

# BIPM Report to the EURAMET General Assembly

Dr Martin Milton  
Director, BIPM



Bureau  
International des  
Poids et  
Mesures

Krakow  
June 2015

## Content

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- ◆ Towards a new SI
- ◆ Review of the CIPM MRA
- ◆ *25th Conférence Générale des Poids et Mesures*
- ◆ Members and Associates

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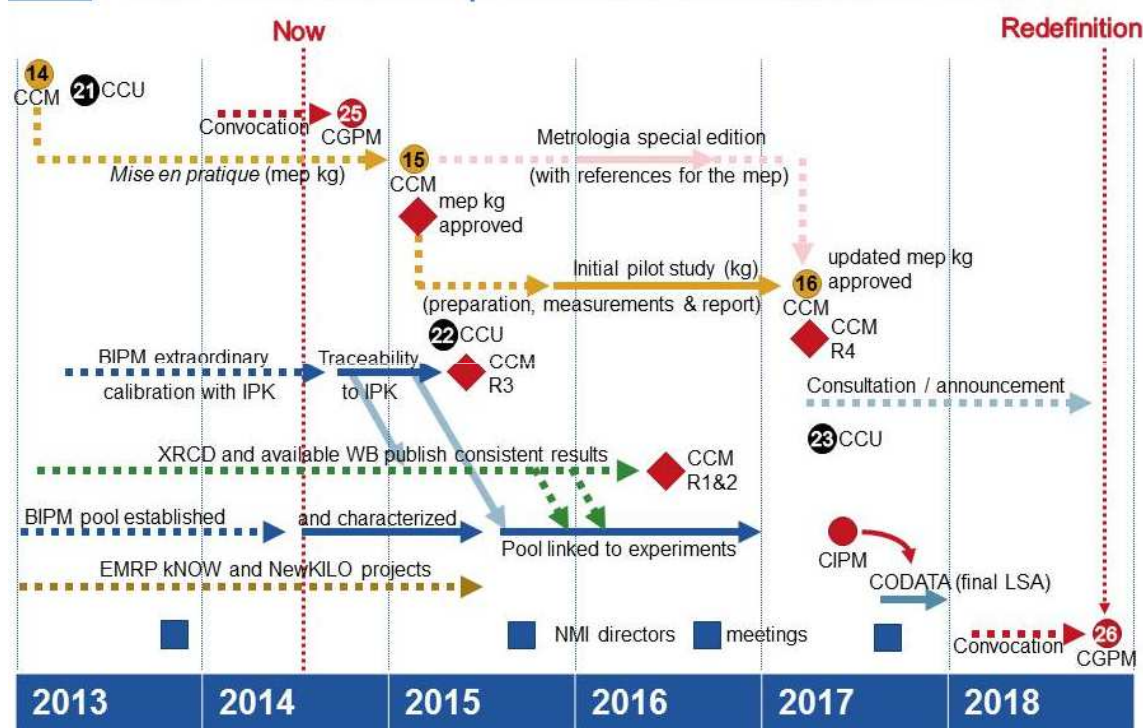
## Towards a new SI



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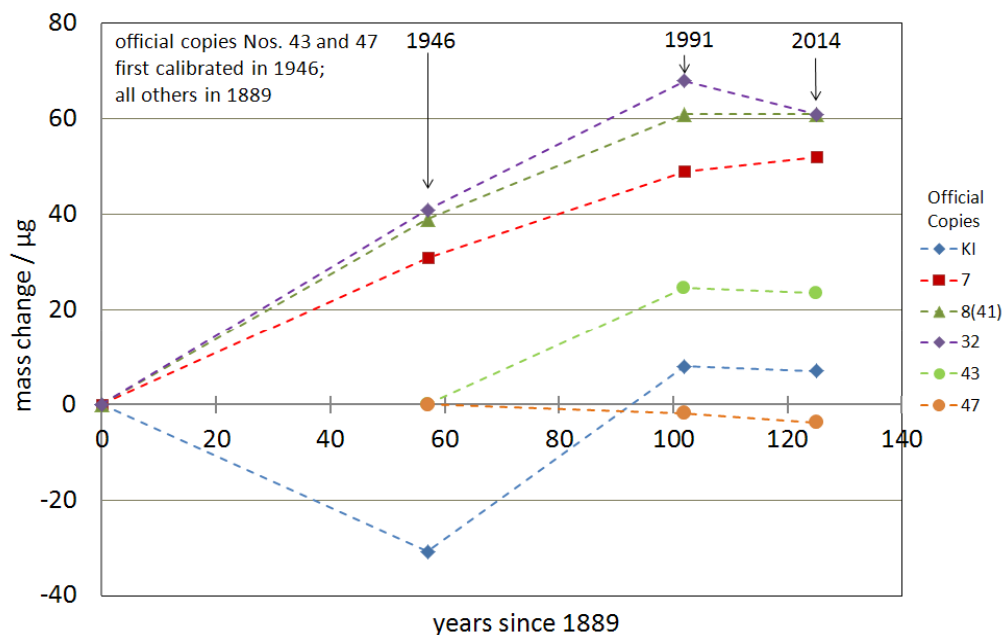
## The CCM roadmap towards a redefinition in 2018



◆ Conditions from CCM G1 (2013)

METAS 18.07.2014 5

# “Extraordinary Calibrations” with the International Prototype of the Kilogram and official copies



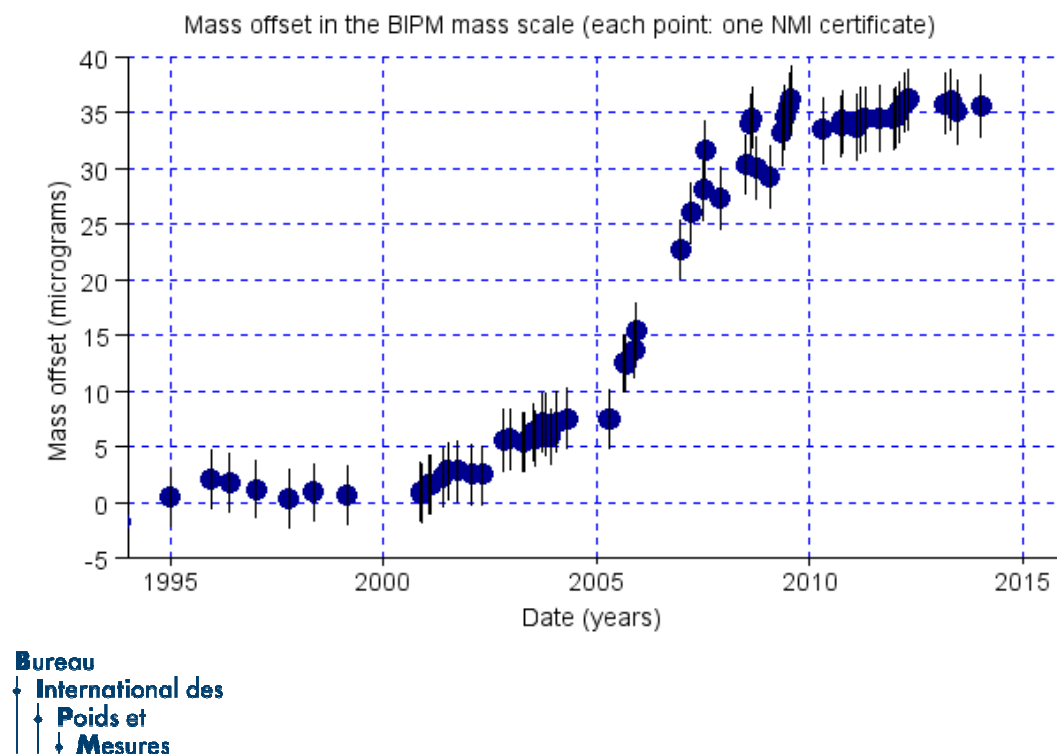
## The BIPM “as-maintained” mass unit

- Since the IPK is only accessible at the time of agreed *Periodic Verifications*, the BIPM must maintain a mass unit in its laboratoires using working standards – « the BIPM as-maintained mass unit »
  - This was last traceable to the IPK in 1992.
- As a result of the 2014 measurements with the IPK, the BIPM as-maintained mass unit has been found to be 35 mg different from the IPK:

$$m(X)_{\text{maintained}} - m(X)_{\text{IPK}} = + 35 \text{ mg}$$

- All BIPM working standards have lost mass wrt to the IPK since 1992 (3rd PV), between 18 mg and 88 mg
- The relative drift within the set of working standards had been noticed by BIPM, but not the common drift (because IPK was not available)
- The undetected common drift has led to the offset of the BIPM mass unit

## Evolution of the offset of the “as-maintained” mass unit



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## CCM Recommendation to NMIs on managing the consequences of the corrections to the BIPM as-maintained mass unit

The Consultative Committee for Mass and Related Quantities (CCM), at its 15<sup>th</sup> meeting in 2015,

### considering

- the good uniformity of world-wide mass measurements of NMIs in CCM.M-K4 (key comparison of 1 kg stainless steel standards),
- that CMCs for mass calibrations at the level of 1 kg have uncertainties that range from 28  $\mu\text{g}$  to 1850  $\mu\text{g}$ ,
- that determinations of the Planck constant will provide the basis for the future definition of the kilogram after the introduction of the “new SI”,
- that an extraordinary calibration using the International Prototype of the Kilogram (IPK) took place at BIPM from January 2014 to January 2015,
- that the BIPM as-maintained mass unit (traceable to the IPK at the 3rd Periodic Verification (3rd PV) 1988-1992) had changed over 22 years by 35  $\mu\text{g}$ ,
- that a mathematical model established by BIPM was able to explain this change between the 3rd PV and 2014,
- that the BIPM will update calibration certificates issued between 1.1.2003 and 31.12.2013 for calibrations of 1 kg mass standards,

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**decides**

- that the published results of key comparisons carried out by the CCM will not be corrected, and that the WGD-kg will advise the RMOs about how degrees of equivalence may be linked in a way that maintains consistency,

**recommends**

- that determinations of the Planck constant shall be updated based on the corrections provided by the BIPM to the NMIs concerned,
- that NMIs receiving updated calibration certificates from the BIPM should take appropriate action as regards the need to inform their customers and the correction of calibration certificates affected, and should take the updated mass values as the basis for their future calibrations.

**Revised certificates**

- 69 revised certificates sent for Pt/Ir standards in April/May 2015
- 92 revised certificates to be sent for SS standards in May/June 2015

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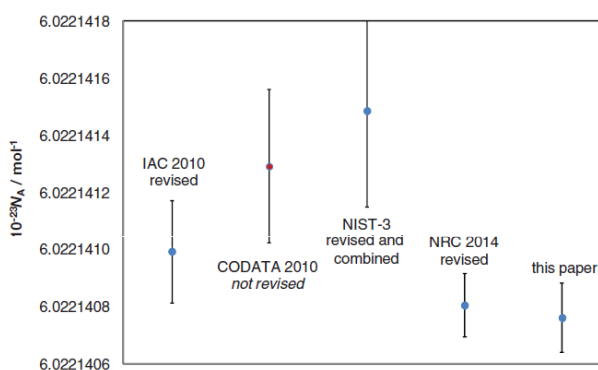
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## Towards a new SI

New data published in the April edition of *Metrologia*.

**CCM criteria**

At least 3 experiments, using  
2 different methods with  
 $u_r < 50$  ppb,  
at least one with  $u_r < 20$  ppb.



The most accurate Avogadro constant determinations available at present. The value labelled CODATA 2010 is not corrected for the recalibration of the mass standards following the Extraordinary Calibration Campaign against the IPK. The vertical error bars indicate the standard uncertainty of each value.

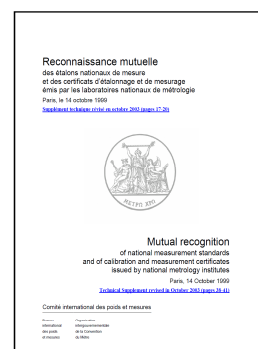
*Metrologia* 52 (2015) 360

# Review of the CIPM MRA

## Review of the CIPM MRA

It is approaching 15 years since the CIPM MRA was signed,  
**Since 1999:**

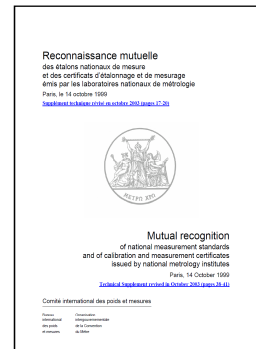
- ◆ Continuous *growth in all areas of metrology* to cover:
  - 887 key comparisons
  - 404 supplementary comparisons
- ◆ The calibration and measurement capabilities of the participants are recognised through
  - 25 000 published claims.



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Whilst considered a great success, Member States are calling for a rationalization of the workload in order to enter what is being termed a “sustainable” phase.

- ◆ The CC strategies brought the planning of CC Key comparisons under a more strategic direction, and in many cases the number of planned comparisons was reduced.
- ◆ In March 2013, the JCRB organised a workshop on CMC review which led to some incremental improvements in efficiency, but no substantive “step” changes.

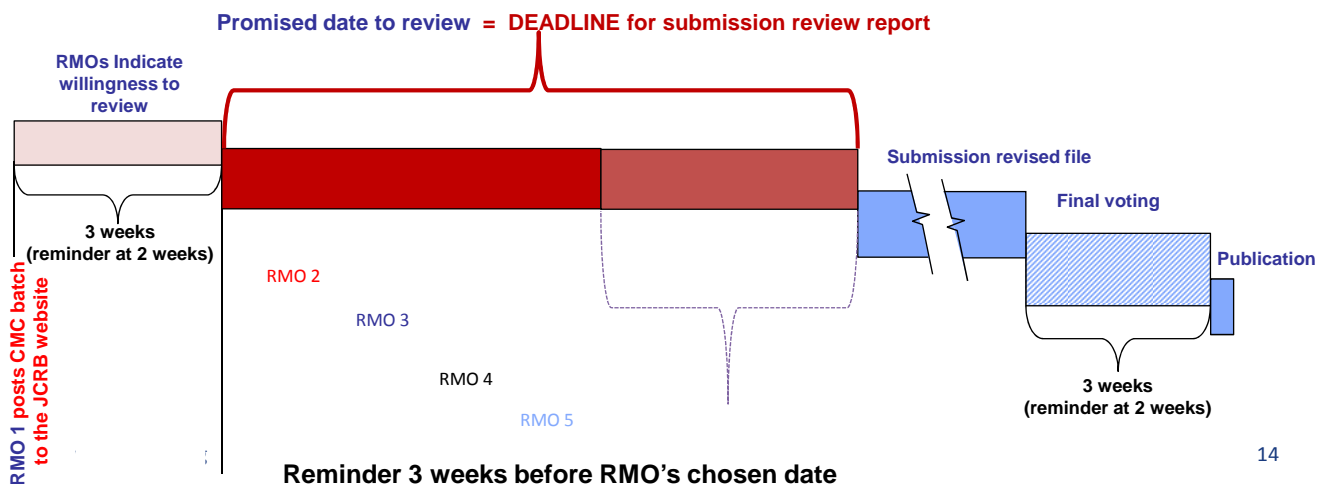
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## Improvements in Inter-regional CMC Review

Changes have been made to the CMC review process following the 30th JCRB meeting.

- The time to indicate “intention to review” has been reduced from 6 to 3 weeks (with a reminder after 2 weeks);
- The deadline chosen by each RMO for submission of its review report has been made a “hard deadline” (with a reminder 3 weeks before);
- The deadline for approval of CMCs has been reduced from 6 to 3 weeks (with a reminder after 2 weeks).



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## Some statistics from the Database

### Results of analysis of CMC sets which were posted and approved on the JCRB CMC review website

Time Period	CMC Sets			Average time, post to publish, days	
	Submitted to JCRB	Approved			
		Fast track	Classic	Fast track	Classic
Jan '13 to July '13	33	13	13	17	107
Aug '13 to Feb '14	35	11	13	17	76
Mar '14 to Feb '15	51	15	21	15	131

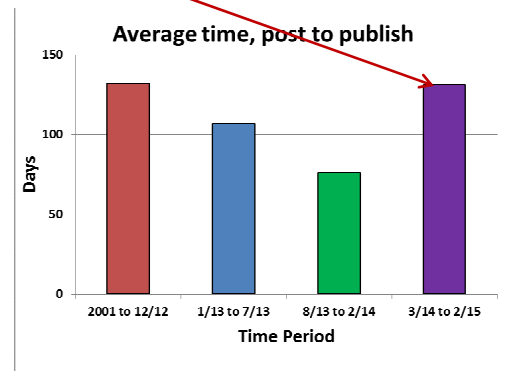
Classic review, Mar '14 to Feb '15	Average time, days
Post CMC to last RMO review	62
Last RMO review to revised post	55
Revised post to publish	14
<b>Total</b>	<b>131</b>

#### Old deadlines

- Indicate intent to review – 6 wks (remind at 3 wks)
- Submit review report – RMO chosen date + 6 wks (remind at 3 wks)
- Vote – 6 wks (remind at 3 wks)

#### New deadlines: applied since August 2013

- Indicate intent to review – 3 wks (remind at 2 wks)
- Submit review report – RMO chosen date (remind at 3 wks)
- Vote – 3 wks (remind at 2 wks)



## Initiating a review of the CIPM MRA

- ◆ **25<sup>th</sup> CGPM (Nov 2014) - Resolution E, On the importance of the CIPM Mutual Recognition Arrangement**
- ✓ a **workshop planned for 2015 to engage in a broad discussion of the CIPM MRA**, involving: Directors of National Metrology Institutes, Member States representatives, representatives of RMOs and other relevant stakeholders concerning the **benefits of the CIPM MRA**, as well as establishing views on **what works well**, and **what needs to be improved regarding its implementation**,
- ✓ the **CIPM to establish a working group under the chairmanship of its President**, with membership to be determined at the 2015 workshop, to conduct a review of the implementation and operation of the CIPM MRA,

<http://www.bipm.org/utis/common/pdf/CGPM-2014/25th-CGPM-Resolutions.pdf>



*25th Conférence Générale des Poids et Mesures  
November 2014, Versailles*



# 25th Conférence Générale des Poids et Mesures

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- ◆ Delegates: 46 BIPM member states. Observers: 20 Associate States and Economies
- ◆ Chaired by Professor Philippe Taquet, president of French *Académie des Sciences*
- ◆ Presentations by:
  - Dr Barry Inglis, President of the CIPM
  - Dr Martin Milton, Director of the BIPM
  - CIPM Consultative Committee Presidents
  - International organisations and invited speakers

<http://www.bipm.org/en/cgpm-2014/>

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## Resolutions of the 25<sup>th</sup> Meeting of the CGPM

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- ◆ Resolution 1 - On the future redefinition of the International System of Units, the SI
- ◆ Resolution 2 - On the election of the International Committee for Weights and Measures
- ◆ Resolution 3 - On the Pension and Provident Fund of the BIPM
- ◆ Resolution 4 - Dotation of the BIPM for the years 2016 to 2019
- ◆ Resolution 5 - On the importance of the CIPM Mutual Recognition Arrangement

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**Background:** 25<sup>th</sup> CGPM, amendment to Resolution 4 ‘Dotation of the BIPM for the years 2016 -2019’  
“....urges Member States, as well as international organizations, private organizations and foundations to maintain the provision of additional voluntary support of all kinds **to support specific BIPM mission-related activities, particularly those that facilitate participation in the activities of the BIPM by those countries without well-developed metrology infrastructure.**”

### Programme goals:

- To assist individual NMI staff, NMIs and RMOs to increase their understanding and capability with regard to engagement in the world metrology system, with the aim of strengthening the capacity of the international metrology community to operate the world-wide measurement system on an equitable cost-shared basis.
- To embed metrology more effectively in wider quality infrastructure development initiatives.

## BIPM CBKT Proposed Activities

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### Focused training opportunities at the BIPM

- Visits by staff from new/inexperienced Member States and Associates to aid their engagement in the international system;
- Visits by new/inexperienced chairs and potential chairs of RMO TCs/WGs with the aim of improving the efficiency and effectiveness of the CIPM MRA;
- Visits by staff from NMIs that have participated in comparisons but not yet piloted, with the aim of encouraging them to become future pilot laboratories;
- Visits by staff from NMIs that are in the process of developing CMCs for the first time;
- Visits from RMO Secretariat staff.

*Opportunities could also be linked with time spent with the RMO secretariat and/or at the donor NMI.*

### Engagement with the Global QI capacity building community

- Enhanced BIPM engagement in the DCMAS Network;
- Specific engagement with states after they first become involved with the BIPM as Member States or Associates;
- Metrology school activities and placements.

### Comparisons of particular interest to Member States that are developing countries

- Additional BIPM relevant scientific/technical project(s) of interest to developing countries, including visiting scientists.

# Election of the CIPM – by a new process

An election was held for all 18 positions on the CIPM at the CGPM.

Seven New Members were elected.

## New CIPM Bureau Elected

- ♦ President – Barry Inglis (Australia)
- ♦ Secretary – Jim McLaren (Canada)
- ♦ Vice Presidents- Willie May (USA) & Joachim Ullrich (Germany)



## New CC Presidents

CCRI – Wynand Louw (South Africa)

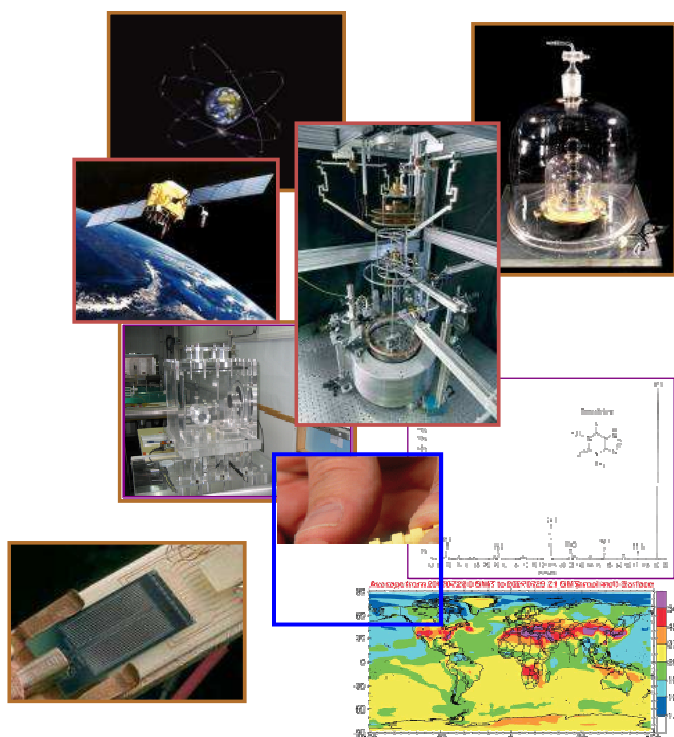
CCL – Massimo Inguscio (Italy)

CCAUUV – Takashi Usuda (Japan)

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# Members and Associates



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# Members States and Associates

**Bureau International des Poids et Mesures** – the intergovernmental organization through which Member States act together on matters related to measurement science and measurement standards.

As of 1 January 2015, there are **55 Member States** of the BIPM, and **41 Associate States** and Economies of the General Conference:

**Member States**

As of 1 January 2015, there are 55 Member States of the BIPM, and 41 Associate States and Economies of the General Conference.

**List of Member States:** [see Associate States and Economies](#)

Argentina	India	Romania
Australia	Indonesia	Russian Federation
Austria	<u>Iran (Islamic Republic of)</u>	Saudi Arabia
Belgium	Iraq	Serbia
Brazil	Ireland	Singapore
Bulgaria	Israel	Slovakia
Canada	Italy	South Africa
Chile	Japan	Spain
China	Kazakhstan	Sweden
Colombia	Kenya	Switzerland
Croatia	Korea (Republic of)	Thailand
Czech Republic	Malaysia	Tunisia
Denmark	Mexico	Turkey
Egypt	Netherlands	United Kingdom
Finland	New Zealand	United States of America
France	Norway	Uruguay
Germany	Pakistan	Venezuela (Bolivarian Rep. of)
Greece	Poland	
Hungary	Portugal	

**Summary**

- Notice of Contributions
- The original signatories
- Procedure for a State to become a Member of the BIPM

**Governance**

- BIPM Compendium
- Procedure for a State to become a Member of the BIPM
- Notice of Contributions
- CIPM publications
- Calculating Member State contributions

**Hub for Member States:**

- Directors of NMIs of Member States
- Representatives of States Parties

**Dominican Republic:**

- no longer a member state
- excluded end of 2014

Metrology area: AUV EM L M PR QM RI T TF U

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**List of Associate States and Economies:** [see Member States](#)

Albania	Ghana	Panama
<u>Azerbaijan</u>	Hong Kong (China)	Paraguay
Bangladesh	Jamaica	Peru
Belarus	Latvia	Philippines
Bolivia (Plurinational State of)	Lithuania	Seychelles
Bosnia and Herzegovina	Luxembourg	Slovenia
Botswana	Macedonia (fmr Yugoslav Rep. of)	<u>Sudan</u>
CARICOM	Malta	Syrian Arab Republic
Chinese Taipei	Mauritius	Ukraine
Costa Rica	Moldova (Republic of)	Viet Nam
Cuba	Mongolia	Yemen
Ecuador	Montenegro	<u>Zambia</u>
Estonia	Namibia	Zimbabwe
Georgia	Oman	

**Since 1 January 2015, Azerbaijan is an Associate.**

**Since 26 June 2014, Sudan is an Associate.**

**Since 21 July 2014, Yemen is an Associate.**

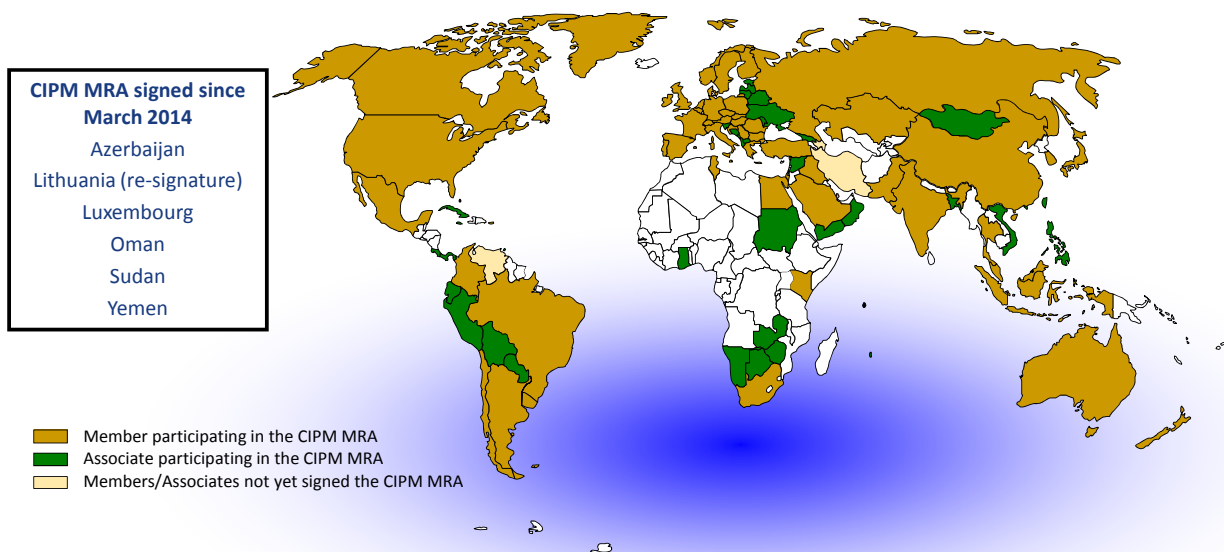
**Sri Lanka:**

- no longer an associate state
- excluded end of 2014

Metrology area: AUV EM L M PR QM RI T TF U

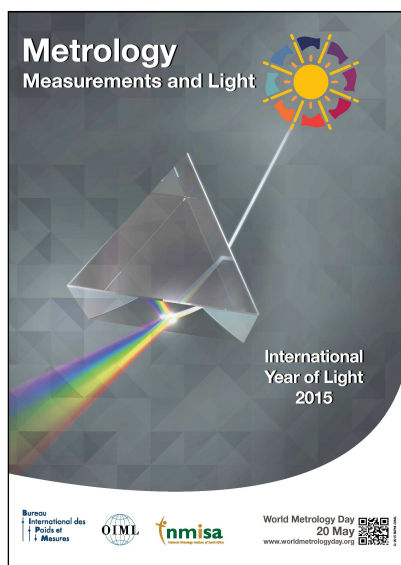
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# CIPM MRA Participation



The CIPM MRA has been signed by the representatives of **98 institutes** – from **53 Member States**, **41 Associates of the CGPM**, and **4 international organizations** – and covers a further **152 institutes designated by the signatory bodies**.

# World Metrology Day



- ◆ Events recorded on the website in 32 countries (30 in 2014).
- ◆ Poster translated into 24 languages (21 in 2014).
- ◆ A new record set according to all metrics: distinct visits, pages viewed, hits and volume

Azerbaijan - Brazil - Bulgaria - Chinese Taipei - Colombia - Denmark - France - Iran - Italy - Korea - Malaysia - Mexico - Norway - Portugal - Saudi Arabia - Singapore - Spain - Syria - Tunisia - Turkey - United Kingdom - United States



# Evolution of the BIPM website

www.bipm.org/en/worldwide-metrology/metre-convention/

Bureau International des Poids et Mesures

– the intergovernmental organization through which Member States act together on matters related to measurement science and measurement standards.

Search facility:

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ABOUT US WORLDWIDE METROLOGY INTERNATIONAL EQUIVALENCE MEASUREMENT UNITS SERVICES PUBLICATIONS MEETINGS

> You are here: worldwide metrology > Metre Convention

## The Metre Convention

→ The Convention of the Metre (Conventio-  
Measures (BIPM), an intergovernmental  
Measures (CGPM) and the supervision of the  
matters of world metrology, particularly of  
range and diversity, and the need to dem-  
onstrate the need for a permanent agree-  
ment on all matters relating to units of  
measurement. The BIPM now has fifty-six Member States, including all the major industrialized countries.

→ The Convention was signed in Paris in 1875, laying down the way in which the  
Metre Convention established a permanent agree-  
ment on all matters relating to units of  
measurement. The BIPM now has fifty-six Member States, including all the major industrialized countries.

→ The Convention, modified slightly in 1901, 1946 and 1983, is a permanent agree-  
ment on all matters relating to units of  
measurement. The BIPM now has fifty-six Member States, including all the major industrialized countries.

General Conference on Weights and Measures (CGPM)  
International Committee of Weights and Measures (CIPM)  
International Bureau of Weights and Measures (BIPM)  
States Parties to the Metre Convention (generally referred to as "Member States")

Text of the Metre Convention, other official texts, and the BIPM Compendium  
Chain of responsibility (the organizational structure of the BIPM)

What is the CIPM MRA?  
Participating laboratories  
CIPM MRA documents  
BIPM key comparison database  
Calibration and measurement capabilities (CMCs)  
CMC approval process  
Use of the CIPM MRA logo  
JCRC: Joint Committee of the RMOs and the BIPM

Bureau of Weights and Measures (BIPM), an intergovernmental organization through which Member States act together on matters related to measurement science and measurement standards.

As well as founding and managed, the BIPM acts in common with the other major industrialized countries.

Summary

- Text of the Metre Convention, other official texts, and the BIPM Compendium
- Chain of responsibility
- General Conference on Weights and Measures (CGPM)
- International Committee of Weights and Measures (CIPM)
- International Bureau of Weights and Measures (BIPM)
- States Parties to the Metre Convention

Governance

- BIPM Compendium
- Procedure for a State to become a Member of the BIPM
- Notice of Contributions
- Annual report (and other CIPM publications)

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# Evolution of the BIPM website

www.bipm.org/en/cipm-mra/cipm-mra-documents/

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ABOUT US WORLDWIDE METROLOGY INTERNATIONAL EQUIVALENCE MEASUREMENT UNITS SERVICES PUBLICATIONS MEETINGS

> You are here: international equivalence: the CIPM MRA > CIPM MRA documents

## CIPM MRA documents

Policy documents Guidance on CMCs Guidance on comparisons Complementary info. Us

Title
Calibration and Measurement Capabilities in the context of the CIPM MRA
Additional instructions and templates for CMC excel files:   General   AUV   EM   PR   QM   RI   TF   U
Links to RMO Guidelines on Quality Systems and CMCs:   AFRIMETS   APMP   COOMET   EURAMET   SIM
For the classification of services in the various fields, see:   AUV   EM   L   M   PR   QM   RI   T   TF   U
Traceability in the CIPM MRA
JCRB guidelines for the monitoring and reporting of the operation of quality systems by
Guidelines for the review of CMCs and the monitoring and reporting of the operation of international intergovernmental organizations who are signatories of the CIPM MRA
Recommendations for on-site visits by peers and selection criteria for on-site visit peer
Uncertainty contributions of the device under calibration or measurement
Subcontracting of measurements under the CIPM MRA

Time and Frequency Metrology

Committee structure

Strategic plan

What time is it?

Timescales

Unit of time (second)

International comparisons

Calibration and measurement capabilities (CMCs)

Recommended values of standard frequencies

BIPM technical work

BIPM calibrations: Time transfer equipment

BIPM technical publications

BIPM Annual Report on Time Activities

FTP server of the BIPM Time Department

IERS Conventions Center

BIPM liaison and coordination work

BIPM contact

Metrology area: AUV EM L M PR QM RI T TF U

metrology/time-frequency/

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# Meetings in 2015

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- ◆ June/July 2015 BIPM Workshops on
  - The New Guide to the Expression of Uncertainty (GUM)
  - Carbon Metrology
- ◆ September 2015 – 34<sup>th</sup> JCRB
- ◆ October 2015 - NMI Director's Meeting (to review the CIPM MRA), CIPM
- ◆ Also during 2015
  - CCM
  - CCRI
  - CCQM
  - CCTF
  - CCL
  - CCAUV

[www.bipm.org](http://www.bipm.org)

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Thank you.

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Daejeon, Korea  
September 2014



[www.bipm.org](http://www.bipm.org)