Report to the 14th CCM Meeting on Working Group Mass and associated Task Groups 1 & 2

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Role of WGM

- **Working Group on Mass Standards**
  - To study, develop and advise the CCM on issues related to mass standards
  - To define, organize and approve the necessary key comparison
  - To collaborate with the WGSI-kg, Task Group 1, Task Group 2 and other relevant WGs

Task Groups 1 & 2 address research issues associated with the future re-definition of the kilogram …

Role of Task Groups 1 & 2

- **TG1 - Mass metrology under vacuum**
  - **For a *mise en pratique* of the definition of the kilogram**
    - Mass-in-vacuum to mass-in-air, mass stability
    - Materials for masses, surface studies, cleaning techniques
    - Experiments for future realisation of kg
    - Mass transfer/transportation, mass metrology for new kg definition
- **TG2 – Uncertainty due to traceability to IPK**
    - Correlation between measured mass values of prototypes
    - Recommendations for additional measurements
      - some including IPK
    - Uncertainty components inherent in *mise en pratique o*f kilogram

Recent meetings: Task Group 1, am 18 Feb 2013

- **Scientific presentations including**
  - **PTB - ^{28}Si sphere mass determination & stability**
  - **BIPM - status of BIPM ensemble of mass standards**
  - **NIST - mass-in-air vs mass-in-vacuum, surface artefacts**
  - **METAS - extensive surface studies, analysis tools**
  - **NPL - air-vacuum mass transfer**
  - **NRC - development of vacuum mass metrology**
- **Also**
  - **Discussion of draft *mise en pratique***
    - From vacuum mass metrology perspective
  - **TG1 comparison of sorption artefacts**

Recent meetings: Task Group 2, pm 18 Feb 2013

- **Focus**
  - **Modelling historical mass behaviour of prototype copies**
- **Three approaches developed & presented**
  - **DFM - Least squares analysis with *t* and $\sqrt{t}$ dependence on time after cleaning**
    - Gives values up to 30 µg different from those assigned by BIPM
  - **NRC - Modelling with Kalman filter**
    - Results not yet available
  - **BIPM - Optimised fitting using three parameter model**
    - Gives values originally assigned. Expected as this approach mimics the way BIPM traditionally has assigned mass values

Task Group 2 Meeting (ctd)

- **Conclusion**
  - **The analysis shows that proper modelling of the change in mass of a prototype over time is necessary in order to disseminate traceability from the international prototype to the national copies with a standard uncertainty of about 0.006 mg.**
- **Future work**
  - **Modelling stability of pool of artefacts**

Recent meetings: WGM, 19 Feb 2013

- **Wide range of mass related presentations**
  - NPL - cleaning, transfer and storage towards new kg
  - METAS - 3 talks on cleaning and surface studies
  - NRC - Novel mass artefacts for watt balances
  - LATU - Magnetic field gradients in electronic balances
  - BIPM - Proposal to use IPK
  - INRIM - mass activities
  - MSL - watt balance based on pressure balances
  - BIPM - ensemble of mass standards

Generally high quality of scientific work presented at meetings of TG1, TG2 and WGM

WGM meeting – Key comparisons

- **Current CCM mass comparisons**
  - **CCM.M-K4 pilot BIPM, 17 participants**
    - 1 kg SS
    - Started 2011 Status: Results being analysed
  - **CCM.M-K6 pilot CENAM, 10 participants**
    - 50 kg
    - Started 2011 Status: Protocol complete
  - **CCM.M-K7 pilot KRISS, ? participants**
    - 500 mg, 5 g, 10 g, 100 g, 5 kg (Set 3)
    - Planned Status: Protocol complete
- **New CCM mass comparisons for approval**
  - **None**

WGM meeting – Proposals to CCM

- **Approval is sought from the CCM**
  - To form a new working group WGD-kg for the dissemination of the kilogram by combining the current WGM with Task Groups 1 & 2. This will replace the current WGM.
  - To confirm Dr Chris Sutton as chair of WGD-kg
  - To confirm members of WGM and Task Groups 1 & 2 as members of WGD-kg
- **New mass comparisons for CCM approval**
  - None

Outputs from WGM, TG1 and TG2 meetings

- **Presentations from the WGM, TG1 and TG2 meetings and a summary of the WGM meeting**
  - **will be made available on the CCM-WGM (restricted access) part of the BIPM website (subject to author approval)**
    - User CCM-WGM (later CCM- WGD-kg)
    - Password kilo

Any questions?