



**TC Length:**  
**Highlights and Challenges**

**Michael Matus, TC-L Chair**  
**BEV, Austria**

**5<sup>th</sup> General Assembly**  
**Sarajevo, Bosnia and Herzegovina, 6 to 9 June 2011**

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**OUTLINE**

- Retrospection of challenges and highlights in TC-L
- MRA (CMC) Matters
- TC-L meetings

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## Metrological Challenges for TC-L

Both, the definition and the realization of the unit, are in a highly-developed state since many years. It is hard to envisage that the uncertainty of the unit (some  $10^{-14}$ ) can ever be a limiting factor for real dimensional measurements



So are there challenges at all?

Not in the realization but in dimensional metrology where real demands are coming from the user-side.

Three not so eye-catching examples will be demonstrated in the following

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## Research & Development Collaboration

**The role of EMRP**


The running projects within TC-L show a real intensive collaboration between institutes. This kind of cooperation was unusual in the length community.

About four years ago only the few big NMIs were able to initiate or to take part on multinational metrology projects. This situation has changed dramatically.

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## Metrological Challenges for TC-L



**Onsite dimensional metrology using data fusion techniques**

Ways to cope with some of the problems are the integration of optical and tactile probing systems on the same or separated CMMs, eventually complemented by laser tracer and/or trackers, Integration of X-ray CT, local form sensors etc. → Measurement data originating from different systems acting on the same artefact.

And the evaluation should be as fast as the production!

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## Metrological Challenges for TC-L

Huge amount of input data ( $10^5$  -  $10^9$ ) with different uncertainties and degrees of traceability can be used to obtain global features of interest (e.g. airplane wing “shape”, geometry of microparts)

**Calibration artifacts**


**Integration techniques**

**Traceability routes**



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## Metrological Highlights for TC-L

NIMTech to master some challenges. **EMRP**



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## Metrological Challenges for TC-L

**Long range dimensional metrology**

Main challenge is to estimate the mean refractive index of air better than  $10^{-7}$  (all other influence quantities are mastered nowadays). Doesn't sound too ambitious compared to the  $10^{-14}$  of the unit realization. But no commercial instrument exist nowadays.

**parameter route**

- mean air temperature better than 0.1 °C
- air humidity also important

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## Metrological Highlights for TC-L

### Long range dimensional metrology

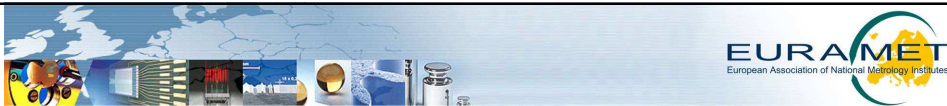
Multi-wavelength route: utilizing the dispersion of air to deduce the relevant parameters

On line air spectroscopy: Using absorption ratios of ro-vibrational transitions in air molecules ( $O_2$ ) to measure their temperature.

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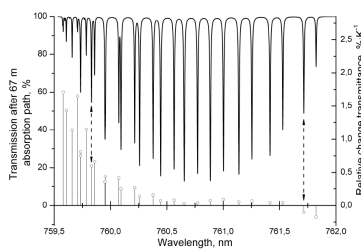
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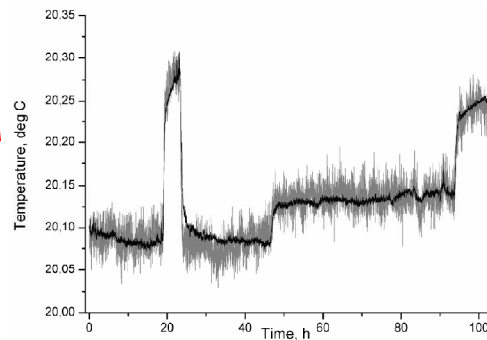


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## Metrological Highlights for TC-L



MIKES



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## Metrological Highlights for TC-L


Long range dimensional metrology

Different routes to reach the target + method of validation  
→ only possible by many NMIs (!) joining their efforts



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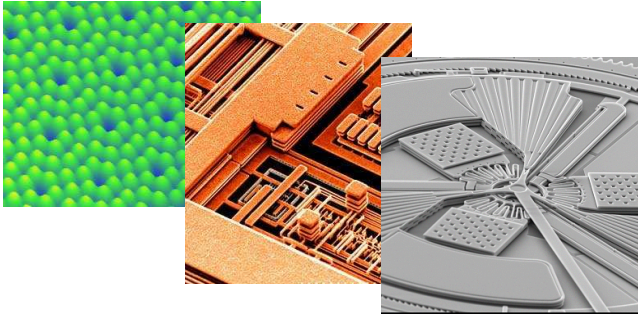


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## Metrological Challenges for TC-L

Needs for higher accuracy and traceability at short distance:  
NanoTrace,  $U \approx 10$  pm

- Nanometrology
- Microelectronics
- Micromechanics



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## Metrological Highlights for TC-L

Many different types of LI to be compared with the COXI! EMRP














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## Support to Members

Projects other than KC/SC


Also in former times (pre-EMRP) there were already some kind of support within EURAMET: Roughly 1/3 of running TC-L projects fall into the category “Cooperation in Research” or “Consultation of Facilities”. These projects have proven to be of great help.

Many incoming NMIs have gained considerable support from the EURAMET community in implementing services.

These projects are mainly unfunded and small size. There is some concern in TC-L that they will eventually become “endangered species”

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## MRA related challenges for TC-L


**Duration of key comparisons**

A lot of measures had been taken to rationalize the process of key comparisons. This includes the elaboration of guide lines for all the parties involved, documents on linking, streamlining of the KC portfolio.

Tardiness of the pilot seems to be the only problem which can not be handled in an easy way.

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## MRA related challenges for TC-L

**Duration CMC review**

Many measures of the former point are strongly related to the CMC process also.

Strict dead-line procedure could be installed (2 sets/year). The delay for institutes to wishing to update their CMCs is considerably short.

It should be noted that the EURAMET approach is quite different from the APMP process.

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## TC-L Meetings

TC-L CP 2010 Sweden 20-21 Sep. 2010

TC-L CP 2011 held at METAS, Switzerland, Oct. 2011



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# Thank you for your attention!

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