TCEM: Highlights

François Piquemal

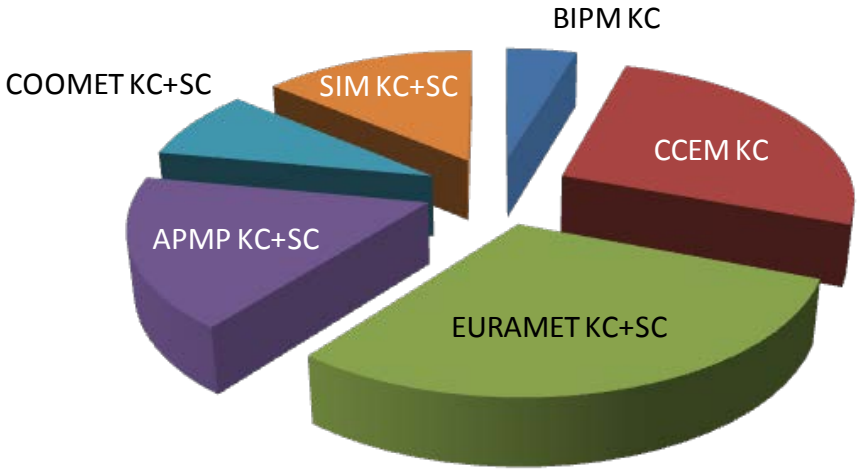
1) CIPM/MRA: comparisons and CMC

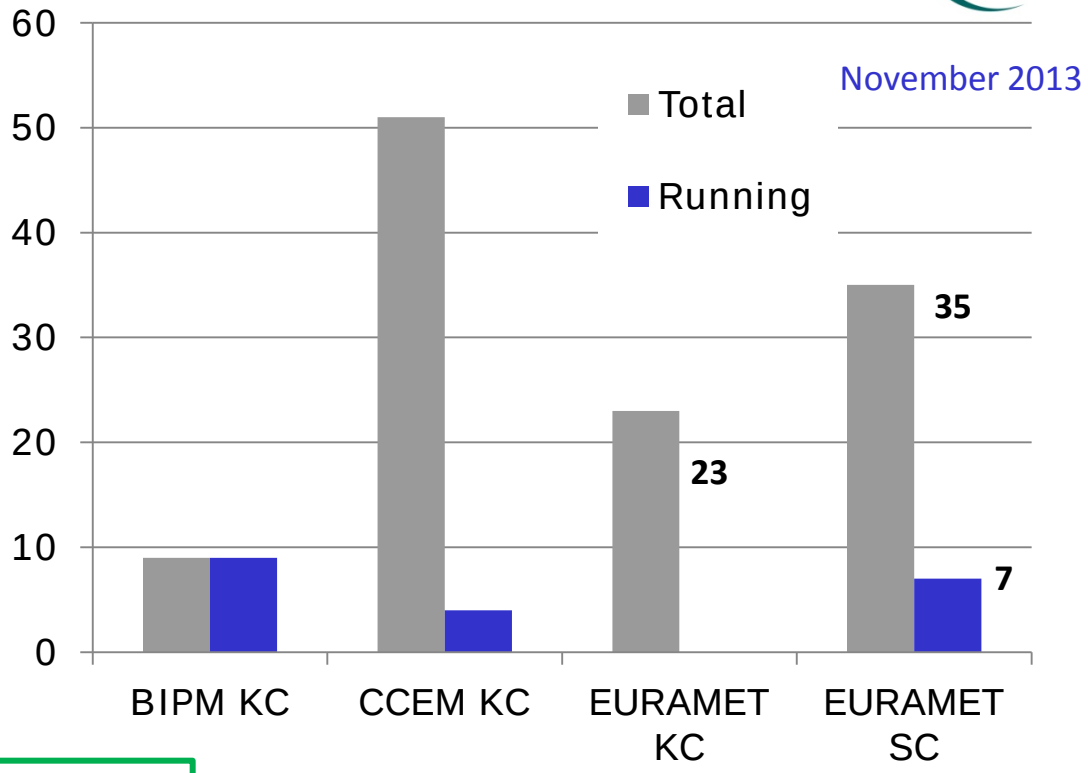
2) iMERA+/EMRP: Overall Results

Comparisons

EURAMET
European Association of National Metrology Institutes

Strong activities





Nb of comparisons steadily increasing:

Over the last 3 years

- ✓completed : 2 to 3 / year
- ✓on-going : 9 / year, constant
- ✓Duration period ≅ 4 years (KC, SC)

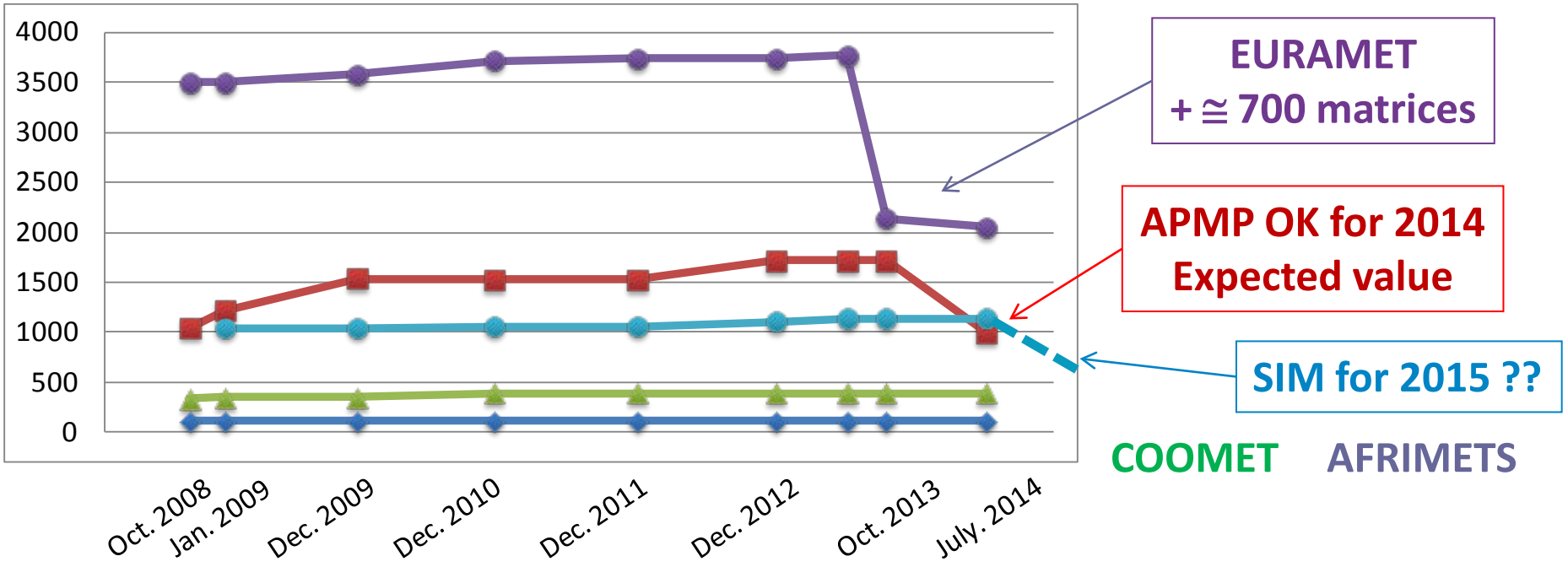
Completed comparisons

	End 2003	Nov 2013
EURAMET KC	11	23
EURAMET SC	16	28

CMC: cleaning-up of CMC tables from 24 NMIs

KCDB office :

"gain in clarity for the KCDB users, gain in efficacy for the NMIs, the RMOs and the KCDB Office as files are easier to handle and review, and more detailed information on the uncertainties that are claimed"



Overall Results of TCEM in iMERA+/EMRP

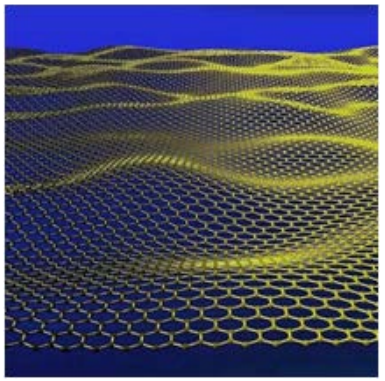
- ✓ 33 founded JRPs over 140 (24%)
- ✓ Success rate: 62 %
- ✓ All calls except for « length » and « Environment »

Fund. SI (QM+WB)	13
Low Freq. (P&E)	12
HF&MW	8

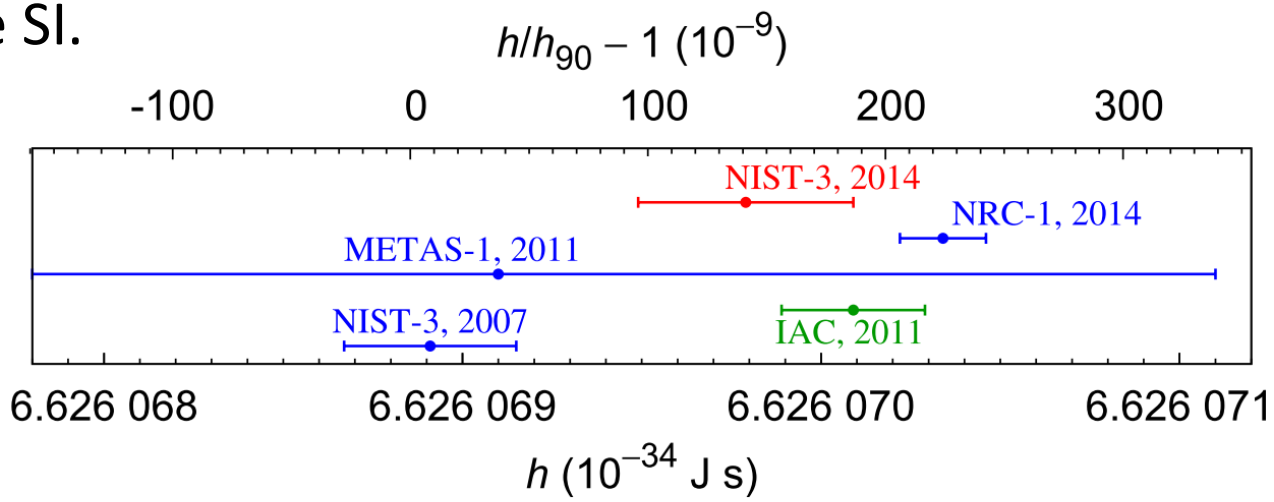
iMERA+				EMRP												
2008 - 2011				call 2009 2010 - 2013	call 2010 2011 - 2014		call 2011 2012 - 2015			call 2012 2013 -2016			call 2013 2014 - 2017			
SI	H	L	EM	En 1	Env 1	Ind 1	H	NT	SI BS 1	Ind 2	SI BS 2	OE	En 2	Env 2		
e-Mass			JOSY	Energy harvesting		EMINDA	MRI safety	THz security	KNOW	EMC	Graphohm	SPINCAL	SolCell			
Reuniam			ULQHE	Power plant		MetMags		MEMS	Qu-ampere	MORSE	Q-WAVE	µphoton	SmartGrid 2			
			Nanospin	SSL		Ultrafast Electronics					HF-Circuits		Future Grids			
			Power & Energy	Smart elec. grids							Aim-QUTE		GridSens			
			EMF&SAR	HVDC												

Fundamental metrology (SI & QM)

EURAMET leadership maintained over the last years thanks to the remarkable results obtained on QHE in graphene, SET pumps, Josephson devices.



Big efforts pursued on fundamental tests (Δ…) and determination of constants (h, e, α) placing some EURAMET NMIs at the forefront in the discussion of revising the SI.



Metrology for Low Frequency quantities

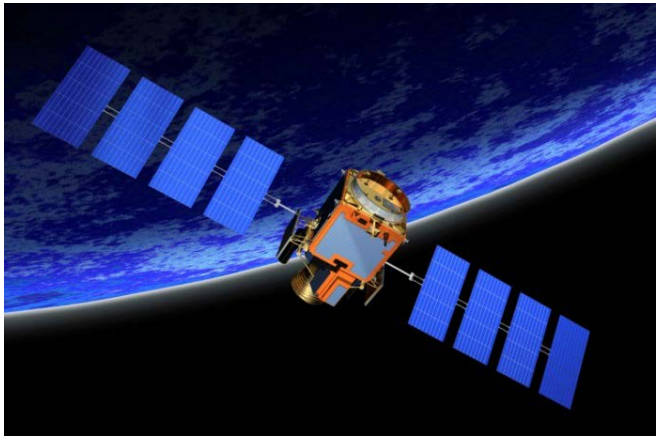
Since 2007, EURAMET NMIs never stopped developing capabilities to efficiently support stakeholders involved in the pioneering decision of EC towards energy transition .

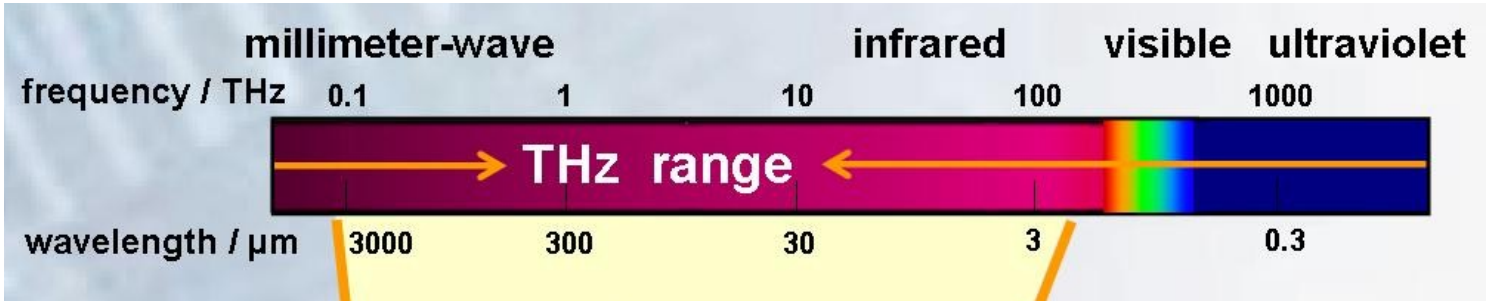
- Generation (incl. Harvesting)
- Distribution (smart grid)
- Storage
- Consumption

RadioFrequency and MicroWave metrology

A more solid traceability to SI units in fundamental measurement quantities with a push to higher frequencies (THz).

Extending the range of capabilities on track to deal with emerging ICT issues and human exposure to EMF.





Conclusion and outlook (1)

✓ **Very wide capabilities and skills of EURAMET NMIs duly established in EM over all frequency range, from DC to hundreds of GHz.**

✓ **Global leader in research (not only in EM)**

- Quantum and HF&MW metrology;
- *via* open EURAMET expert meetings and JRPs in all subfields

✓ **Strong efforts in P&E (smart grid)** allowing EURAMET to catch up with NIST and support European stakeholders towards energy transition

Conclusion and outlook (2)

✓ **General trend of the strategic research agenda towards**

- **Quantum SI**

  Quantum engineering ⇒ quantum enhanced standards

- **Emerging ICT (nanoelectronics, THz, NFC/wireless)**

- **Multi-parameter (hybrid) or multidisciplinary metrology**

  - Multi-parameter characterization of RF systems
  - Charact. of electrical, mechanical, optical … properties of materials or devices
  - Large experiments (watt balance, Avogadro … γ'_p, *G* ?)

- **Great challenges**

  Energy, possible actions in Health and environment

- **Prenormative research**

  P&E meas., smart grid, communic. systems and EMC testing, nanoelectrotechnics

Hvala lijepa !