

HIGHLIGHTS and SCIENTIFIC CHALLENGES of the TC-T

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Overview

- TC-T Meeting 2012
- Involvement of the TC-T in the EMRP Programme:
 - HiTeMs
 - InK
 - NOTED
- ITS⁹, 9th International Temperature Symposium
- TEMPMEKO2013

Technical Committee for Thermometry

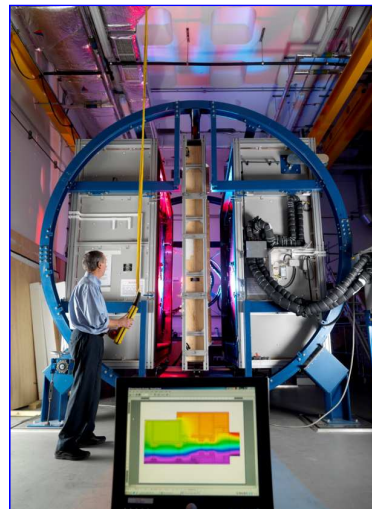
Thermometry (main field)



Humidity (sub-field)



Thermo-Physical Properties



TC-T
Thermometry
EURAMET Technical Committee



TC-T Meeting 2012



TC-T
Thermometry
EURAMET Technical Committee



TC-T Meeting 2012

- Usual 1 and 1/2 day meeting
- Novelty 2012: 1/2 day dedicated to presentations given by CPs
 - More relaxed atmosphere
 - Freedom in choice of the subject of the presentation
 - Small/emerging NMIs expressing their needs
 - Positive feedback (will be repeated in 2013)
- 1/2 day EMRP Workshop:
 - Look at TC-T involvement in EMRP programme
 - Share experience of coordinators
 - Prepare future calls

TC-T Involvement in the EMRP Programme

Call	Field	JRP	Name	TC-T Field
2009	Energy	ENG01	Characterization of Energy Gases	H
2009	Energy	ENG02	Metrology for Energy Harvesting	TPM
2009	Energy	ENG03	Metrology for Liquefied Natural Gas	T
2009	Energy	ENG06	Metrology for Improved Power Plant Efficiency	T
2009	Energy	ENG08	Metrology for New Generation Nuclear Power Plants (Metrofission)	TPM & T
2009	Energy	ENG09	Metrology for Biofuels	TPM
2010	Industry	IND01	High temperature metrology for industrial applications (HiTeMS)	T
2010	Industry	IND07	Metrology for the Manufacturing of Thin Films	TPM
2010	Industry	IND11	Metrology to Assess the Durability and Function of Engineered Surfaces	TPM
2010	Industry	IND13	Thermal Design and Time-Dependent Dimensional Drift Behaviour of Sensors, Materials and Structures	TPM
2010	Environment	ENV05	Metrology for Ocean Salinity and Acidity	TPM
2010	Environment	ENV07	Metrology for Pressure, Temperature, Humidity and Airspeed in the Atmosphere	T & H
2011	SI Broader Scope	SBS01	Implementing the New Kelvin (InK)	T
2011	SI Broader Scope	SBS10	Novel Techniques for Traceable Temperature Dissemination (NOTED)	T
2011	New Technologies	NEW09	Metrology of Electro-Thermal Coupling for New Functional Materials Technology	TPM & T

HiTeMS: solving high temperature measurement problems in industry

➤ 14 formal partners:

- **NMI partners:** NPL (coordinator, UK), CEM (ES), CMI (CZ), CNAM (FR), INRiM (IT), LNE (FR), PTB (DE), SMU (SK), TUBITAK UME (TR), VSL (NL)
- **Industrial Partners:** GDF-Suez, Meggitt Sensing Systems, Commissariat à l'Energie Atomique (CEA), Endress-Hauser

➤ 6 workpackages (WPs), each addressing a different high temperature measurement challenge:

- 3 addressing **non-contact thermometry**
- 3 addressing **contact thermometry**

HiTeMS: solving high temperature measurement problems in industry

➤ Typical sectors impacted:

- Aerospace/space (1300 °C – 3000 °C)
- Nuclear fuel and essential nuclear safety testing (1800 °C – 2500 °C)
- Refractory metals (2500 °C)
- Silicon carbide, carbon/carbon composites (> 2800 °C)
- Iron, steel, glass and ceramics (1100 °C – 2000 °C)



HiTeMS: solving high temperature measurement problems in industry

- **WP1:** Traceable and accurate measurement techniques for *in-situ* surface temperature above 1000 °C
- **WP2:** validated methodology for lifetime and drift tests for thermocouples above 1000 °C
- **WP3:** selfvalidating contact thermometry sensors for above 2000 °C
- **WP4:** Validated methods for non-contact thermometry above 2500 °C including novel correcting techniques
- **WP5:** Traceable temperature measurements for exotic thermal processing (with lasers)
- **WP6:** Establishment of reference functions of non-standard thermocouples

InK: Implementing the new kelvin

- Develop and demonstrate primary thermometry methods that will challenge and supplant the defined scales at very high (>1000 °C) and ultra-low (1K) temperatures
- Determine new values of $T - T_{90}$ with the world's lowest uncertainties (≤ 1 mK) from 1 K to 933 K
- Determine new values for $T - T_{2000}$ which will address the discrepancy in existing background data of the PLTS-2000

InK: Implementing the new kelvin

- **WP1:** Assignment of thermodynamic temperature to HTFP above 1000 °C
 - Re-C, Pt-C, Co-C and Cu ($U = 0.5 \text{ K}$ at Re-C to $U = 0.05 \text{ K}$ at Cu)
- **WP2:** Realisation and dissemination of thermodynamic temperatures at high temperatures
 - *a priori* calibrated HTFPs
 - absolute radiometry, directly traceable to the electrical watt, the meter and the second
- **WP3:** Determination of $T - T_{90}$ with ultra-low uncertainties
 - $T - T_{90}$ through DCGT, RIGT, AGT, ENT, Primary Radiometry
 - twofold reduction in uncertainties in the range 150 K to 500 K
 - measure $T - T_{90}$ in ranges where few or no determinations exist (500 K to 1000 K, < 77 K and where there are inconsistencies: 25 K to 255 K)
- **WP4:** Primary thermometry for low temperatures
 - New and improved thermometers to simplify the dissemination of the kelvin at ULT
 - Resolve discrepancies in the background data for the PLTS-2000



NOTED: Novel techniques for traceable temperature dissemination

- **Objective:** the development of new advanced techniques for providing improved traceability to the kelvin to support its wider and simpler dissemination to users



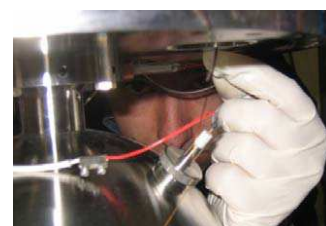
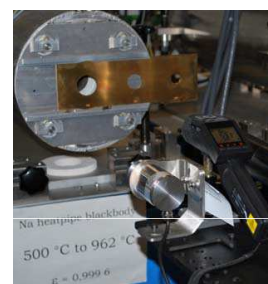
NOTED: Novel techniques for traceable temperature dissemination

- **WP1:** Reducing the uncertainties related to the realisations of the defining fixed points
 - *Thermal effects and impurity effects*
- **WP2:** SPRT and CSPRT calibration procedures and temperature scale non-uniqueness
 - *SPRT oxidation, contamination, annealing*
- **WP3:** New temperature fixed points for improved dissemination of ITS-90 and future ITS
 - *Fill the gaps between current defining FPs*



NOTED: Novel techniques for traceable temperature dissemination

- **WP4:** New Approximation of the kelvin in the range from 500 °C to 1000 °C
 - *InGaAs detector based radiation thermometers and NIR tunable radiation thermometers*
- **WP5:** Exploring new methods to establish traceability to the kelvin
 - *Au/Pt thermocouples to supplant the HT-SPRTs*





9th International Temperature Symposium (Disneyland, Anaheim California, 19 -23 March 2012)

- Major event for the thermometry world community
- Substantial contribution from EURAMET countries:
 - 81 papers from EURAMET countries out of 250 papers



Symposium on Temperature and Thermal Measurements in Industry and Science

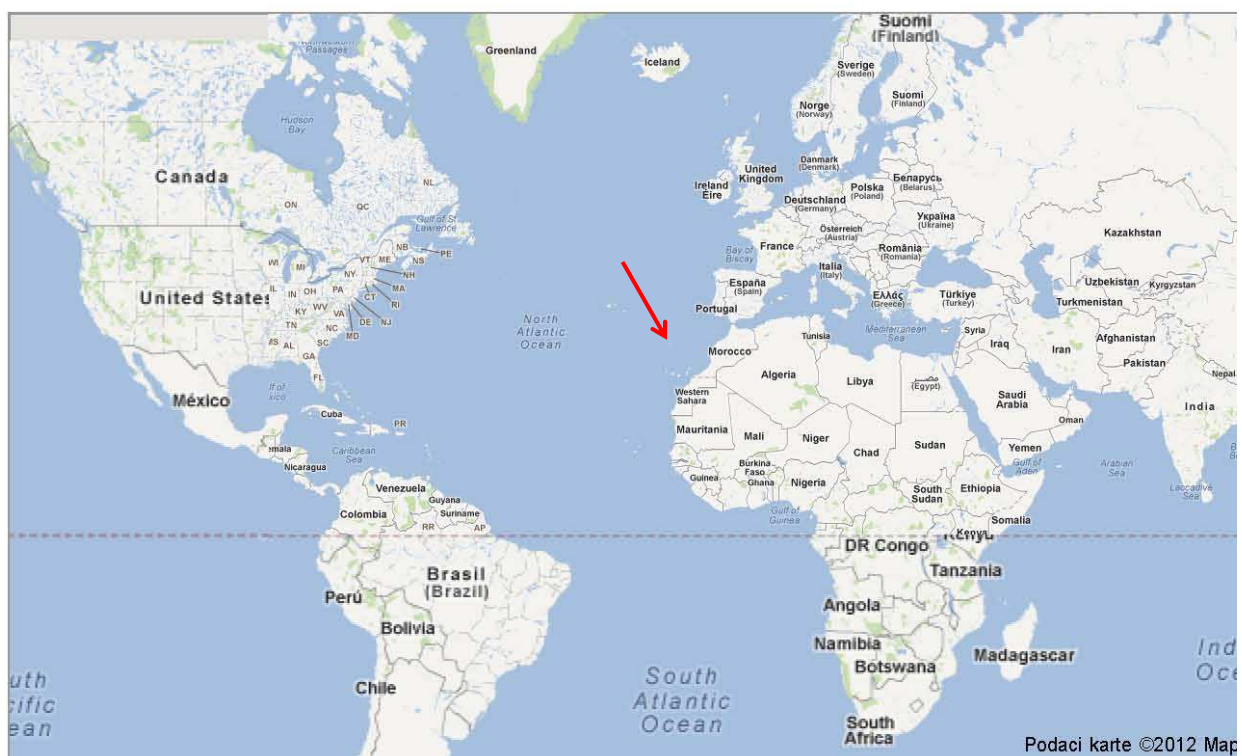
14th – 18th October 2013
Funchal



Funchal is on the Island of Madeira



Where is Madeira?





Why Madeira



- Madeira is a renowned tourist destination
- Good infrastructure for events
- Amazing scenery
- Friendly people
- Good weather
- Excellent wine
- Easy access
- Low cost air companies
- Convenient mix of hotels
- Easy access to the other islands

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Dates

October 14 – 18, 2013

- Low season
- Good mild weather



Conference Deadlines

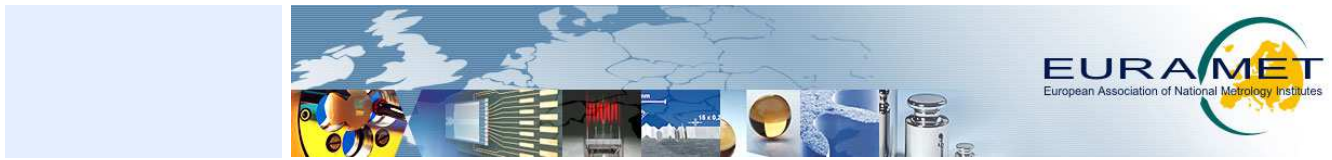
<i>First call for papers</i>	–	<i>October 2012 (One year prior)</i>
<i>Final call for papers</i>	–	<i>January 2013 (Nine months prior)</i>
<i>Abstracts acceptance</i>	–	<i>March 2013</i>
<i>Manuscripts due</i>	–	<i>June 2013</i>
<i>Program finalized</i>	–	<i>September 2013</i>
<i>First day of TEMPMEKO</i>	–	<i>October 14th</i>

Christophor Colombo (when he was not discovering America) lived with his wife in Madeira



Colombo's house in
Porto Santo - **Madeira**





HIGHLIGHTS and SCIENTIFIC CHALLENGES of the TC-T

Thank you for your Attention!