TC Thermometry
Graham Machin

Euramet GA
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Thermometry

Overview

- Introduction to TC-T
- Annual meeting
- Selected comparisons
- TC-T training for future thermal metrologists
- Workshops
- COOMET TC-T links
- EMPIR project “EMPRESS”
- Kelvin redefinition and implementation
- Tempmeko ‘16

TC-T

- Main field – thermometry (NPL)
- Sub committee on humidity (INRIM)

- Working groups on
  - Cmc review (NPL)
  - Strategy (CEM)
  - Best practice and guides (VTT-MIKES)
  - Thermophysical quantities (CNAM-LNE)

Annual meeting 24-27 Feb 2015

IPQ, Lisbon – around 70 delegates

Selected comparisons - I

CCT key comparisons – K10

- Euramet (NPL) – leading KC of highest strategic importance for CCT – establishment of ITS-90 above the silver point (962 ºC) to around 3000 ºC
- Involves participants from EURAMET (4), APMP (3), SIM (2), COOMET (1)
- Radiation thermometers and fixed points currently in APMP
  - Measurements complete in NMIJ, NIM underway in KRISS
- Schedules:
  - End date of measurements Oct ‘16, draft A Sep ‘17

Selected comparisons - II

CCT K09 Euramet linkage loop

- Comparison of SPRT calibration – core ITS-90 realisation (-189 ºC to 420 ºC)– CCT K09 led by NIST
  - 5 pilots (LNE-Cnam [Lead: Fr], PTB[DE], INRIM[IT], VSL[NL], NPL[GB])
  - 27 participants: (DPM[AL], BEV[AT], SMD[BE], IMBiH[BA], BIM[BG], HMI[HR], CMI[CZ], DTI[DK], MIKES[FI], BoM[MK], EIM[GR], MKEH[HU], NSAI NML[IE], VMT/FTMC[LT], MCCAA[MT], JV[NO], GUM[PL], IPQ[PT], INM[RO], DMDM[RS], SMU[SK], MIRS/UL-FE/LMK[SI], CEM[ES], SP[SE], Roth+co.AG [CH], UME[TR])
- Measurements underway – draft A ~Mar ‘17

High level training for future metrologists

- EMRP NOTED - Novel Techniques for Traceable Temperature Dissemination
  - Brussels, 4-6 May 2015
  - first day: training on state-of-art scale realisation thermometry
  - Up to date developments – optimum use of fixed points and standard platinum resistance thermometers
  - Emerging approaches for dissemination – eg practical primary thermometry
- EMRP METefnet – Metrology for Moisture in Materials Workshop
  - CETIAT, Lyon, June 17th, 2015
  - Developing rigorous metrology for challenging conditions

High level training for future temperature metrologists – 4-6 May SMD 2015

CIM 2015 participation

- International Congress of Metrology – 21-24 Sep 2015
- Strong participation from TC-T
  - Leading workshop to identify industrial needs for thermal metrology of materials – to identify future requirements to steer capability development in NMIs and Dis
  - Thermal poster and session S15 papers mostly arising directly from TC-T activities

Cooperation with COOMET TC-T

- TC-T invited to gave the two keynote addresses at the All Russian and COOMET countries 21-24 April Temperature 2015 conference
- GM – Progress with implementing the new kelvin
- Jean-Remy - Thermal Quantities Metrology: Research Highlights led by the European National Metrology Institutes

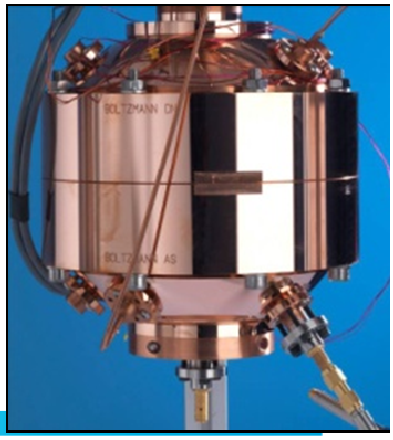
EMPIR thermometry project for industry

- EMPIR Industry focused project – “EMPRESS” (Enhancing process efficiency through improved temperature measurement) – started May 15
  - Strong focus on addressing unsolved thermometry problems in industry – industrial trials planned in project
    - Low drift temperature sensors with target *in-situ* traceable uncertainty of <3 ºC at 1450 ºC, <5 ºC at > 2000 ºC
    - Non drift temperature sensors (<1 ºC >6 months service), optimised for temperatures around 1350 ºC
    - Traceable surface temperature measurement methods to~500 ºC
    - *in-situ* combustion standard of known temperature with x10 lower uncertainty than current approaches to validate flame temperatures

Heat treatment of aero-engine turbine blades

Redefinition of the kelvin

- IUPAP 1-6 February 2015, Fundamental constants Eltville, Germany
- 4th Feb pm on Boltzmann constant determinations
- Three methods presented acoustic (NPL, LNE, INRIM, NIM), dielectric constant gas thermometry (PTB), Doppler broadening (2nd U. Naples)

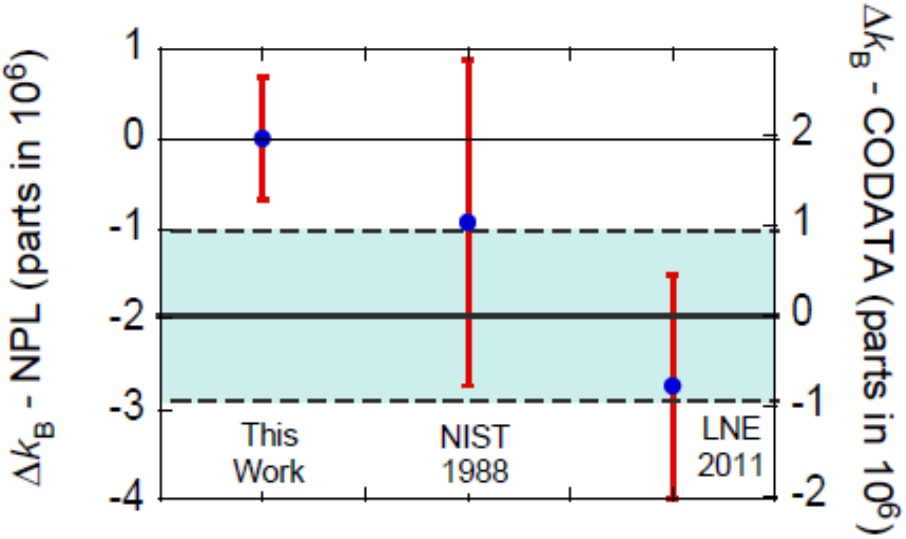


Acoustic resonator for determining the Boltzmann constant

$$u_0^2 = \gamma kT / m$$
$$\gamma = c_p / c_v$$

Redefinition of the kelvin

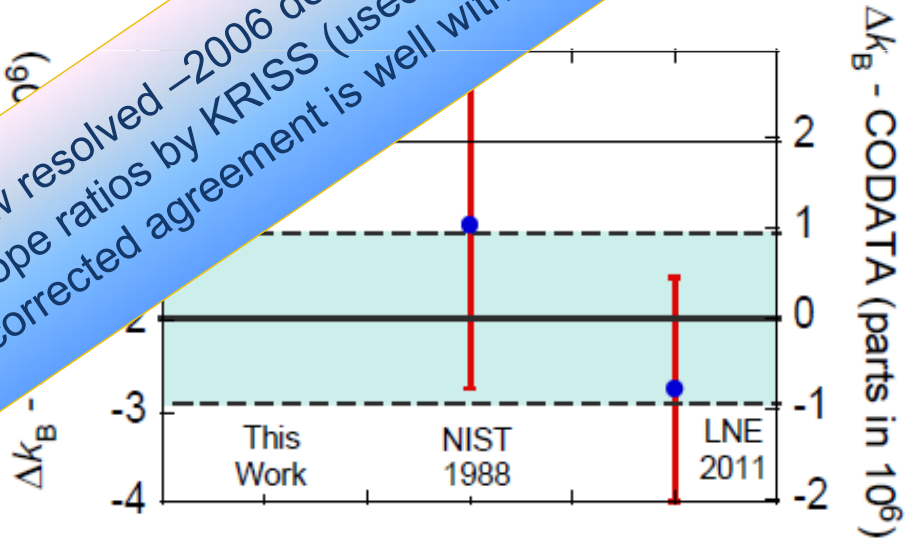
- Serious issue – NPL and LNE did not agree not even within the expanded uncertainties



Redefinition of the kelvin

- Serious issue – NPL and LNE did not
within the expanded uncertainties

- Problem now resolved –2006 determination of atmospheric argon isotope ratios by KRISS (used by NPL) were in error – when corrected agreement is well within 1 ppm



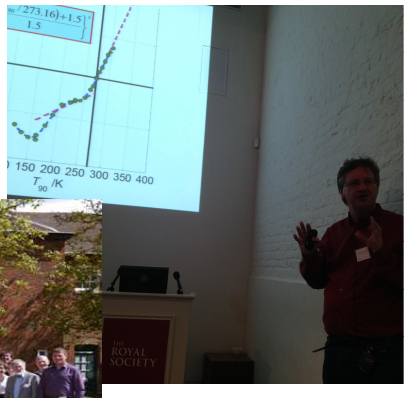
Royal Society Meeting

- EMRP project Implementing the new kelvin (InK)
- International scientific meeting at the Royal Society Kavli Centre https://royalsociety.org/about-us/history/kavli/
- Meeting dates 18 -19 May 2015
  - InK special edition of *Phil Trans A*
  - *Will be the definitive document in field for significant number of years*
- Details available on website
- https://royalsociety.org/events/2015/05/new-kelvin/

Meeting held at Chichley Hall – home of the Royal Society Kavli Centre

Towards implementing the new kelvin

- 50 world leading researchers, 16 talks linked to EMRP InK
- Consensus report (to be submitted to *Metrologia*) – remaining research requirements for effective new kelvin implementation and successor scale in ~2025



Tempmeko 2016

- To be held at Zakopane 25 June – 1 July 2016
- GM joint-chair of International Programme Committee
- Chair of local organising committee - Anna Szmyrka-Grzebyk
- Call for papers open - June 2015
- Covers all areas and applications: temperature, humidity and moisture, thermophsyical quantities, meteorology, industry, medicine.....
- www.tempmeko2016.pl

Wł. Trzebiatowski Institute
of Low Temperature and Structure Research
of the Polish Academy of Sciences