Key NPL thermometry research activities in thermometry, humidity and moisture metrology 2017 - 2020

- Sub-ppm uncertainty determination of the Boltzmann constant for the kelvin redefinition
- Ultra-low uncertainty determination of T-T_{90} to ~300 K using acoustic thermometry
- Lead EMPIR project to complete the “Implementing the new kelvin” ahead of the redefinition in May 2019 (including contributions to *MeP*-K-19 and new T-T_{2000} measurements)
- Development of quantitative thermal imaging capability for use in a variety of applications, for e.g. space, diabetes and nuclear decommissioning
- Development of traceable phosphor-based thermometry to facilitate low uncertainty reliable surface temperature and fibre-optic based measurement
- Initiated research activity on photonic thermometry based on ring resonators
- Coordinate EMPIR project Realising the redefined kelvin (EMPIR SIB02)
- Development of miniature phase-change (fixed point) cells for in situ calibration of Pt100 thermometers used for determining temperature of calibration blackbodies on board spacecraft
- Development of self-validating thermocouples
- Development of optimal Pt-Rh thermocouples for temperatures above 1100 °C
- Investigation of effects (calibration drift, insulation resistance breakdown) arising from contamination of insulation in mineral insulated, metal sheathed thermocouples
- Collaboration with Metrosol on development of a practical Johnson noise thermometer
- Investigation of SPRT non-uniqueness, immersion, self-heating effects
- Lead CCT-K10, participation in CCT-K9, CCT-K8 (Protocol), EURAMET.T-K8 (Draft A), CCT K6.1 (draft A), local pilot in EURAMET.T-K9, participation in EURAMET.T-S3
- Developments in definitions and concepts of relative humidity in the SI (with BIPM/IAPWS workshop)
- Study of air thermometer radiance errors with diameter, for air temperature measurements in precision metrology and in meteorology
- Upwards extension of dew point range
- Incremental developments of multi-gas, multi-pressure humidity calibration and testing capability
- Development of calibration and testing of hygrometers in hydrogen for vehicles (EMPIR MetroHyVE)
- Development of simplified expression of uncertainty for meteorological observations of mixed quality from wide sources (EMPIR SIP 17SIP02 SimpleMeteoU)
- Development and application of soil moisture measurements and calibrations

Key publications 2017-2020:

- **Type 3 Non-Uniqueness in Interpolations Using Standard Platinum Resistance Thermometers Between -196 °C and 100 °C**, R.L. Rusby, H. Stemp, J.V. Pearce and R.I. Veltcheva, Int. J. Thermophys. **40**, 103 (2019)
- **Miniature gallium fixed point cells for space use**, J.V. Pearce, R.I. Veltcheva, D. Peters, D. Smith, T. Nightingale, Meas. Sci. Tech, Special Issue on Tempmeko 2019, **30**, 124003 (2019) https://doi.org/10.1088/1361-6501/ab38e4
- **A systematic investigation of the thermoelectric stability of Pt-Rh thermocouples between 1300 °C and 1500 °C**, J.V. Pearce, F. Edler, C.J. Elliott, C. Garcia Izquierdo, Y.-G. Kim, M.J. Martin, D. Tucker, R.I Veltcheva, Metrologia **55**, 558-567 (2018)

- **The link between SPRT sub-range inconsistency and Type 3 non-uniqueness in the ITS-90**, R.L. Rusby, J. Crabb, J.V. Pearce, C.J. Elliott, Int. J. Thermophys. **38**, 186 (2017) DOI 10.1007/s10765-017-2319-2
- **A Slim-line Integrated Self-validating Thermocouple – Initial Results**, C.J. Elliott, A. Greenen, D. Tucker, T. Ford, J.V. Pearce, Int. J. Thermophys. **38**, 141 (2017)
- **Extra points for thermometry**, J.V. Pearce, Nature Physics Vol. **13**, January 2017, p. 104
- **Relating composition and thermoelectric stability of Pt-Rh alloy thermocouples**, J.V. Pearce, A. Smith, C.J. Elliott, A. Greenen, Int. J. Thermophys. **38**, 26 (2017)
- **The development of a practical, drift-free, Johnson noise thermometer for industrial applications**, P. Bramley, D. Cruickshank, J.V. Pearce, Int. J. Thermophys. **38**, 25 (2017)
- **Liquidus Slopes for Impurities in ITS-90 Fixed Points**, J.V. Pearce, J.A. Gisby, P.P.M. Steur, Metrologia **53** 1101-1114 (2016)
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- Dong, W., Lowe, D., Machin, G., Bloembergen, P., Wang, T., Lu, X., "**Investigation of the furnace effect in cobalt-carbon high-temperature fixed-point cells**" *Measurement* **106** 88-94 (2017) https://doi.org/10.1016/j.measurement.2017.04.005
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