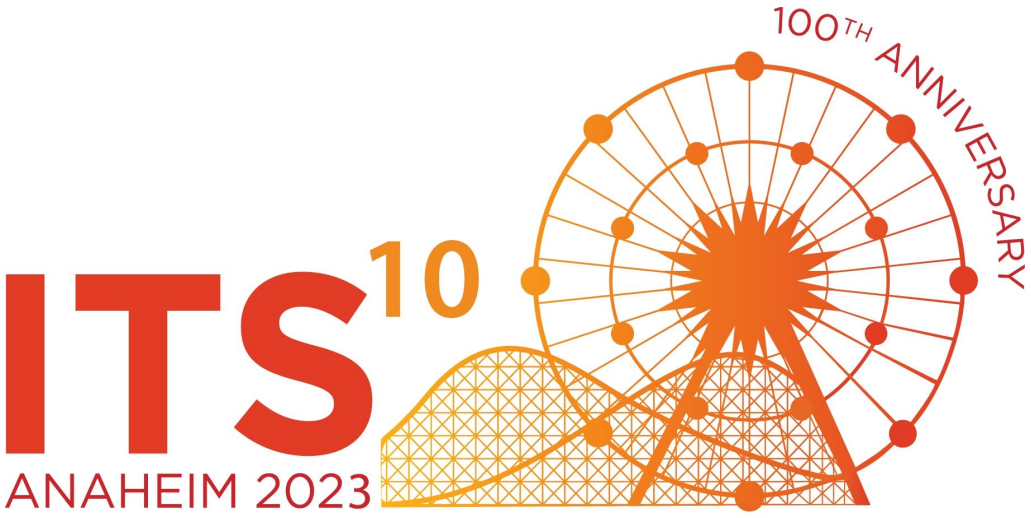

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Realizing the redefined kelvin: Extending the life of the ITS-90

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Following the redefinition of the kelvin [1,2], the user is presented with a more nuanced traceability choice through the *mise en pratique* for the definition of the kelvin (MeP-K-19) [3]. Here we describe research to address several present and potential shortcomings with the current main dissemination route, namely using the International Temperature Scale of 1990 (ITS-90) [4]. The ITS-90 has served the global temperature measurement community well, providing reliable, low uncertainty traceability for over 30 years. However, there are some potentially life-limiting issues for the ITS-90. Among these are the impact of the main types (1 and 3) of non-uniqueness which currently limit the uncertainties achievable with the ITS-90, and the need to identify a possible alternative to the mercury triple point (a key fixed point of the ITS-90) whose use could be banned by an international treaty [5]. Progress in addressing these problems will be described through:

- New determinations of Type 3 non-uniqueness have been undertaken in the range –189 °C to 156 °C and between 660.323 °C and 961.78 °C;
- A comprehensive evaluation of Type 1 non-uniqueness on a large number of Standard Platinum Resistance Thermometers (SPRTs) across multiple regions;
- New designs of CO_2 and SF_6 cells for use with long-stem SPRTs. These have been improved by using purer gases and more stable and uniform temperature-controlled baths, and by the development of a flexible set-up that can accommodate both capsule and long-stem SPRTs. The effect of replacing mercury on the ITS-90 interpolating equations and uncertainty propagation is also being investigated.

References

[1] https://www.bipm.org/en/publications/si-brochure
[2] G. Machin, The kelvin redefined, Meas. Sci. Technol. 29 022001 (11pp) (2018) https://doi.org/10.1088/1361-6501/aa9ddb
[3] B. Fellmuth, J. Fischer, G. Machin, S. Picard, P.P.M. Steur, O. Tamura, D.R. White, H. Yoon, The kelvin redefinition and its *mise en pratique*, Phil. Trans R. Soc. A., 374 (2064) (2016), p. 20150037, https://doi.org/10.1098/rsta.2015.0037
[4] Real-K project website: https://real-k.aalto.fi/
[5] The use of mercury, even for scientific purposes, could be severely restricted or even banned by international convention (UN Minamata Convention on Mercury which introduces controls over a myriad of products containing mercury).