

Highlights in the work of the BIPM during 2019

Dr Martin Milton
BIPM Director
23 October 2019

Member States and Associates *(As of 06 August 2019)*

- 61 Member States*
- 41 Associates of the CGPM
(States and Economies)

* The official term is "State Parties to the Metre Convention"; the term "Member States" is its synonym and used for easy reference.

110 of the 193 states listed by the UN participate in the BIPM's activities, covering around 98 % of the world's GDP according to 2018 IMF.

New Member States and Associates since last NMI Directors meeting (2017)

New Member States:

- Montenegro on 24 January 2018 (formerly an Associate since 2011)
- Ukraine on 7 August 2018 (formerly an Associate since 2002)
- Morocco on 24 May 2019
- Ecuador on 6 August 2019 (formerly an Associate since 2000)

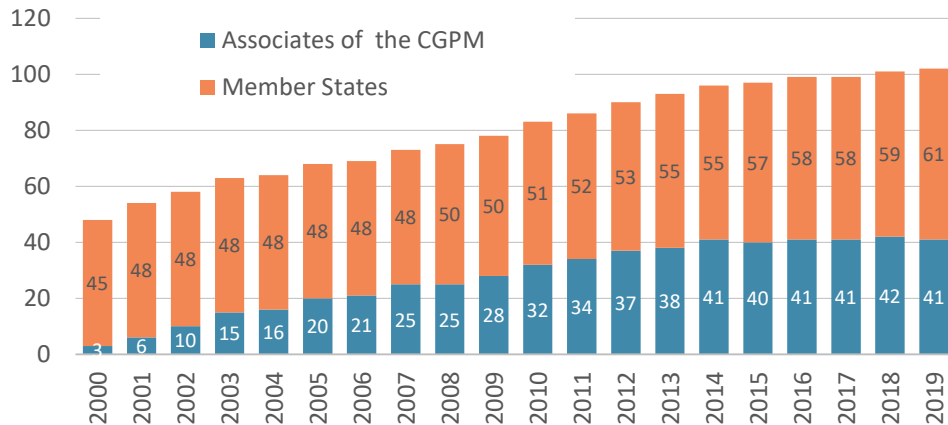
New Associates of the CGPM:

- Ethiopia on 1 January 2018.
- Tanzania on 1 January 2018.
- Kuwait on 23 March 2018.
- Uzbekistan on 13 July 2018.

Exclusions:

- Yemen on 1 January 2018 (Associate since 2014).
- Venezuela on 14 November 2018 (Member State since 1960. Original signatory of *Metre Convention*)

MEMBER STATES AND ASSOCIATES *(States and Economies)*



*2019 data as of August 2019

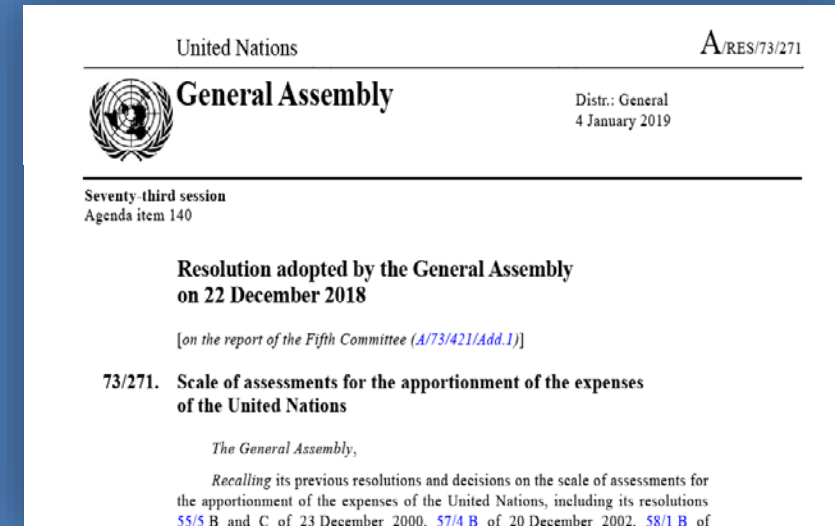
Source of Finance

by RMO

- AFRIMETS
- APMP
- COOMET
- EURAMET
- GULFMET
- SIM

UN Scale of Assessment
for 2019 to 2021 was published in
January 2019

The 2020 contributions to BIPM will
be available before the end of the
month.



Organizational structure of the BIPM

The CIPM

President

Dr W. Louw (South Africa)

Secretary

Dr T. Usuda (Japan)

Vice-Presidents

Prof. J. Ullrich (Germany)

Dr J. Olthoff (United States of America)

Other CIPM members

Dr F. Bulygin (Russian Federation)

Dr I. Castelazo (Mexico)

Dr D. del Campo Maldonado (Spain)

Dr Y. Duan (People's Republic of China)

Dr N. Dimarcq (France)

Dr H. Laiz (Argentina)

Dr T. Liew (Singapore)

Prof. P. Neyezhnikov (Ukraine)

Dr S.-R. Park (Republic of Korea)

Dr M.L. Rastello (Italy)

Dr P. Richard (Switzerland)

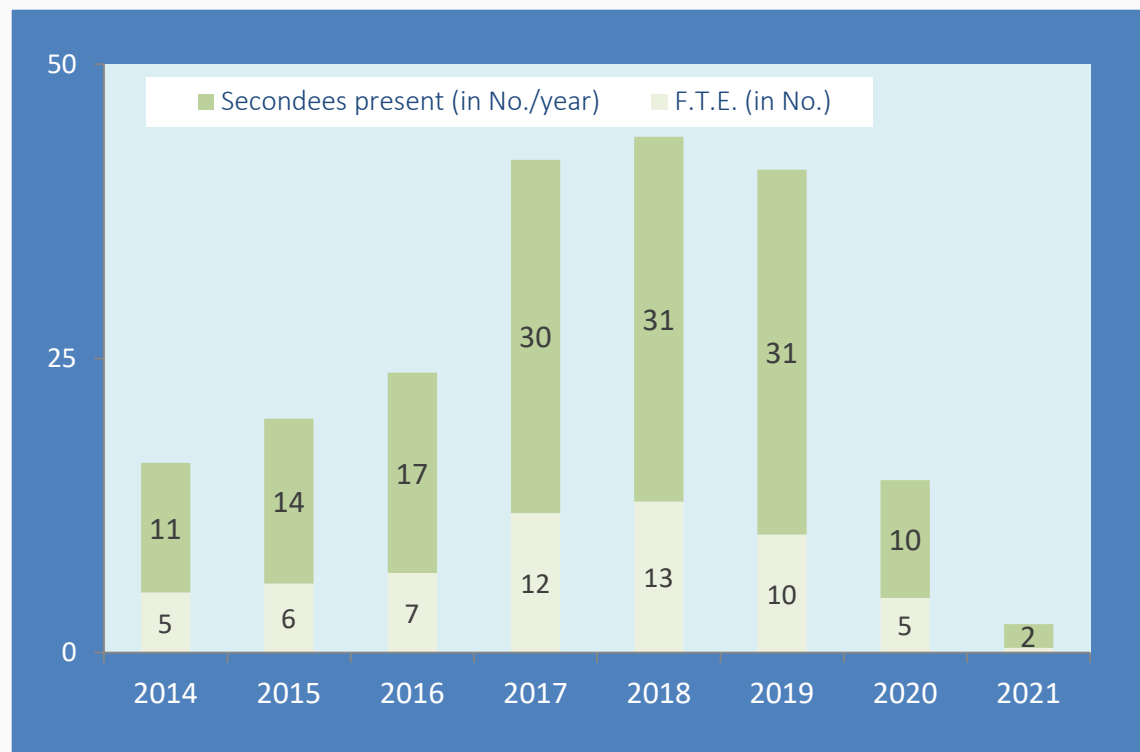
Dr G. Rietveld (Netherlands)

Dr M. Sené (United Kingdom)

Dr A. Steele (Canada)

*Elected on 16 November 2018

Secondees / Consultants from NMIs and DIs (2014-2021)



The 100th secondee
will arrive in Dec. 2019

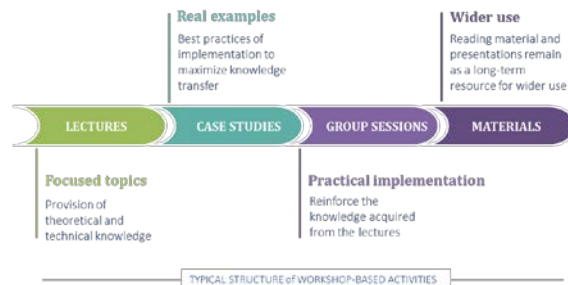


Capacity building and knowledge transfer (CBKT)

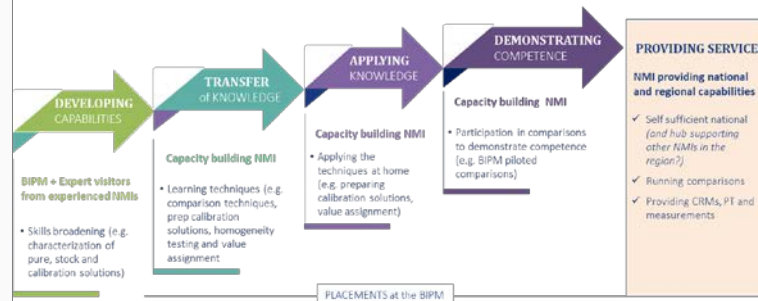
Capacity Building and Knowledge Transfer

“to increase the effectiveness with which Member States and Associates engage in the world-wide coordinated metrological system”

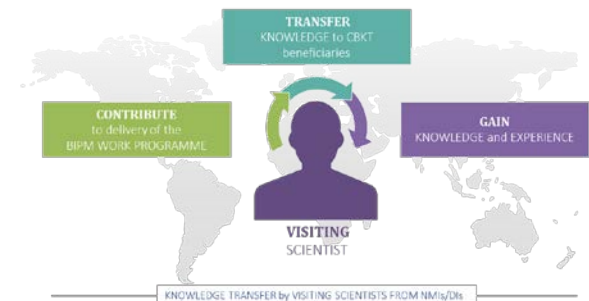
Workshop-based activities



Laboratory-based CB placements



Knowledge transfer



Over 75 % of Member States and Associates have participated in the CBKT Programme
(as trainees, lecturers and sponsors)

www.bipm.org

Bureau International des Poids et Mesures

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

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ABOUT US WORLDWIDE METROLOGY INTERNATIONAL EQUIVALENCE SI UNITS SERVICES PUBLICATIONS MEETINGS

BIPM Capacity Building & Knowledge Transfer Programme

Future initiatives

→ The BIPM Capacity Building and Knowledge Transfer Programme aims to increase the effectiveness within the world-wide metrology community of those Member State and Associates with emerging metrology systems.

- 2019 course "Optimizing the CIPM MRA - the KCDB 2.0"

The 2019 "Optimizing the CIPM MRA - the KCDB 2.0" course is designed to equip RMO TC/WG Chairs and TC/WG members (it is aimed at those who actually coordinate the review and act as reviewers) with the necessary knowledge to use the 'optimized' CIPM MRA and the KCDB 2.0.

- Dates and application process

- 2019 BIPM-APMP Workshop "Important transitions in the CIPM MRA infrastructure"
- 2019 EURAMET-BIPM Training Course on Organisation and Piloting of Intercomparisons in Ionizing Radiation
- 2018 & 2019 "BIPM - TÜBITAK UME project placements"
- 2019 Varenna Metrology School and METAS project
- 2016-2018 "Metrology for Emerging Economies" project
- 2016-2019 "Metrology for Emerging Economies" project
- 2017-2018 "Support for GULFMET key comparison of Zener voltage standards" project

Completed initiatives

Contacts:

- BIPM
- AFRIMETS
- EURAMET
- APMP
- GULFMET
- COOMET
- SIM

Background and supporting documents

→ Countries and Economies face particular challenges in developing metrology systems (CEEMS) face particular challenges in developing metrology systems (CEEMS). The BIPM Capacity Building and Knowledge Transfer Programme aims to increase the effectiveness within the world-wide metrology community of those Member State and Associates with emerging metrology systems.

Individual NMI staff, their understanding and capacity 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 PROGRAMME GUIDEBOOK
- Information for participants
- Copyright information
- Information for sponsors
- Resolution 3 of the 26th CGPM (2018): On the objectives of the BIPM

Sponsors:

The BIPM thanks...

Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin
Nationales Metrologieinstitut

Information for PARTICIPANTS

Information for SPONSORS

BIPM CBKT PROGRAMME GUIDEBOOK

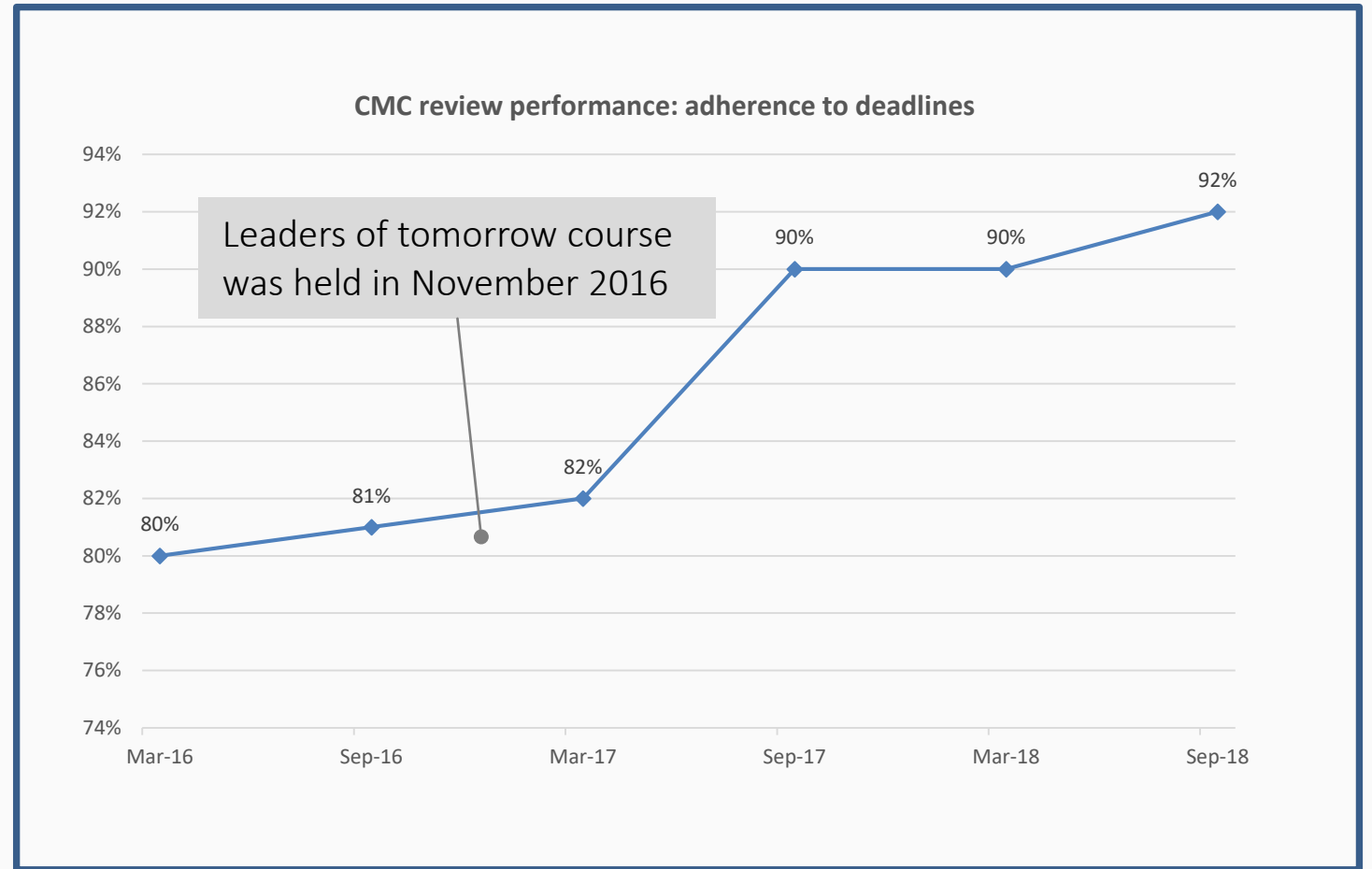
Impact of the *"Leaders of tomorrow"* courses...

Balancing the load

- **14 new** RMO TC/WG Chairs
- **12 existing** RMO TC/WG Chairs benefited from the CBKT programme

Increasing efficiency

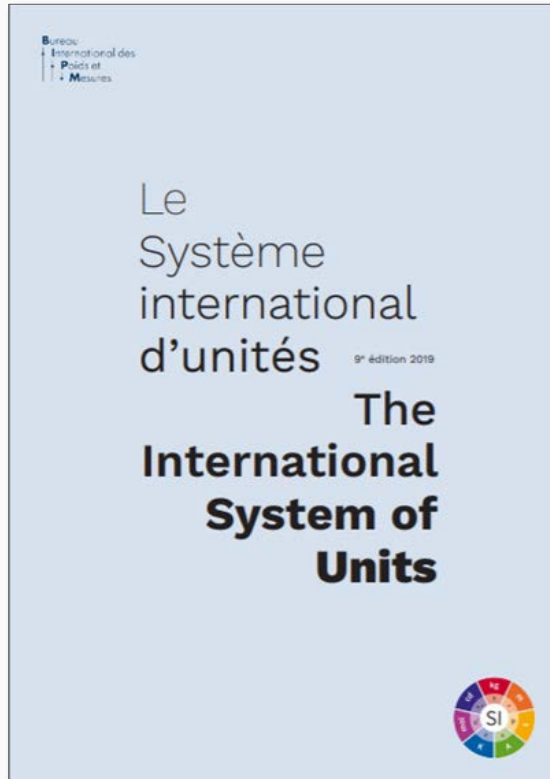
- **10 % increase** in CMC review performance





Liaison work

Implementation of the SI



[The 9th edition of the SI Brochure](https://www.bipm.org/publications/si-brochure) is available on the BIPM website.

The International System of Units (SI)

Introduction

Definition of the SI

SI base units

SI prefixes

The 2018 revision of the SI

How to realize the SI units

SI Brochure

History

→ The recommended practical system of units of measurement is the International System of Units (*Système International d'Unités*), with the international abbreviation **SI**.



The SI is defined by the **SI Brochure**, which is published by the BIPM.

In a landmark decision, the BIPM's Member States voted on 16 November 2018 to revise the SI, changing the world's definition of the kilogram, the ampere, the kelvin and the mole.

This decision, made at the 26th meeting of the General Conference on Weights and Measures (CGPM), means that from 20 May 2019 all SI units are defined in terms of constants that describe the natural world. This will assure the future stability of the SI and open the opportunity for the use of new technologies, including quantum technologies, to implement the definitions.

The seven defining constants of the SI are:

- the caesium hyperfine frequency $\Delta\nu_{\text{Cs}}$;
- the speed of light in vacuum c ;
- the Planck constant h ;
- the elementary charge e ;
- the Boltzmann constant k ;
- the Avogadro constant N_{A} ; and
- the luminous efficacy of a defined visible radiation K_{cd} .

The SI was previously defined in terms of seven base units and derived units defined as products of powers of the base units. The seven base units were chosen for historical reasons, and were, by convention, regarded as dimensionally independent: the metre, the kilogram, the second, the ampere, the kelvin, the mole, and the candela. This role for the base units continues in the present SI even though the SI itself is now defined in terms of the defining constants above.

World Metrology Day

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創新科技署
Innovation and
Technology Commission
Standards and
Calibration
Laboratory, Hong Kong, China



Bureau
International des
Poids et
Mesures



20 May 2019
www.worldmetrologyday.org

World Metrology Day 2019

***“The International System of Units -
Fundamentally better”***

The 2019 poster was designed by the
Standards and Calibration Laboratory,
Hong Kong, China.

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創新科技署
Innovation and
Technology Commission

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standards and
Calibration
Laboratory, Hong Kong, China

- 18 languages (WMD poster was translated)

Information on national WMD activities is posted on the website:

<http://www.worldmetrologyday.org>

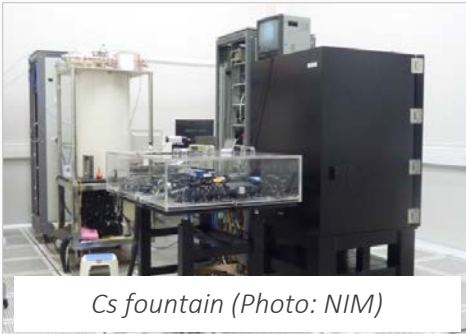


Laboratory work

New frequency standards contribute to UTC

In August 2019 the relative accuracy of UTC with respect to the SI second was:

$$0.32 \pm 0.13 \times 10^{-15}$$



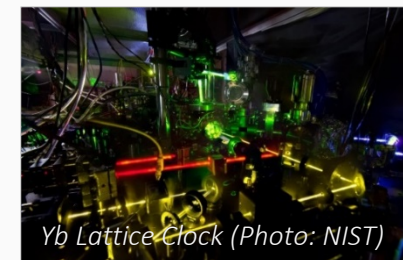
Cs fountain (Photo: NIM)

- The accuracy of UTC is based on the steering versus the primary realizations of the SI second.

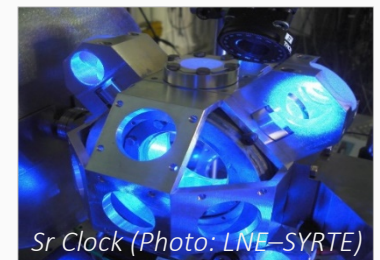
Primary realizations from NMIs are 10 Cesium fountains (accuracy 10^{-16}) and 2 traditional Cesium beam (accuracy 10^{-14}). 6 additional Cs fountains under development.

- Secondary representation of the second **are also contributing:**

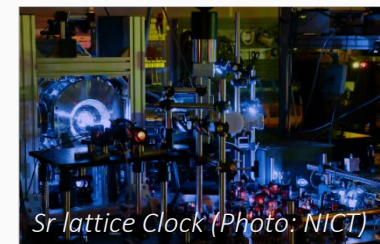
- July 2015, first contribution from the SYRTE Rb fountain
- March 2017, first results from the SYRTE Strontium lattice standards
- Dec 2018, the NICT and SYRTE Strontium standards and
- Feb 2019, the NIST Ytterbium lattice standard entered in the UTC computation.



Yb Lattice Clock (Photo: NIST)

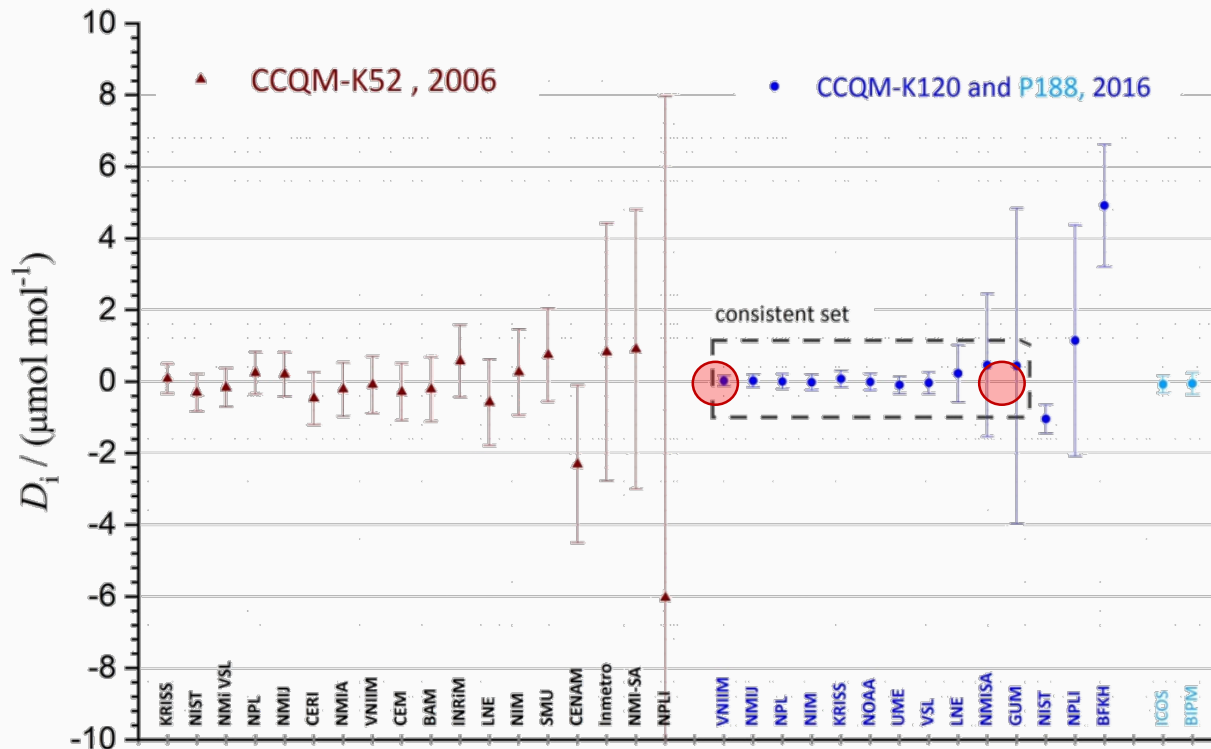
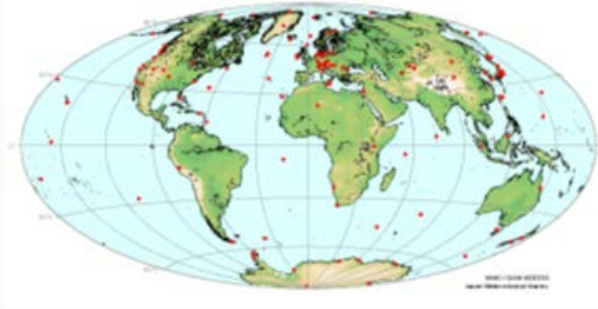


Sr Clock (Photo: LNE-SYRTE)

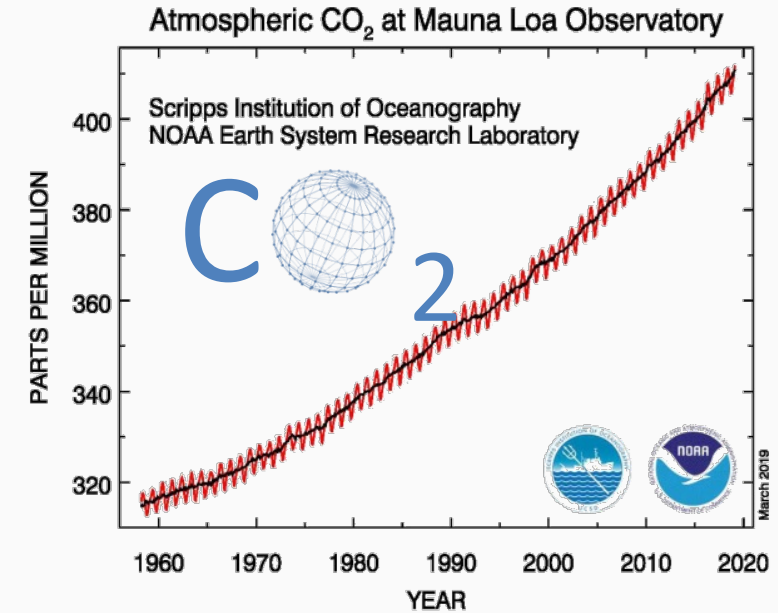


Sr lattice Clock (Photo: NICT)

Accuracy of Global CO₂ measurement scale demonstrated

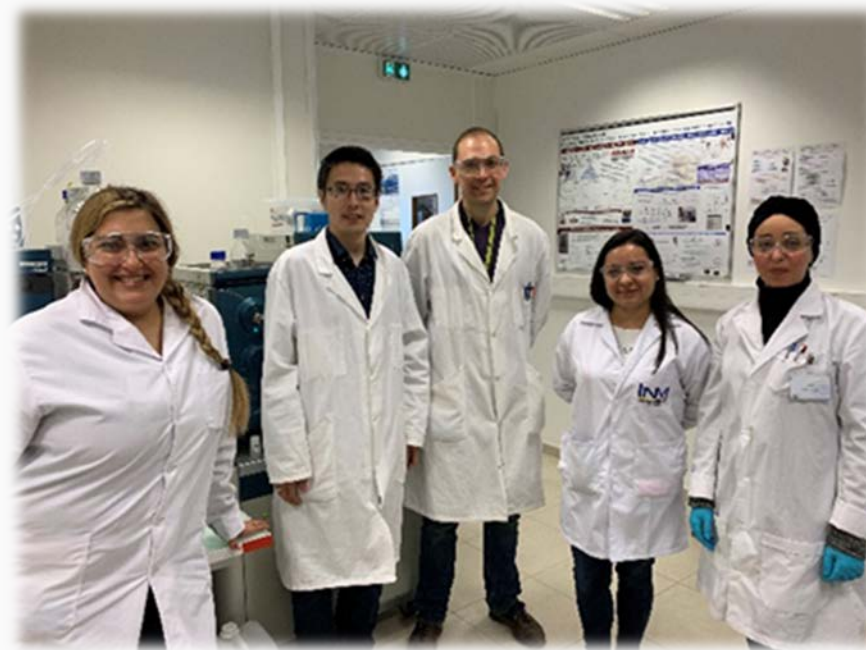


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WMO-CO₂-X2019 Scale

Laboratory-based Capacity Building and Knowledge Transfer



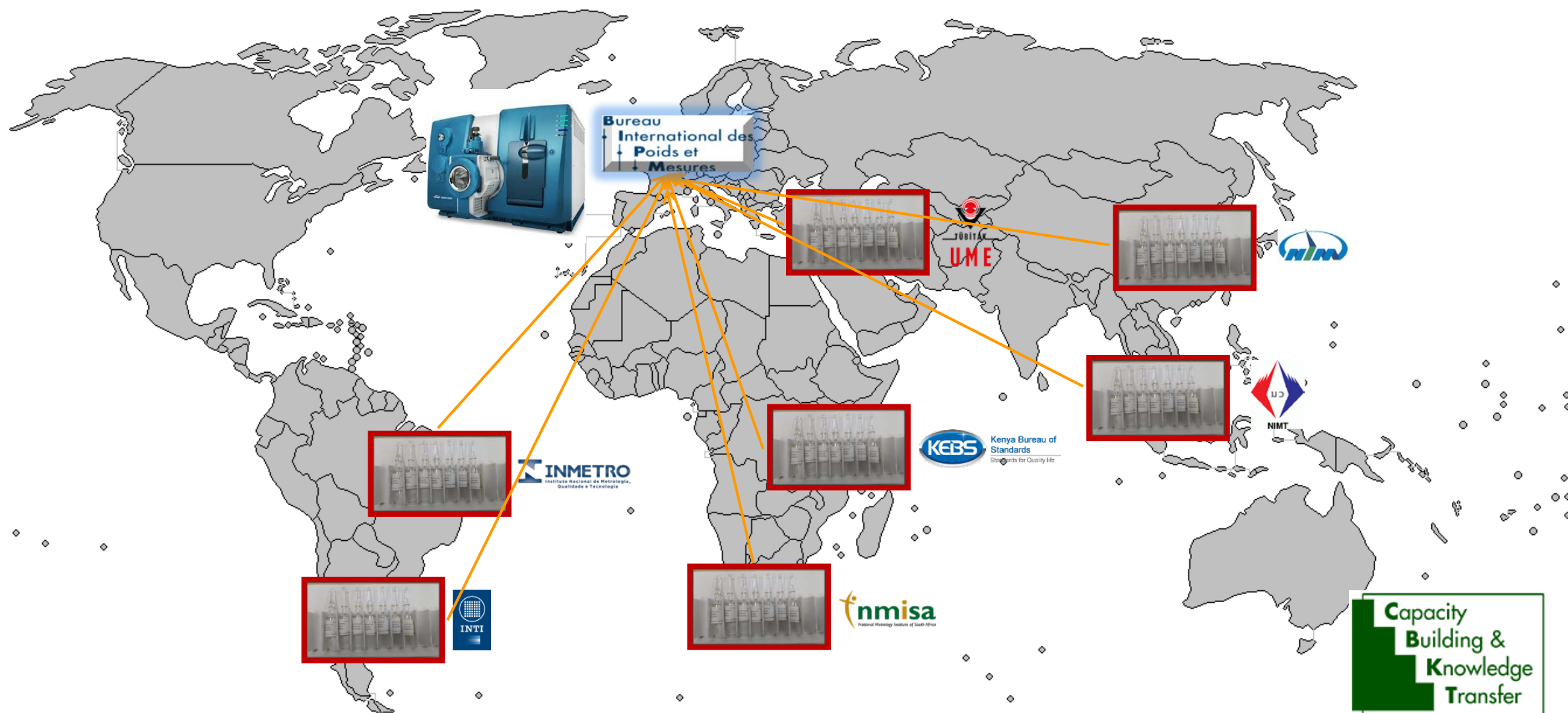
Established with support from



Support for 7 visiting scientists

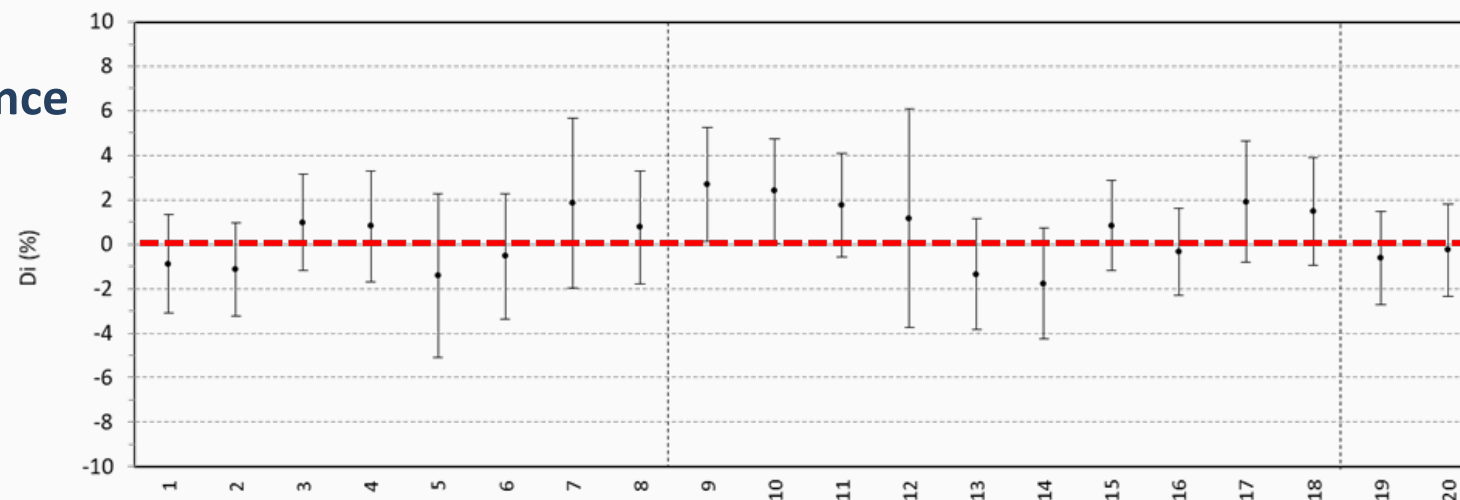


Laboratory-based Capacity Building and Knowledge Transfer



Laboratory-based Capacity Building and Knowledge Transfer

Demonstration of Competence CCQM-K154.a – ZEN



Overview of services (1 Jan. 2016 – 30 June 2019)



427 Calibrations
certificates and
Study notes issued
by the BIPM



376 Participations in
comparisons
coordinated by the
BIPM



85/61 Participations
in the TIME
comparisons
(*Circular T/ UTCr*)

WP overview (1 Jan. 2016 – 30 June 2019)

Technical Services



427 Calibrations
certificates and
Study notes issued
by the BIPM



376 Participations in
comparisons
coordinated by the
BIPM



85/61 Participations
in the TIME
comparisons
(*Circular T/ UTCr*)



333 Participation in
Workshop- based
CBKT activities of the
BIPM



51 Participation in
Laboratory-based
CBKT (25 placements
at the BIPM)



43 WP Secondees
assisted to deliver the
Work Programme
projects

Coordination work

The coordination work of the BIPM

10 Consultative Committees



- CIPM Consultative Committees
- Plus 67 WGs etc.

4 Joint Committees



- JCGM
- JCRB
- JCTLM
- INetQI

3 international databases



- KCDB
- JCTLM
- IMRR

The BIPM Key Comparison Database (KCDB)

262 Institutes *(August 2019)*

- 102 National Metrology Institutes
 - 61 Member States
 - 41 Associates
- 4 International organizations
(ESA, IAEA, JRC, WMO)
- plus 156 Designated Institutes

6 RMOs

Playing an important role to support mutual confidence in the validity of calibration and measurement certificates issued by participating institutes



1,613 comparisons

1039 key, 574 supplementary
comparisons

25 242 CMCs

regionally and internationally peer-
reviewed CMC declarations

the KCDB 2.0

← to BIPM.org



All data listed in the KCDB have been reviewed and approved within the CIPM Mutual Recognition Arrangement

New features

- Extended search facilities on CMCs and comparisons
- Web portal for CMC submission and review
- Customized statistics



CMCS

COMPARISONS

NEWS

STATISTICS

Comparison search

KCDB

What is the KCDB

Help with searching

Help on CMC edition, review and management

FAQs

CIPM MRA

Participants

About the CIPM MRA

JCRB

Policy documents

CLASSIFICATION OF SERVICES

Acoustics, Ultrasound and Vibration

Chemistry and Biology

Electricity and Magnetism

Ionizing Radiation

Mass and related quantities

Photometry and Radiometry

Thermometry

Time and Frequency

A framework for deeper BIPM/OIML collaboration

The presentation of the CIPM President at the 26th CGPM (Nov 2018)

Ongoing discussions: OIML & CIPM Presidents; BIML and BIPM Directors

- ◆ Collaboration on representation (*ie steps towards presenting our shared interests better*)
 - **INetQI, WTO, OECD**
- ◆ Joint strategic initiatives (*ie joint activities launched to address our shared strategic goals*)
 - **World Metrology Day (UNESCO), collaboration on OIML-D-01**
- ◆ ?



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Thank you