Realisation of the redefined kelvin (Real-K)

... from redefinition to reality

3000K

1300K

1000K

100K

25K

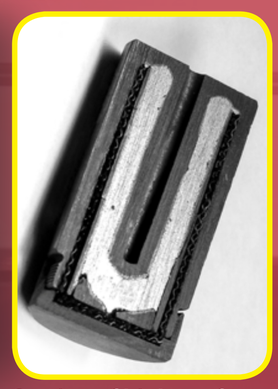
10K

1K

WP: 1

Realisation and dissemination of the redefined kelvin >1300 K

- Construct four High Temperature Fixed Points (HTFPs): Fe-C (1426 K), Pd-C (1765 K), Ru-C (2226 K), WC-C (3020 K) and *for the first time* definitively determine their temperatures: Target U ~ 0.1 K to 0.4 K
- *First ever* full scale demonstration of the *MeP*-K-19 >1300 K showing how to achieve traceability to the redefined kelvin by indirect primary radiometry



Section of high-performance HTFP

WP: 3

Extending the life of the International Temperature Scale of 1990

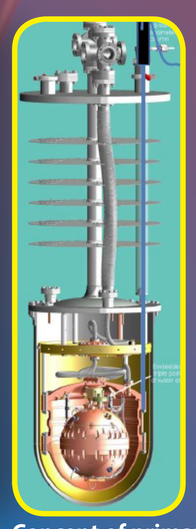
- Reduce Type 1 and 3 non-uniqueness uncertainty contributions in ITS-90 calibrations by *a target of 30%*
- Identify and characterize a *metrologically appropriate replacement* for the mercury triple point for use with long stem standard platinum resistance thermometers

Typical mercury cell

WP: 4

Facilitating full temperature range primary thermometry

- Provide long term access to gas based primary thermometry (25 K to 1300 K) by:
  - Uncertainty reduction (*target 10x*) in the *ab initio* calculation of the thermodynamic non-ideality of monatomic gases (Ne and Ar) to permit use as thermometric gases
  - *Validate ab initio* calculations through selected density and speed of sound measurements Ne and Ar
  - Demonstrate improved primary gas thermometry by trial calibration of thermometers to *T*



Concept of primary thermometry calibrating a long-stem SPRT

WP: 2

Realisation and dissemination of the redefined kelvin <25 K

- *Significant reduction in complexity* of the realisation of the kelvin through practical approaches to primary thermometry in the range 1 K to 25 K
- *Demonstrate continuous connection* to ultra-low temperatures below 1 K with primary thermometers

Three primary thermometry approaches pMFFT, CBT and AGT

Impact

Realisation of the redefined kelvin by:

- Processes and equipment in place for temperature realisation and dissemination, through the *MeP*-K-19, at temperatures >1300 K and <25 K, and mature enough for adoption by the wider temperature community
- Close cooperation with key stakeholders, especially CCT, all RMOs with seven key inputs to CCT which will strongly influence its guides and recommendations
- On-going fitness of ITS-90 for European and global thermometry community through uncertainty reduction and mercury fixed point replacement
- Provision of a comprehensive set of *ab initio* calculations of key thermophysical properties for gases (e.g. Ar, Ne), spurring development of full range primary thermometry
- Extensive knowledge transfer through e.g. refereed publications (>25), conference presentations (>30), Euramet workshop, international symposium, staff exchanges, enewsletter, website and stakeholder community

Letters of Support

There were 50 letters of support including: 2 CIPM CC Presidents, all 6 RMO TCT chairs, 16 companies, 4 Accreditation bodies

> *"I believe the proposal (Real-K) is of unprecedented scientific and real-world importance to the whole thermometry community"*
>
> Duan Yuning: President of the CCT

> *"… the results from Real-K will have a profound impact… it is particularly fitting that this project is launched in Europe because no other region in the world has presently all the capabilities and competencies that are needed to take on a task of this magnitude"*
>
> Arno Laesecke: NIST Boulder, IUPAC Fellow