CCT member and observer Activity Report

Period: June 2024 to April 2026

Institute: National Research Council Canada

State economy: Canada

Number of persons involved in thermometry of the institute: 7

Short summary of research and development:

The redefined kelvin: progress and prospects UK Royal Society Theo Murphy meeting
NRC was a co-organizer of the redefined kelvin: progress and prospects meeting, hosted by the UK Royal Society in Glasgow, UK in February 2025, and co-authored an invited oral presentation and a poster presentation. NRC co-guest edited the published proceedings of this meeting, and co-authored 4 articles within [2, 3, 4, 5].

TEMPMEKO 2025 conference
At the TEMPMEKO 2025 conference, held in Reims, France in October 2025, NRC co-authored 8 oral and 2 poster presentations, including an invited oral plenary presentation.

Primary thermometry
NRC has contributed two capsule standard platinum resistance thermometers calibrated on thermodynamic temperature via acoustic gas thermometry to the EURAMET "Dissemination of the redefined kelvin" (DireK-T) project. It was the only participant to perform thermodynamic calibrations at all target temperatures of DireK-T Work Package 2 (25 K to 303 K range).

Short summary of recent comparison activity:

CCT-K9.4 bilateral zinc point comparison with NPL
The comparison was registered in October 2023. An NPL standard platinum resistance thermometer and zinc fixed point cell were exchanged. This comparison has now been completed and published in the KCDB: https://doi.org/10.59161/KAXC2980.

SIM.T-K9.4 bilateral argon point comparison with NIST
The comparison was registered in July 2024. Two NIST capsule-style standard platinum resistance thermometers + adapter probes were exchanged. The draft of the report was prepared by NIST and is currently under review by NRC.

Short summary of other activities:

NRC chairs CCT-WG-KC and CCT-WG-Dig, and also actively contributes to the work of CCT-WG-CTh, CCT-WG-NCTh, CCT-TG-CTh-TTT, and CCT-WG-SP. As chair of CCT-WG-Dig, NRC acts as the representative of the CCT to the CIPM FORUM-MD, and contributes to the work of FORUM-MD-WG-CC.

Link to bibliography or list of bibliography (last 5 years):

[1] C. Kaur *et al.* 2026 **Impact of Thermal Fields on Rydberg Atom Radio Frequency Sensors** *Physical Review Letters* **136** 123201 https://doi.org/10.1103/lngc-vpr4

[2] A D W Todd *et al.* 2026 **Quantum technology: prospects for new thermometric and radiometric sensor development** *Philosophical Transactions of the Royal Society A* **384** 20250042 https://doi.org/10.1098/rsta.2025.0042

[3] G Machin *et al.* 2026 **The redefined kelvin - Progress and prospects** *Philosophical Transactions of the Royal Society A* **384** 20240463 https://doi.org/10.1098/rsta.2024.0463

[4] P M C Rourke *et al.* 2026 **The triad of trust: Solutions to practical inconsistencies in *T*, T_{90} and *in situ* traceability** *Philosophical Transactions of the Royal Society A* **384** 20240461 https://doi.org/10.1098/rsta.2024.0461

[5] J Pearce *et al.* 2026 **Future traceability of practical primary thermometry and self-validating thermometry** *Philosophical Transactions of the Royal Society A* **384** 20240453 https://doi.org/10.1098/rsta.2024.0453

[6] Y Huang *et al.* 2025 **Cryogenic magnomechanics for thermometry applications** *Applied Physics Letters* **127** 082405 https://doi.org/10.1063/5.0271756

[7] D-X Xu *et al.* 2025 **Advancing PIC Development Using Machine Learning: from Design to Fabrication to Optical Characterization** *Optical Fiber Communication Conference (OFC) 2025, Technical Digest Series* Th1F.1 https://doi.org/10.1364/OFC.2025.Th1F.1

[8] P M C Rourke 2024 **Future of the International Temperature Scale in a Mixed Dissemination Environment** *AIP Conference Proceedings* (ITS10) **3230** 020006 https://doi.org/10.1063/5.0235228

[9] A Peruzzi *et al.* 2024 **Applying Different Analysis Methods to CCT-K7.2021 Key Comparison** *AIP Conference Proceedings* (ITS10) **3230** 050002 https://doi.org/10.1063/5.0234204

[10] S Dedyulin *et al.* 2024 **From CCT-K7 to CCT-K7.2021: Approaching the definition of the triple point of water temperature** *AIP Conference Proceedings* (ITS10) **3230** 050001 https://doi.org/10.1063/5.0234488

[11] D Imbraguglio *et al.* 2024 **From ITS-90 to Thermodynamic Temperature: Hybrid CSPRT Calibrations with LNE-Cnam Acoustic Gas Thermometry** *AIP Conference Proceedings* (ITS10) **3230** 080001 https://doi.org/10.1063/5.0236619

[12] J V Pearce *et al.* 2024 **Realizing the redefined kelvin: Extending the life of the ITS-90** *AIP Conference Proceedings* (ITS10) **3230** 020002 https://doi.org/10.1063/5.0234458

[13] S Dedyulin *et al.* 2024 **En route to a practical ring-resonator thermometer with an uncertainty of 1 mK** *Proceedings of SPIE - The International Society for Optical Engineering* **13083** 130830Z https://doi.org/10.1117/12.3022411

[14] S Janz *et al.* 2024 **Measurement accuracy in silicon photonic ring resonator thermometers: Identifying and mitigating intrinsic impairments** *Optics Express* **32** 551 https://doi.org/10.1364/OE.499055

[15] S Dedyulin *et al.* 2023 **Practical ring-resonator thermometer with an uncertainty of 10 mK** *Measurement* **221** 113453 https://doi.org/10.1016/j.measurement.2023.113453

[16] J M Mantilla *et al.* 2023 **Construction and comparison of high temperature fixed points at NRC and CEM** *Journal of Physics: Conference Series* **2554** 012007 https://doi.org/10.1088/1742-6596/2554/1/012007

[17] S Dedyulin and M Gotoh 2023 **Caesium- and sodium-filled pressure controlled heat pipe at NRC** *Journal of Physics: Conference Series* **2554** 012005 https://doi.org/10.1088/1742-6596/2554/1/012005

[18] A D W Todd 2023 **Preface to the Proceedings of TEMPMEKO and TEMPBEIJING 2019** *Journal of Physics: Conference Series* **2554** 011001 https://doi.org/10.1088/1742-6596/2554/1/011001

[19] V Žužek *et al.* 2023 **Least squares approach to standard platinum resistance thermometer subrange inconsistency reduction with redundant gallium and indium fixed points** *Measurement* **220** 113400 https://doi.org/10.1016/j.measurement.2023.113400

[20] S Dedyulin *at al.* 2023 **Nonlinear optical impairments in silicon ring resonator thermometers and their mitigation** *2023 Photonics North (PN)* https://doi.org/10.1109/PN58661.2023.10222952

[21] A Peruzzi *et al.* 2023 **CCT-K7.2021: CIPM key comparison of water-triple-point cells** *Metrologia* 60 03002 https://doi.org/10.1088/0026-1394/60/1A/03002

[22] C Gaiser *et al.* 2022 **2022 Update for the Differences Between Thermodynamic Temperature and ITS-90 Below 335 K** *Journal of Physical and Chemical Reference Data* **51** 043105 https://doi.org/10.1063/5.0131026

[23] S Dedyulin *et al.* 2022 **Progress on Silicon Photonic Thermometry for Secondary and Working Measurement Standards** *2022 Photonics North (PN)* https://doi.org/10.1109/PN56061.2022.9908405

[24] S Dedyulin and A Peruzzi 2022 **No country for old borosilicate triple-point-of-water cells** *Metrologia* **59** 055009 https://doi.org/10.1088/1681-7575/ac8d0f

[25] A Peruzzi and S Dedyulin 2022 **NRC measurement set-up and preparatory work for CCT-K7.2021 key comparison of triple-point-of-water cells** *Metrologia* **59** 045011 https://doi.org/10.1088/1681-7575/ac7bc1

[26] S Dedyulin *et al.* 2022 **Emerging technologies in the field of thermometry** *Measurement Science and Technology* **33** 092001 https://doi.org/10.1088/1361-6501/ac75b1

[27] A Peruzzi *et al.* 2022 **A comparison of relative humidity calibration facilities at temperatures up to 170 °C** *Measurement* **189** 110435 https://doi.org/10.1016/j.measurement.2021.110435

[28] G Leblanc *et al.* 2021 **A practical validation of uncooled thermal imagers for small RPAS** *Drones* **5** 132 https://doi.org/10.3390/drones5040132

[29] P M C Rourke 2021 **Perspective on the refractive-index gas metrology data landscape** *Journal of Physical and Chemical Reference Data* **50** 033104 https://doi.org/10.1063/5.0055412

[30] P M C Rourke 2021 **ITS-90 reproducibility, xenon fixed point substitution and new interpolating equations between 13.8033 K and 273.16 K** *Metrologia* **58** 055004 https://doi.org/10.1088/1681-7575/abfd8e

[31] A Peruzzi *et al.* 2021 **Survey of subrange inconsistency of long-stem standard platinum resistance thermometers** *Metrologia* **58** 035009 https://doi.org/10.1088/1681-7575/abe8c1

[32] S Dedyulin *et al.* 2021 **Accurate measurements of a wavelength drift in high-temperature silica-fiber Bragg gratings** *Metrology* **1** 1 https://doi.org/10.3390/metrology1010001

[33] A D W Todd *et al.* 2021 **On the uncertainties in the realization of the kelvin based on thermodynamic temperatures of high-temperature fixed-point cells** *Metrologia* **58** 035007 https://doi.org/10.1088/1681-7575/abe9c5

[34] A Peruzzi *et al.* 2021 **Metrological evaluation of deep-ocean thermometers** *Journal of Marine Science and Engineering* **9** 398 https://doi.org/10.3390/jmse9040398

[35] D Grobnic *et al.* 2021 **Fiber Bragg grating wavelength drift in long-term high temperature annealing** *Sensors* **21** 1454 https://doi.org/10.3390/s21041454

[36] Y Yamada and A Todd 2021 **Special section on TEMPMEKO 2019: a feature on the XIV International Symposium on Temperature and Thermal Measurements in Industry and Science & IV International Temperature Conference, Beijing (TEMPMEKO & TEMPBEIJING 2019) and Metrology for Meteorology and Climate (MMC 2019)** *Measurement Science and Technology* **32** 020101 https://doi.org/10.1088/1361-6501/abac89