
# Report from the BIPM

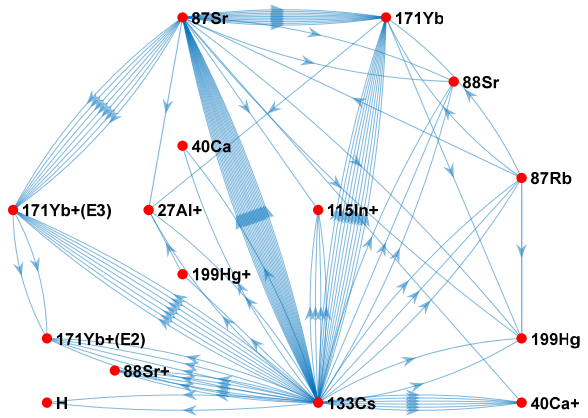
## to the Meeting of NMI Directors & State Reps

Dr Martin Milton

BIPM Director

Bureau International des Poids et Mesures

# New estimation technique for reference frequency values

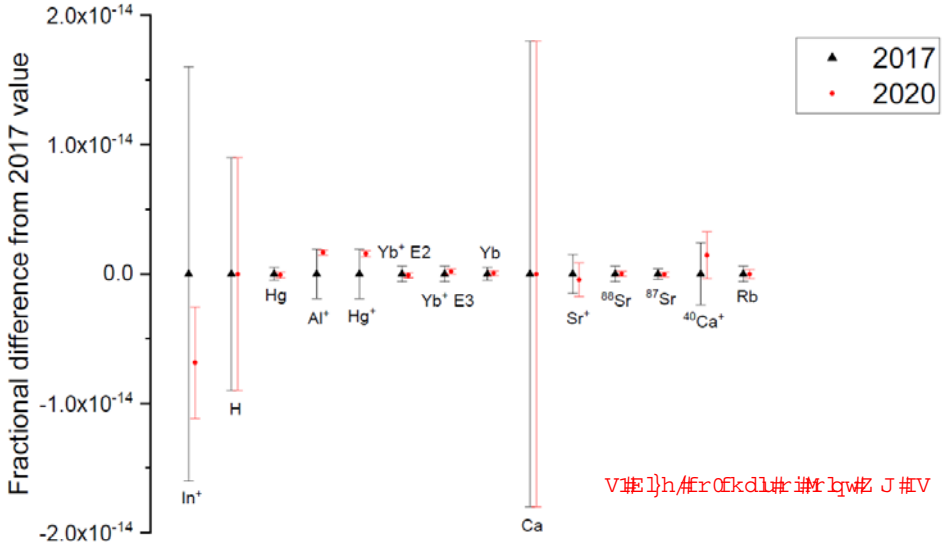



Calculation of 14 frequency values from 105 frequency ratios

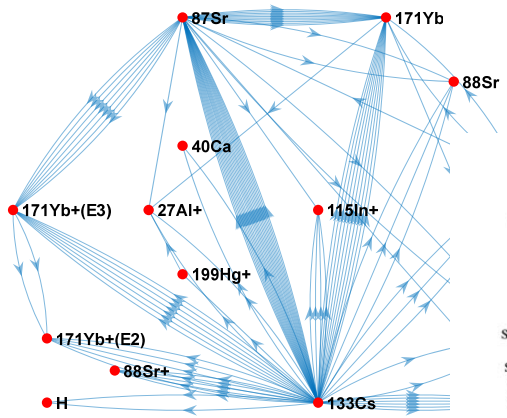
(33 optical ratios and 72 absolute frequency measures vs Caesium)

The new computational mode takes account of 483 correlations

A step towards a new optical definition for the second.



# New estimation technique for reference frequency values

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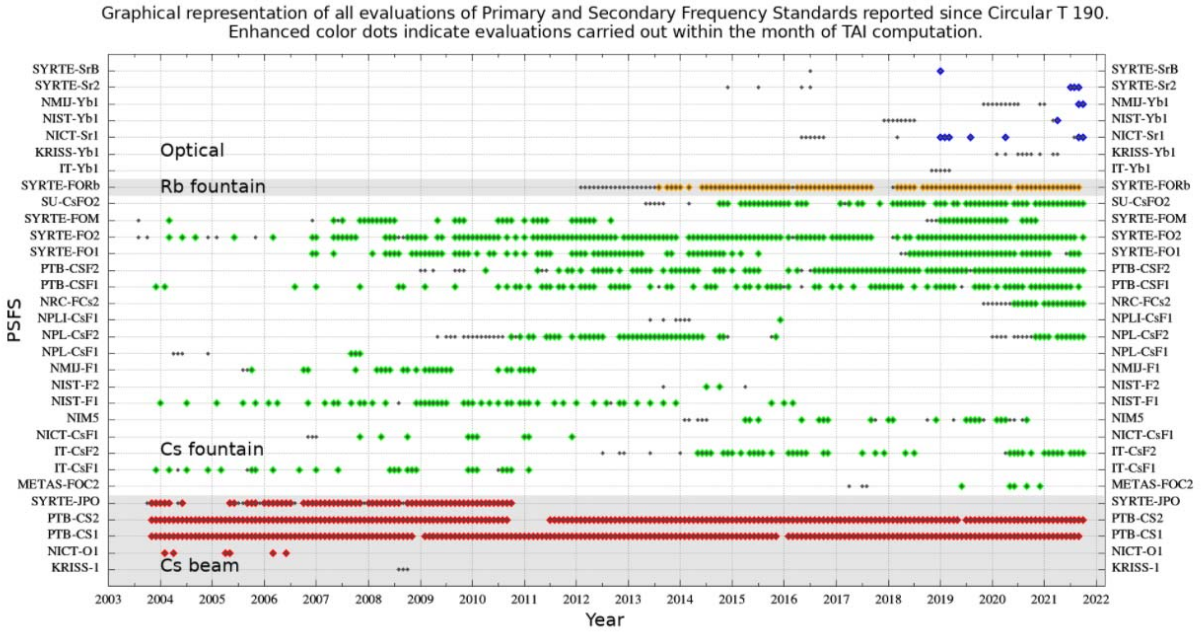
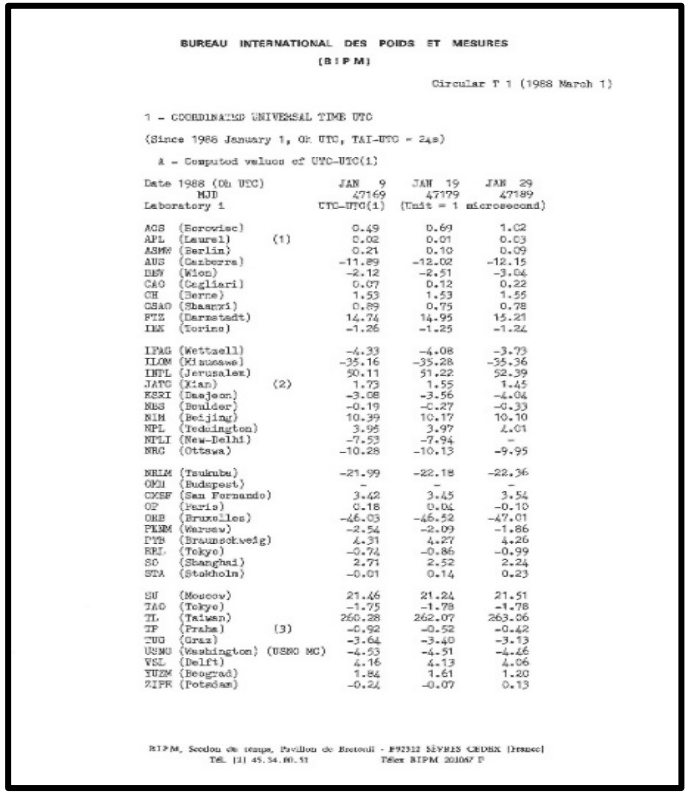


# 400th publication of CIRCULAR-T in April 2021



BUREAU INTERNATIONAL DES POIDS ET MESURES
(B I P M)

Circular T 1 (1988 March 1)

1 - COORDINATED UNIVERSAL TIME UTC

(Since 1988 January 1, 0h UTC, TAI-UTC = 24s)

A - Computed values of UTC-UTC(i)

| Date 1988 (0h UTC) | | JAN 9 | JAN 19 | JAN 29 |
|---|---|---|---|---|
| MJD | | 47169 | 47179 | 47189 |
| Laboratory i | | UTC-UTC(i) | (Unit = 1 microsecond) | |
| AOS (Borowiec) | | 0.49 | 0.69 | 1.02 |
| APL (Laurel) | (1) | 0.02 | 0.01 | 0.03 |
| ASMW (Berlin) | | 0.21 | 0.10 | 0.09 |
| AUS (Canberra) | | -11.89 | -12.02 | -12.15 |
| BEV (Wien) | | -2.12 | -2.51 | -3.04 |
| CAO (Cagliari) | | 0.07 | 0.12 | 0.22 |
| CH (Berne) | | 1.53 | 1.53 | 1.55 |
| CSAO (Shaanxi) | | 0.89 | 0.75 | 0.78 |
| PTZ (Darmstadt) | | 14.74 | 14.95 | 15.21 |
| IEN (Torino) | | -1.26 | -1.25 | -1.24 |
| IPAG (Wettzell) | | -4.33 | -4.08 | -3.73 |
| ILOM (Mitzpe Ramon) | | -35.16 | -35.28 | -35.36 |
| INPL (Jerusalem) | | 50.11 | 51.22 | 52.39 |
| JATC (Xian) | (2) | 1.73 | 1.55 | 1.45 |
| KERI (Daejeon) | | -3.08 | -3.56 | -4.04 |
| NBS (Boulder) | | -0.19 | -0.27 | -0.33 |
| NIM (Beijing) | | 10.39 | 10.17 | 10.10 |
| NPL (Teddington) | | 3.96 | 3.97 | 4.01 |
| NPLI (New-Delhi) | | -7.53 | -7.94 | - |
| NRC (Ottawa) | | -10.28 | -10.13 | -9.95 |
| NSLM (Tsukuba) | | -21.99 | -22.18 | -22.36 |
| OMH (Budapest) | | - | - | - |
| ONRJ (Rio de Janeiro) | | 3.42 | 3.45 | 3.54 |
| OP (Paris) | | 0.18 | 0.04 | -0.10 |
| ORB (Bruxelles) | | -46.03 | -46.52 | -47.01 |
| PLRM (Warsaw) | | -2.54 | -2.09 | -1.86 |
| PTB (Braunschweig) | | 4.31 | 4.27 | 4.26 |
| RRL (Tokyo) | | -0.74 | -0.86 | -0.99 |
| SO (Shanghai) | | 2.71 | 2.52 | 2.24 |
| STA (Stockholm) | | -0.01 | 0.14 | 0.23 |
| SU (Moscow) | | 21.46 | 21.24 | 21.51 |
| TAO (Tokyo) | | -1.75 | -1.78 | -1.78 |
| TL (Taiwan) | | 260.28 | 262.07 | 263.06 |
| UP (Praha) | (3) | -0.92 | -0.52 | -0.42 |
| UTC (Graz) | | -3.64 | -3.40 | -3.13 |
| USNO (Washington) | (USNO MC) | -4.53 | -4.51 | -4.46 |
| VSL (Delft) | | 4.16 | 4.13 | 4.06 |
| YUZM (Beograd) | | 1.84 | 1.61 | 1.20 |
| ZIPR (Potsdam) | | -0.24 | -0.07 | 0.13 |

BIPM, Section de temps, Pavillon de Breteuil - F92312 SEVRES CEDEX (France)
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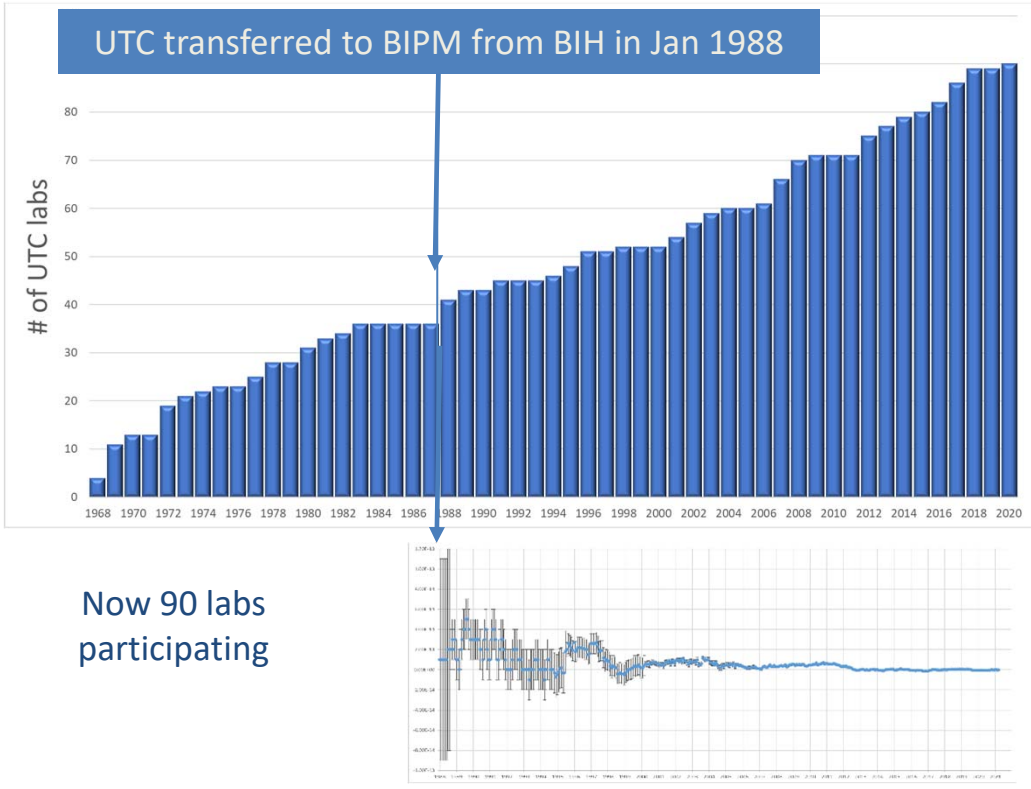


Now 90 labs participating



www.bipm.org

from $10^{-13}$ to $10^{-16}$ accuracy

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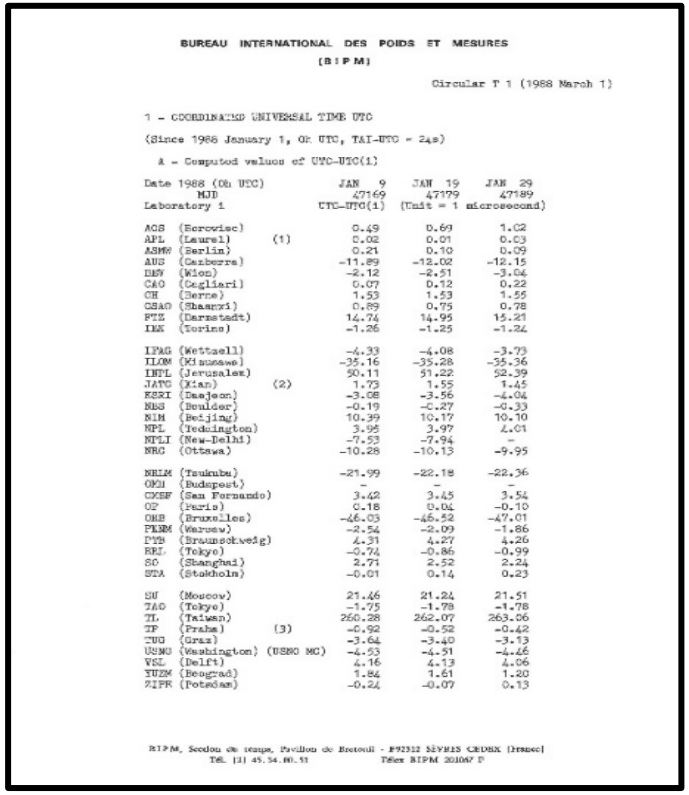

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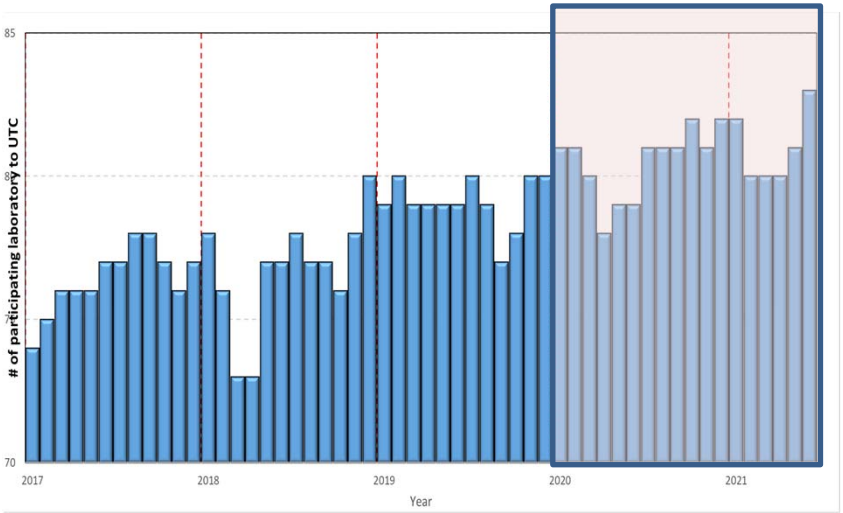
## UTC is extremely resilient

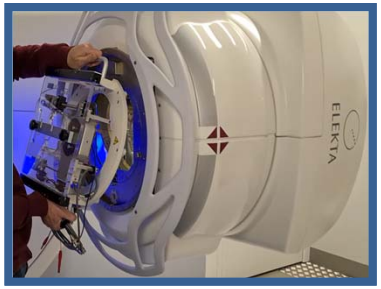
NMI participation increased during the period of global pandemic.



# Staff news

Dr Vincent Gressier (formerly of IRSN, France) has been recruited as Head of the Ionising Radiation Department following the retirement of Dr Steven Judge at the end of June 2021.

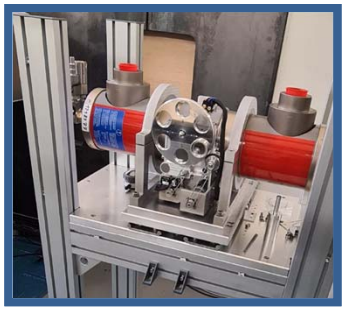
# Dosimetry metrology – upgrading capabilities




## High-energy x-ray beams (6 MV - 18 MV) at DOSEO

- **Launch of the calibration service** for secondary standards for NMIs/DIs.
- New calorimeter for **primary absorbed dose measurements**

Full range of BIPM services for the NMIs in high-energy x-ray beams now available



## Medium-energy x-ray beams (100 kV – 250 kV) at the BIPM

- **New high-voltage generator installed and automation of the calibration bench**
- Design of a **new primary standard** (free-air chamber)

No interruption in services.

# Radionuclide metrology – new services

## SIR Transfer Instrument (SIRTI) short-lived radionucleides for nuclear medicine

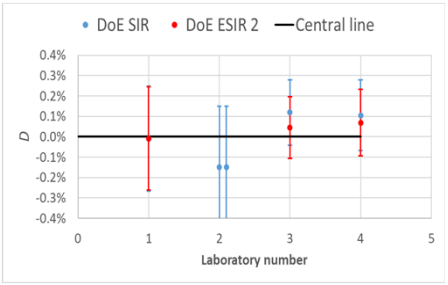
- **First remote SIRTI comparison** at the PTB (in progress)

SIRTI reproducibility check: < 5 x $10^{-4}$

## SIR extension for β–emitters (ESIR) based on TDCR instrument at the BIPM

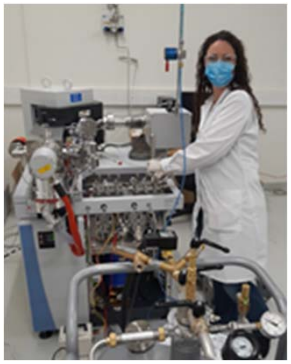
- **First BIPM comparison** of Co-60 in progress

*with 10 participants.*

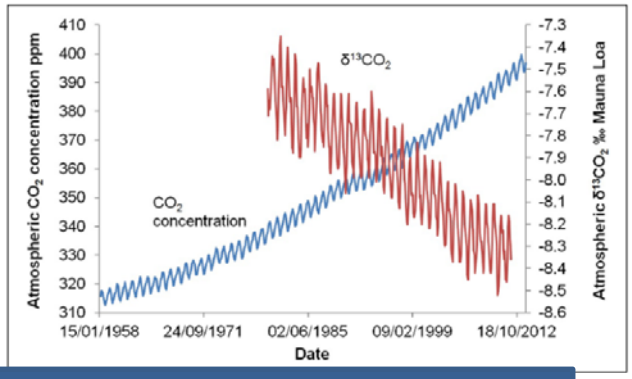


# Chemical metrology – new comparison services

## $CO_2$ isotope ratio reference facility [CCQM-P204]

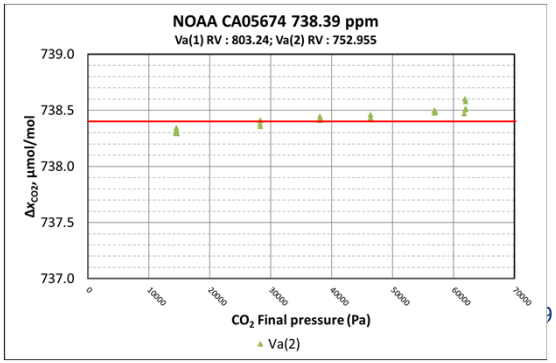


- Primary δ13C scale realization
- CO2 emission source measurement
- 20 participants worldwide
- 120 samples

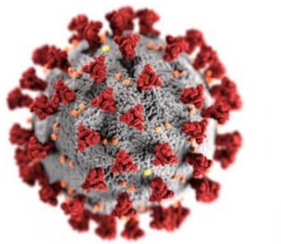



## CO2 amount fraction reference facility [BIPM.QM-K2,5]


- Unique reference facility
- On-demand comparison service to NMIs
- 0.02 µmol/mol reproducibility
- WMO DQO at 0.1 µmol/mol

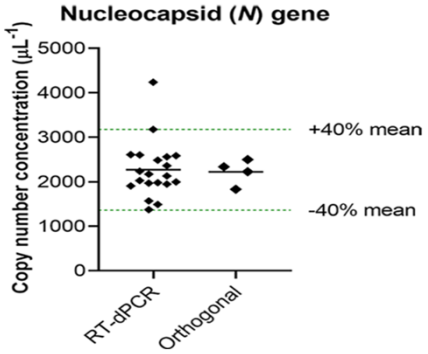


# Chemical metrology – focus on the pandemic

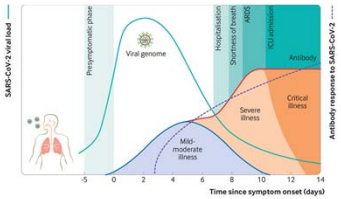


## Comparisons supporting COVID-19 diagnostic measurements at NMIs

- CCQM P199b: SARS-CoV-2 RNA copy number quantification
- CCQM-P216: SARS-CoV-2 Monoclonal Antibody quantification




## CCQM Workshop – A roadmap for metrology for pandemic readiness




- October 5th-7th - 160 participants

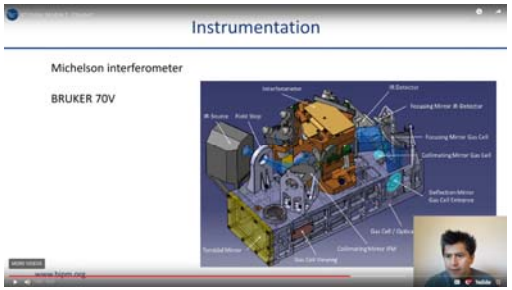
➢ Establishment of a CCQM Task Group for NMIs to develop a metrology roadmap to improve pandemic readiness.

➢ One of the challenges will be to be able to show **metrology responses on a day/week timescale** instead of month/years!

# **Chemical metrology –** Capacity Building and Knowledge Transfer

## FTIR for Gas Standard Characterization


- 1st September 2021 Launch
- 6 Modules over 6 months
- NIMT and NMISA scientists on intensive course
- FTIR facility development in home institute

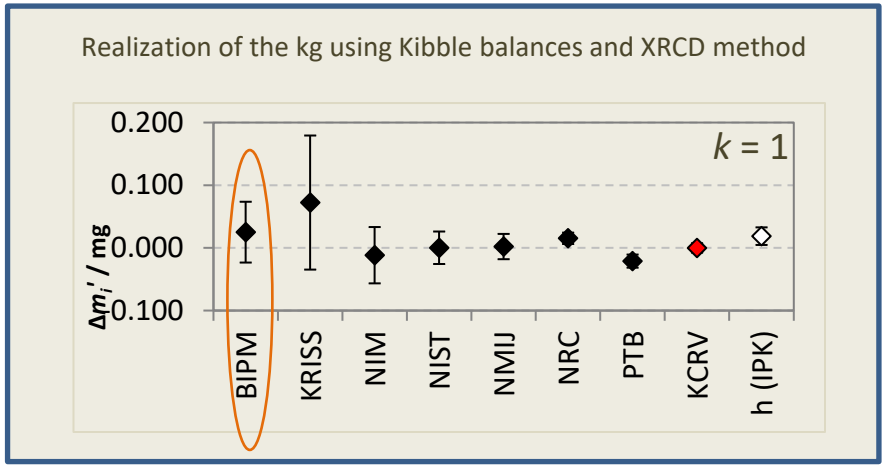



## Organic Analysis for CRM Characterization


- 2nd May 2021 Launch
- 6 modules over 6 months
- 10 scientists on intensive course
- Measurements in own laboratory
- 90 scientists with on-line access

# BIPM Kibble balance - first realization of the kg

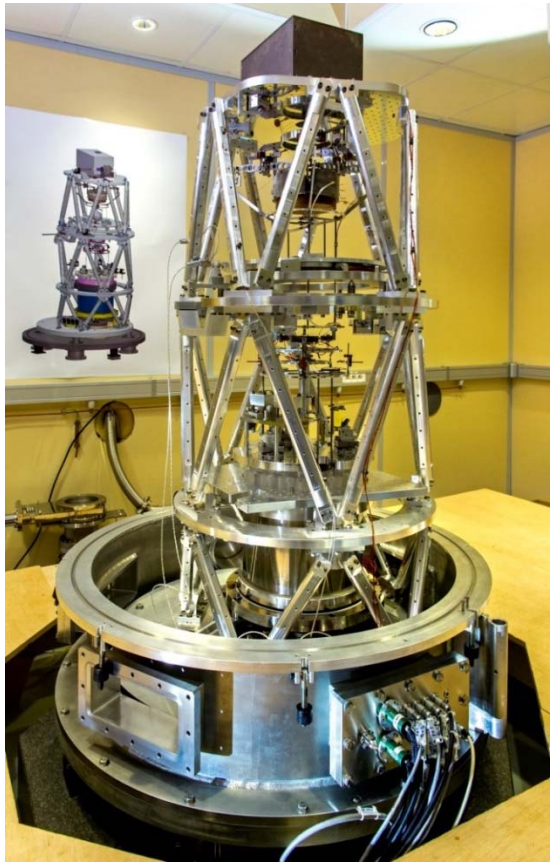
- participation in CCM.M-K8.2019
- standard uncertainty 49 µg at 1 kg ($4.9 \times 10^{-8}$)




IOP Publishing Metrologia
Metrologia 57 (2020) 045009 (10pp) https://doi.org/10.1088/1681-7575/ab860c

**The BIPM Kibble balance for realizing the kilogram definition**

H Fang, F Bielsa, S Li, A Kiss and M Stock

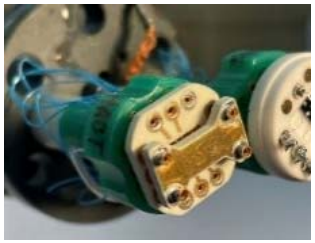



# Quantum Hall standards - upgrading for on-site comparisons

- Implementation of a new compact QHR system based on graphene
- more easily transportable with reduced operating costs
- allowing cryogen-free operation

**Two types of graphene QHR samples tested**

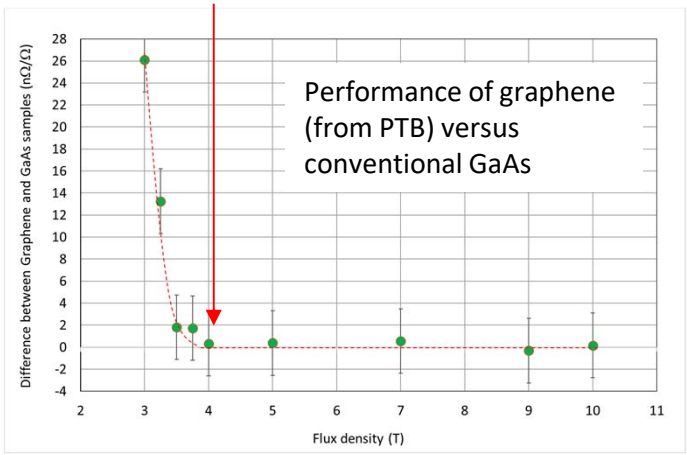
Commercial samples from Graphene Waves based on NIST technologies



PTB sample developped within the GIQS EURAMET project

Samples from other sources to be tested in the near future.

Quantized to 2 ppb or less above 3.5 T @ 4.2 K



# **CIPM initiative** to provide a Digital SI Framework

The CIPM has launched a **Task Group on the "Digital SI Framework"**

- To enable SI-based digital communication in industry
- To support the digital science and open-science paradigms
- To get metrological services ready for artificial intelligence


22nd– 26th February 2021

600 participants on-line

# **CIPM initiative** to provide a Digital SI Framework

How can the work of the BIPM laboratories and databases support the development of “digital NMIs”?

How can we support progress towards the use of Digital Calibration Certificates?


22nd– 26th February 2021

600 participants on-line

# The **Key Comparison Database** (KCDB)

## 262 Institutes

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


KCDB

**1,710 comparisons**

1082 key, 628 supplementary comparisons

**25 748 CMCs**

regionally and internationally peer-reviewed CMC declarations

# The **Key Comparison Database** (KCDB)

## 262 Institutes *(August 2019)*

- 102 National Metrology Institutes
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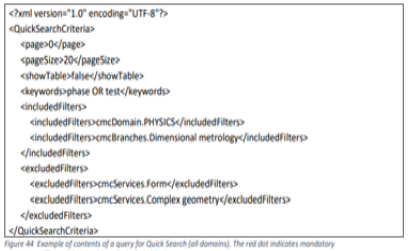
***Web access***


***Machine access***




Application Programming Interface

**1,710 comparisons**

1082 key, 628 supplementary comparisons

**25 748 CMCs**

regionally and internationally peer-reviewed CMC declarations

# xml version of SI-brochure complete

For scientists to share the universe of scientific information, the essential foundations are:

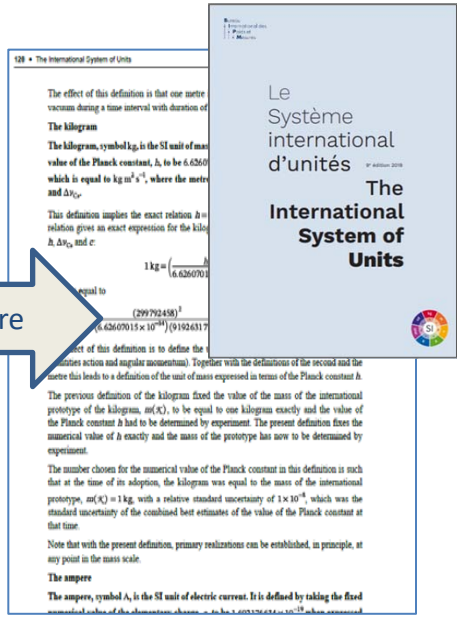
- **Persistent identifiers**: mechanisms for naming and locating documents, data and software in a persistent manner;
- **Metadata and ontologies**: mechanisms for discovery of, and access to, documents, data and software in a structured manner;

*Strategic Research and Innovation Agenda (SRIA) of the European Open Science Cloud (EOSC) - Version 1.0 15 February 2021*

**Technical details**
pdf file generated using Metanorma software (presently being checked at BIPM).
Semantic enrichment* using:
- MathML for equations
- UnitsML for units

* Semantic enrichment: adding a layer of metadata for machine-readability

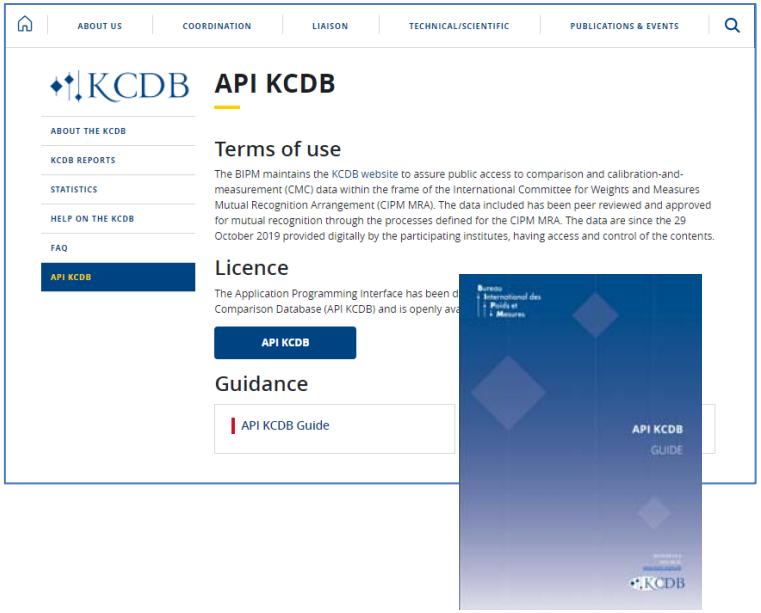

middle-ware



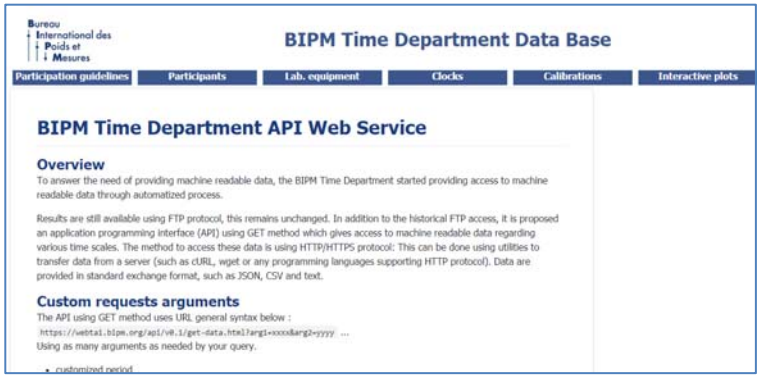

XML file

pdf or HTML file

# new BIPM APIs




https://www.bipm.org/en/cipm-mra/kcdb-api




https://webtai.bipm.org/api/v0.1/

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... search for www.bipm.org for “API”

# Institutional and technical liaison

**FORMALIZATION OF LIAISONS AGREED by CIPM**

| | | |
|---|---|---|
| BIPM-CTBTO | Practical Arrangement | *signed (June 2021)* |
| BIPM-CODATA | MoU | *signed (October 2021)* |

**OIML**

- World Metrology Day 2021 *'Measurement for health'*; poster by SASO, Saudi Arabia (GULFMET)
- New joint BIPM/OIML publication OIML D1:2020 National metrology systems - Developing the institutional and legislative framework *(December 2020)*

**ILAC**

- BIPM-ILAC joint webinar: Mining KCDB 2.0 in the context of accreditation *(21 January 2021)*
- Participation in the ILAC AIC online meetings
- Promoting SI and RMO-NMI/CIPM MRA interests during the revision of the following ILAC documents

**WTO TBT**

- Submission of the BIPM Liaison Report to the WTO TBT Committee and representation of the BIPM at the WTO TBTC meeting (February and June 2021)

**OECD**

- Contribution to the Compendium of IO practices through the *IO Partnership for effective international rule-making*
- BIPM's role on the way forward? (QI initiative, IO Partnership/WG 5 focal point since November 2019…)
- Rethinking and modernizing international rulemaking to design better policies for the 21st century (*Dr. M.J.Milton as panelist).*

**UNESCO**

- Follow up discussion with the UNESCO Secretariat on the BIPM-OIML joint WMD proposal (WMD to be proclaimed by UNESCO as World Day) (June 2021)

# Capacity Building

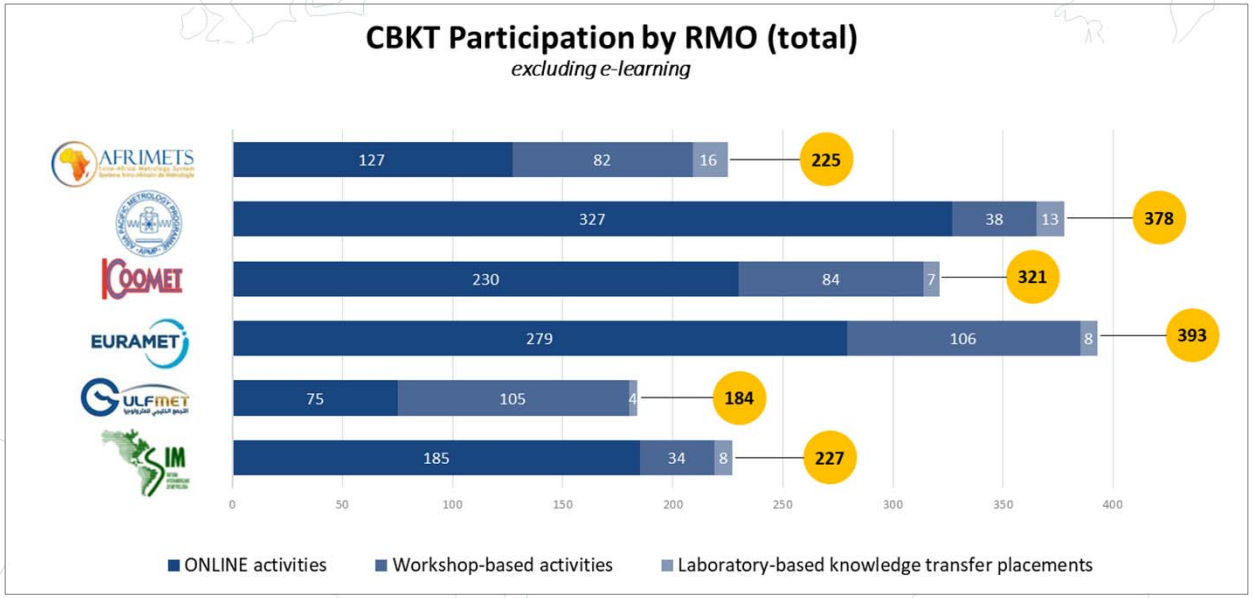
**TOTAL participation (NMIs/DIs) = 1728**

**Events: Jan 2020-Sept 2021:**

- **1** Workshop based course at the BIPM
- **4** short webinars
- **15** technical exchanges *(7 of them repeated in the afternoons to cover all time zones)*

**Participation: Jan 2020-Sept 2021:**

- **1223** NMI/DI community
- **604** Accreditation community
- **+ 363** registered participants in e-learning




***Feedback collected from every course:***

- *without exception feedback highly positive*
- *presented in detail to the CIPM Secretary as part of the QMS review*

# World Metrology Day

- **33** national translations of the poster
- Events in **38** countries/institutions

Partner RMO -

https://www.worldmetrologyday.org/index.html

# World Metrology Day

## Launch of JCTLM Video Series

JCTLM
Accurate results for patient care

**What is Laboratory Medicine?**
Greg Miller, PhD, Chair, JCTLM
Professor of Pathology, Virginia Commonwealth University Health System, USA

**What happens in your local laboratory?**
Graham Jones, Department of Chemical Pathology, St Vincent's Hospital, Sydney, Australia

**Tools for obtaining laboratory result comparability: What the JCTLM is offering?**
Mauro Panteghini, Centre for Metrological Traceability in Laboratory Medicine (CIRME), University of Milan, Italy

**What is special for measurements in Laboratory Medicine?**
Elvar Theodorsson, Linkoping University, Sweden

**Chem-Bio Metrology for Laboratory Medicine**
Sang-Ryoul Park, CIPM/CCQM
Korea Research Institute of Standards and Science

**How IFCC improves the standardization of results in Laboratory Medicine**
Prof. Phillippe Gillery, MD, PhD, IFCC-SD Chair
Professor of Biochemistry and Molecular Biology, Faculty of Medicine and University Hospital of Reims, France

**Platelet Counting Standardization**
Paul Harrison, BSc, PhD, FRCPath, ICSH board member
Associate Professor, Institute of Inflammation and Ageing, University of Birmingham, UK

**How to achieve traceable measurements in Laboratory Medicine jointly in Europe: The European Metrology Network for Traceability in Laboratory Medicine**
Bernd Güttler and Rainer Stosch, PTB, Germany

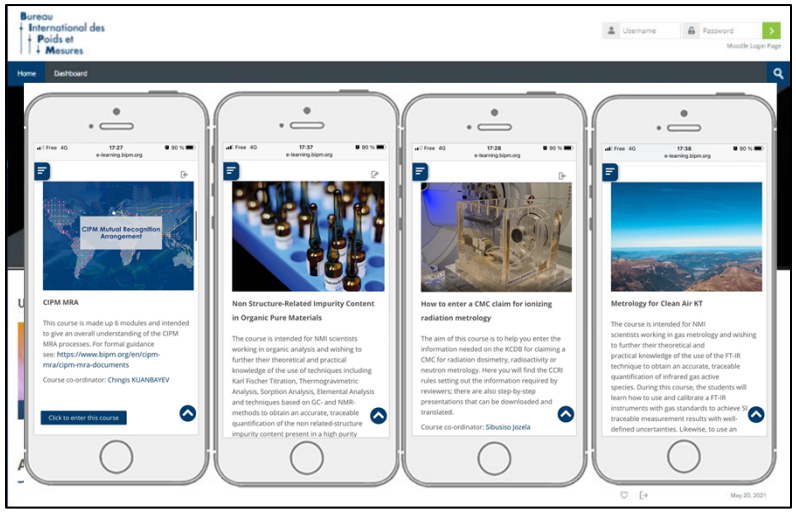
# World Metrology Day

Partner RMO for 2022 -

ЕВРО-АЗИАТСКОЕ СОТРУДНИЧЕСТВО ГОСУДАРСТВЕННЫХ МЕТРОЛОГИЧЕСКИХ УЧРЕЖДЕНИЙ
COOMET
EURO-ASIAN COOPERATION OF NATIONAL METROLOGICAL INSTITUTIONS

The theme will be

**“Digital Transformation”**

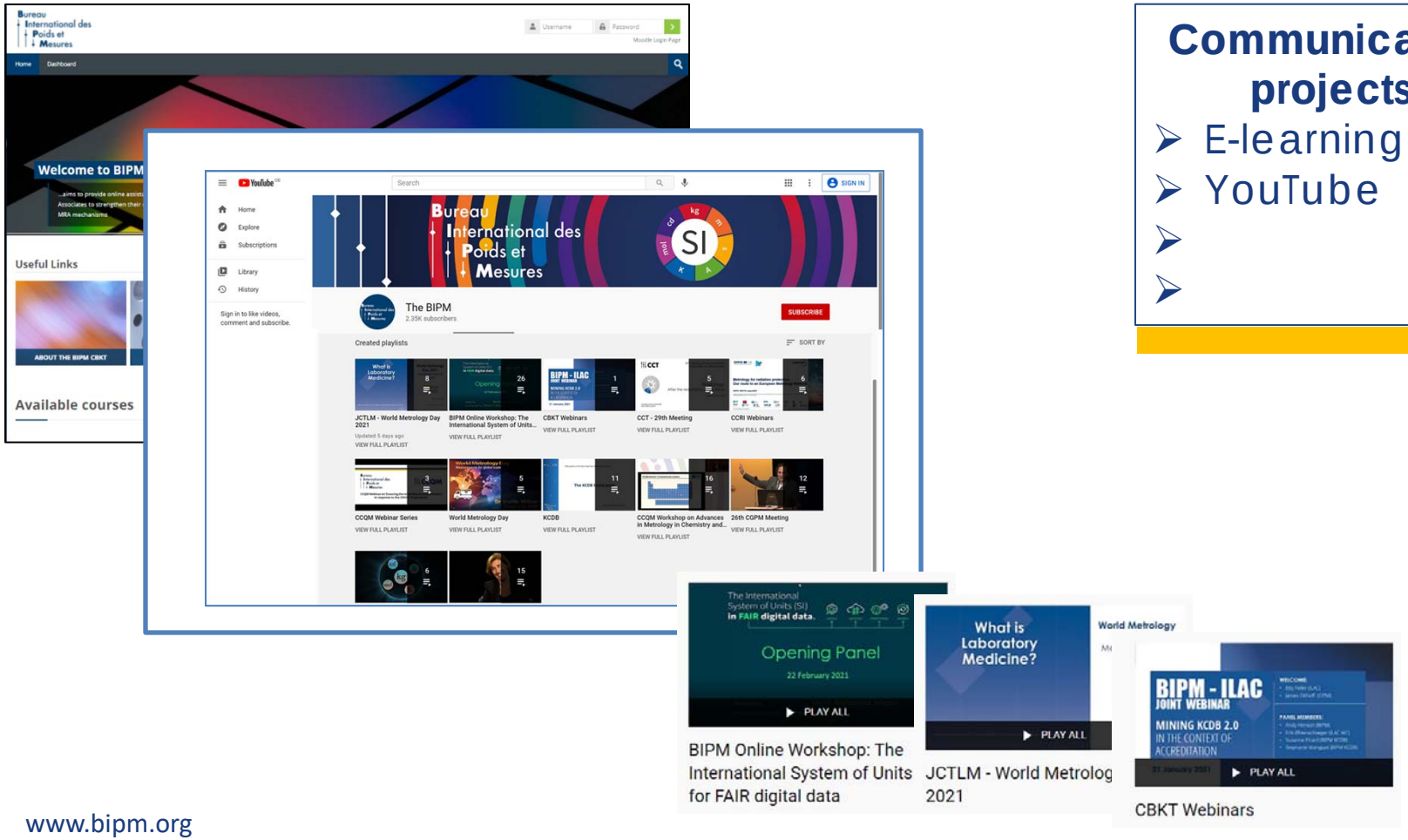



## Communication projects

- E-learning
-
-
-

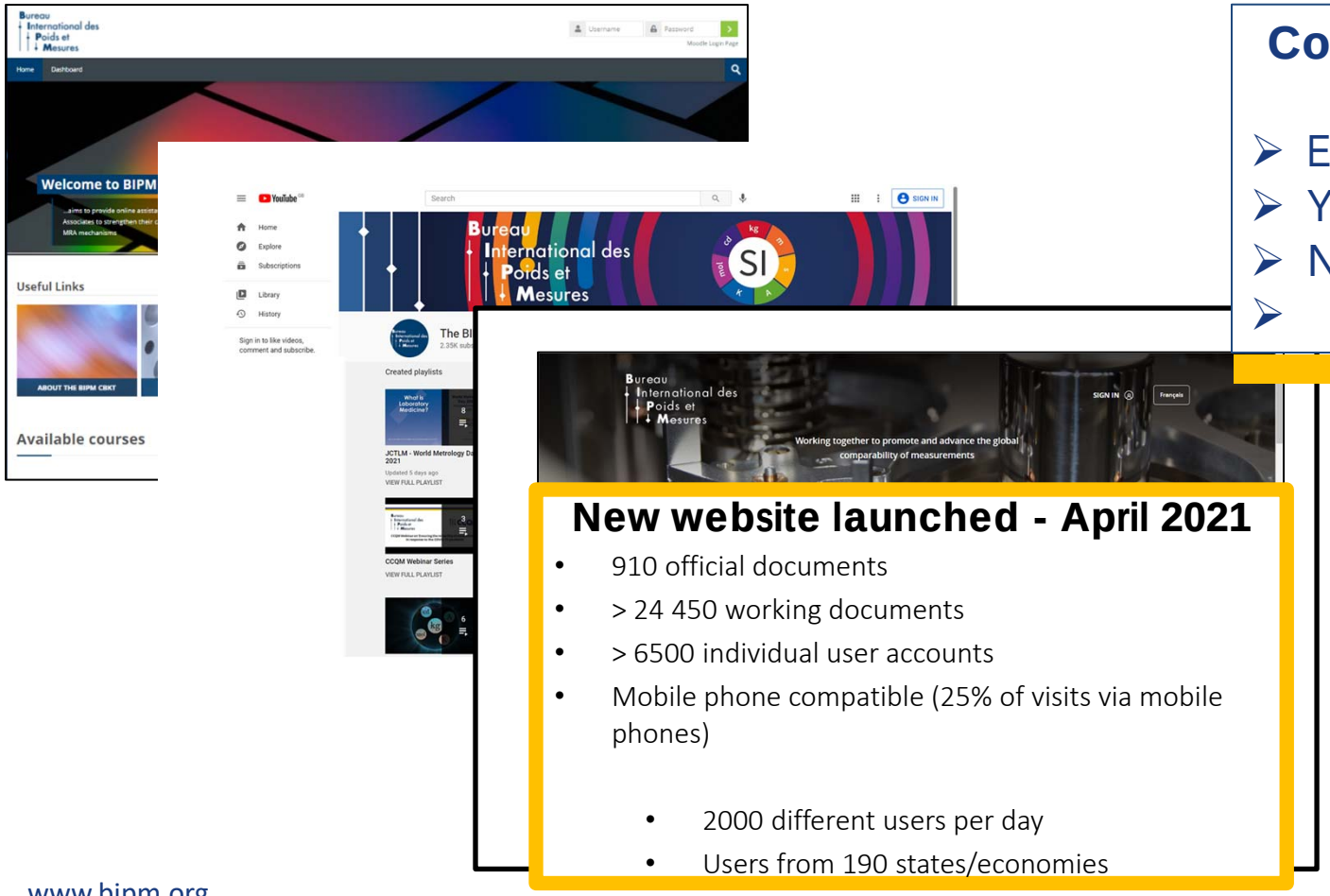
Discussion underway with RMOs about hosting their materials
Sponsorship from METAS to support expansion and on-boarding RMOs.

METAS




## Communication projects

- E-learning
- YouTube
-
-

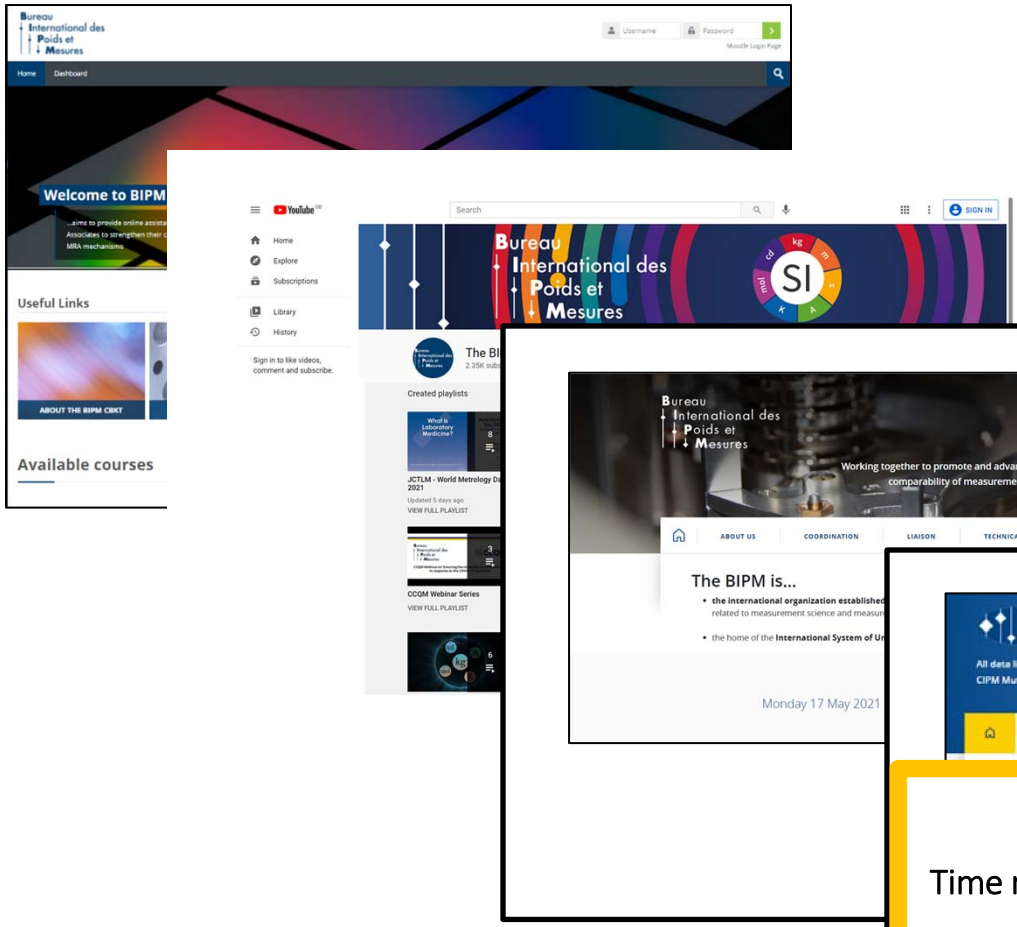



## Communication projects

- E-learning
- YouTube
- New website
-

## New website launched - April 2021

- 910 official documents
- > 24 450 working documents
- > 6500 individual user accounts
- Mobile phone compatible (25% of visits via mobile phones)
    - 2000 different users per day
    - Users from 190 states/economies

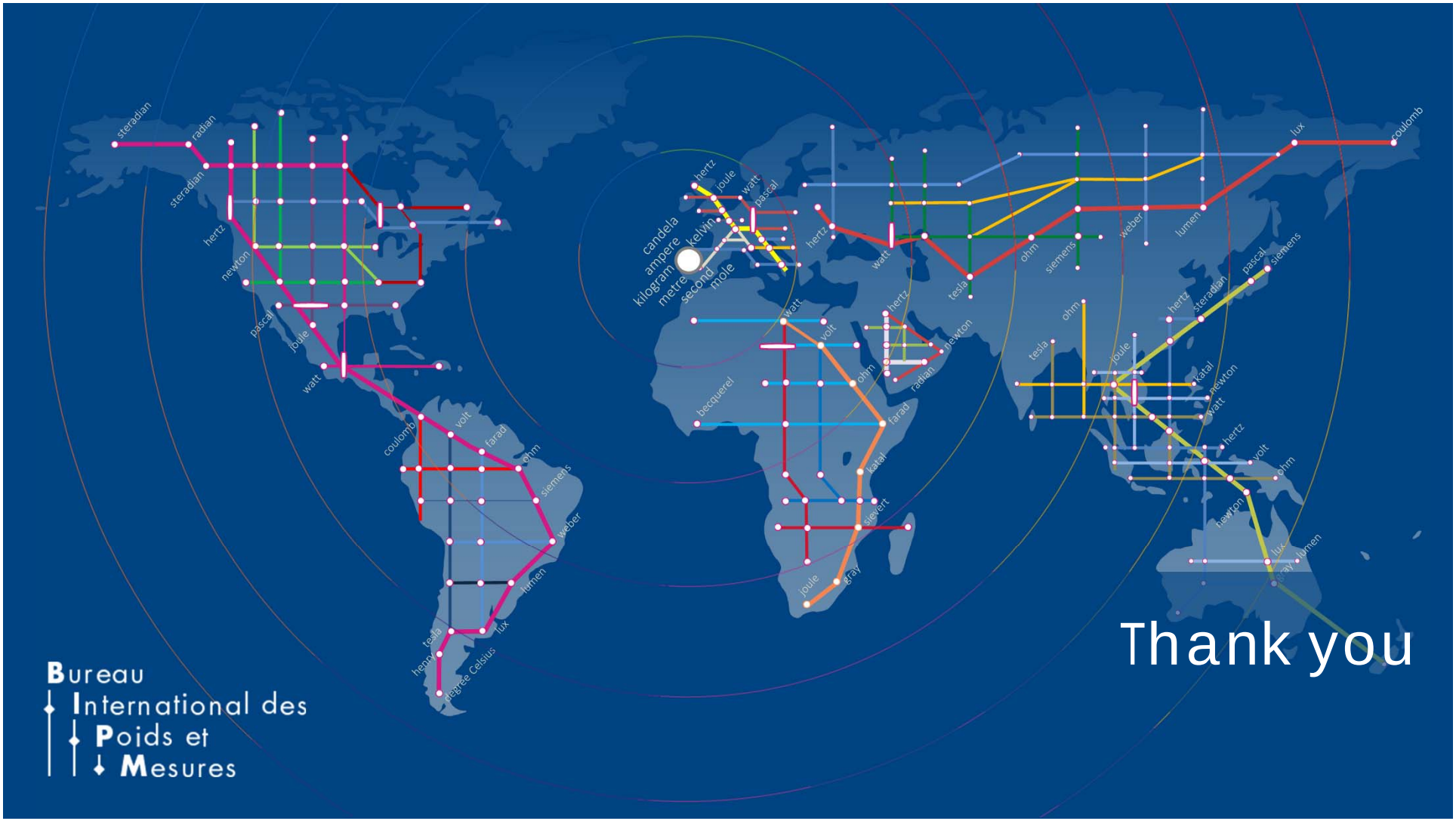



## Communication projects

- E-learning
- YouTube
- New website
- KCDB 2.0

**Two years of successful operation**

Time needed for the inter-regional review of CMCs has been reduced by a factor of 2.




Thank you

Bureau International des Poids et Mesures