

Consultative Committee for Units

24th Meeting

October 8th - 9th, 2019
BIPM, Sevres / France

Joachim Ullrich
President of the CCU
Vice President of the CIPM

Estefania de Mirandés
Michael Stock
Executive Secretary, CCU

Bureau
International des
Poids et
Mesures



Le Système
international d'unités
The International
System
of Units

SI

CCU Contribution: 9th Edition of the SI Brochure

- Open and transparent process trying to achieve consensus
- Finished on time
- In print and as pdf

→ **Thank you all!**

<https://www.bipm.org/utils/common/pdf/si-brochure/SI-Brochure-9.pdf>

www.bipm.org





A historic event!





Merkel, Davos 2019: "...there are things that still work..."

The Role of the Metre Convention and the BIPM

- ◆ The contribution of the Metre Convention and of the BIPM to world-wide harmonization and integration of metrology at highest level **cannot be overestimated**

→ We can all be proud of that!

1.3 Agenda

Draft Agenda for the 24th meeting of CCU

Venue: Pavillon du Mail, BIPM, Sèvres, France.

Start: Tuesday 8 October 2019 at 09:00

- 9:00 1. Opening of the meeting
 - 1.1 Welcoming remarks and introduction 5 min
 - 1.2 Welcoming from the BIPM Director 5 min
 - 1.3 Approval of the Agenda
 - 1.4 Appointment of the *rapporteur*
 - 1.5 Update from the CIPM 10 min
- 2. President's report 10 min
- 9:30 3. CODATA TGFC report on the 2018 CODATA adjustment 15 min
- 9:45 4. Reports from the Consultative Committees 10 min each. Total : 90 min. 10 min for all the discussions
- 11:55 5. Comments on written reports from other organizations :
ISO, IUPAC, IUPAP, Académie des Sciences de Paris, OIML 15 min
- 12:10 6. Questionnaire for CCU members and stakeholders on the implementation of the new definitions of the SI. 50 min including a presentation of the possible questionnaire and discussion
- 14:00 7. Discussion on the definition of the term "unit". 90 min

1.3 Agenda

tomorrow

16:00 8. Discussion on angles and dimensionless quantities 90 min

9:00 9. Discussion on the SI in the digital world 90 min

11:00 10. Discussion on the possible extension of the available range of SI prefixes 60 min

12:00 11. CCU Strategy for the next 10 years 40 min

12:40 12. Any other business

13. Date of the next CCU meeting

19:30 Dinner with lively discussions

- INRIM CCU Membership
- Ukraine CCU Observership
- Establishing a WG on terminology

1.3 Agenda

Draft Agenda for the BIPM Workshop on “Advanced Time and Frequency Transfer: the ultimate frontier for remote comparison methods”

Venue: Pavillon du Mail, BIPM, Sèvres, France.

Start: Thursday 10 October 2019 at 09:00

09.00-09.05 Opening address of the Workshop
[Prof. Joachim Ullrich (PTB) and Dr Davide Calonico (INRIM), Chairs of the Workshop]

09:05 - 09:15 Introduction on CCTF WGATFT activity
[Dr Davide Calonico, INRIM (Italy)]

Session 1: Chair: Prof. Joachim Ullrich, (CCU President)

09.15-10.00 Global quantum communication and precise time frequency dissemination
[Dr Pan Jian-Wei, University of Science and Technology (China)]

10.00-10.45 Optical two-way time and frequency transfer over terrestrial free space links with frequency combs
[Dr Nathan Newbury, NIST (USA)]

10.45-11.30 Tea / Coffee Break

1.3 Agenda

11.30-12.15 Optical time synchronization in the Kepler satellite navigation system
[Prof. Dr Christoph Günther, DLR (Germany)]

Session 2: Chair: Dr Helen Margolis (NPL)

12.15-13.00 Intercontinental Frequency link via VLBI
[Dr Mamoru Sekido, NICT (Japan)]

13.00-14.00 Lunch

14.00-14.45 White Rabbit: accurate time and frequency transfer using standard-based technology
[Dr Maciej Lipinski, CERN (Switzerland)]

14.45-15.30 Coherent optical fibre links: clock comparisons and beyond
[Dr Davide Calonico, INRIM (Italy)]

15.30-16.00 Tea / Coffee Break

Session 3: Chair: Dr Davide Calonico (Chair of CCTF WG-ATFT)

16.00-18.00 Panel discussion: "Moving forward with remote comparison and dissemination in time and frequency"

18.00 Close of the meeting

1.5 Update from the CGPM



On the revision of the International System of Units (SI)

Resolution 1

The General Conference on Weights and Measures (CGPM), at its 26th meeting, considering

- the essential requirement for an International System of Units (SI) that is uniform and accessible world-wide for international trade, high-technology manufacturing, human health and safety, protection of the environment, global climate studies and the basic science that underpins all these,
- that the SI units must be stable in the long term, internally self-consistent and practically realizable being based on the present theoretical description of nature at the highest level,
- that a revision of the SI to meet these requirements was proposed in Resolution 1 adopted unanimously by the CGPM at its 24th meeting (2011) that laid out in detail a new way of defining the SI based on a set of seven defining constants, drawn from the fundamental constants of physics and other constants of nature, from which the definitions of the seven base units are deduced,
- that the conditions set by the CGPM at its 24th meeting (2011), confirmed at its 25th meeting (2014), before such a revised SI could be adopted have now been met,

decides that, effective from 20 May 2019, the International System of Units, the SI, is the system of units in which:

- the unperturbed ground state hyperfine transition frequency of the caesium 133 ν_{Cs} is 9 192 631 770 Hz,
- the speed of light in vacuum c is 299 792 458 m/s,
- the Planck constant h is $6.626\,070\,15 \times 10^{-34}$ J s,
- the elementary charge e is $1.602\,176\,634 \times 10^{-19}$ C,
- the Boltzmann constant k is $1.380\,649 \times 10^{-23}$ J/K,
- the Avogadro constant N_A is $6.022\,140\,76 \times 10^{23}$ mol⁻¹,
- the luminous efficacy of monochromatic radiation of frequency 540×10^{12} Hz, K_{cd} is 683 lm/W,

1.5 Update from the CIPM / 108 / March 2019



1.5 Update from the CIPM / 108 / March 2019



1.5 Update from the CIPM / 107 / March 2019

Decisions of interest

Decision CIPM/108-07

The CIPM appointed Dr S.-R. Park as the President of the Consultative Committee for Amount of Substance: Metrology in Chemistry and Biology (CCQM) for a four-year term.

Decision CIPM/108-08

The CIPM appointed Dr N. Dimarcq as the President of the Consultative Committee for Time and Frequency (CCTF) for a four-year term.

1.5 Update from the CIPM / 108 / March 2019

Decisions of interest

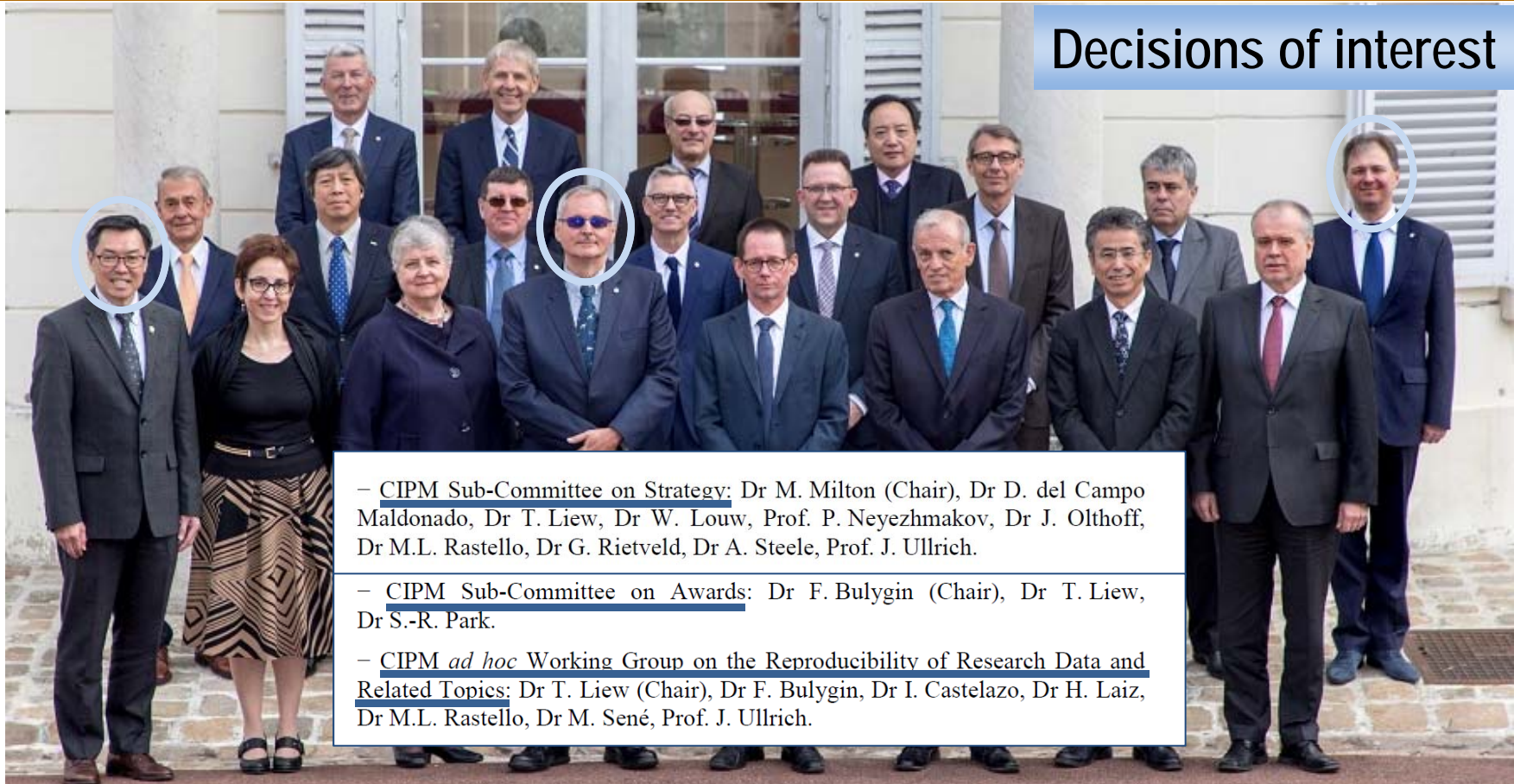
Decision CIPM/108-09

The CIPM thanked the Presidents of the Consultative Committees for their work and their excellent reports to the 26th meeting of the CGPM. It decided to reappoint the Presidents of the following Consultative Committees for four-year terms:

- Consultative Committee for Acoustics, Ultrasound and Vibration (CCAUV): Dr T. Usuda.
- Consultative Committee for Electricity and Magnetism (CEEM): Dr G. Rietveld.
- Consultative Committee for Length (CCL): Dr I. Castelazo.
- Consultative Committee for Mass and Related Quantities (CCM): Dr P. Richard.
- Consultative Committee for Photometry and Radiometry (CCPR): Dr M.L. Rastello.
- Consultative Committee for Ionizing Radiation (CCRI): Dr W. Louw.
- Consultative Committee for Thermometry (CCT): Dr Y. Duan.
- Consultative Committee for Units (CCU): Prof. J. Ullrich.

1.5 Update from the CIPM / 108 / March 2019

Decisions of interest

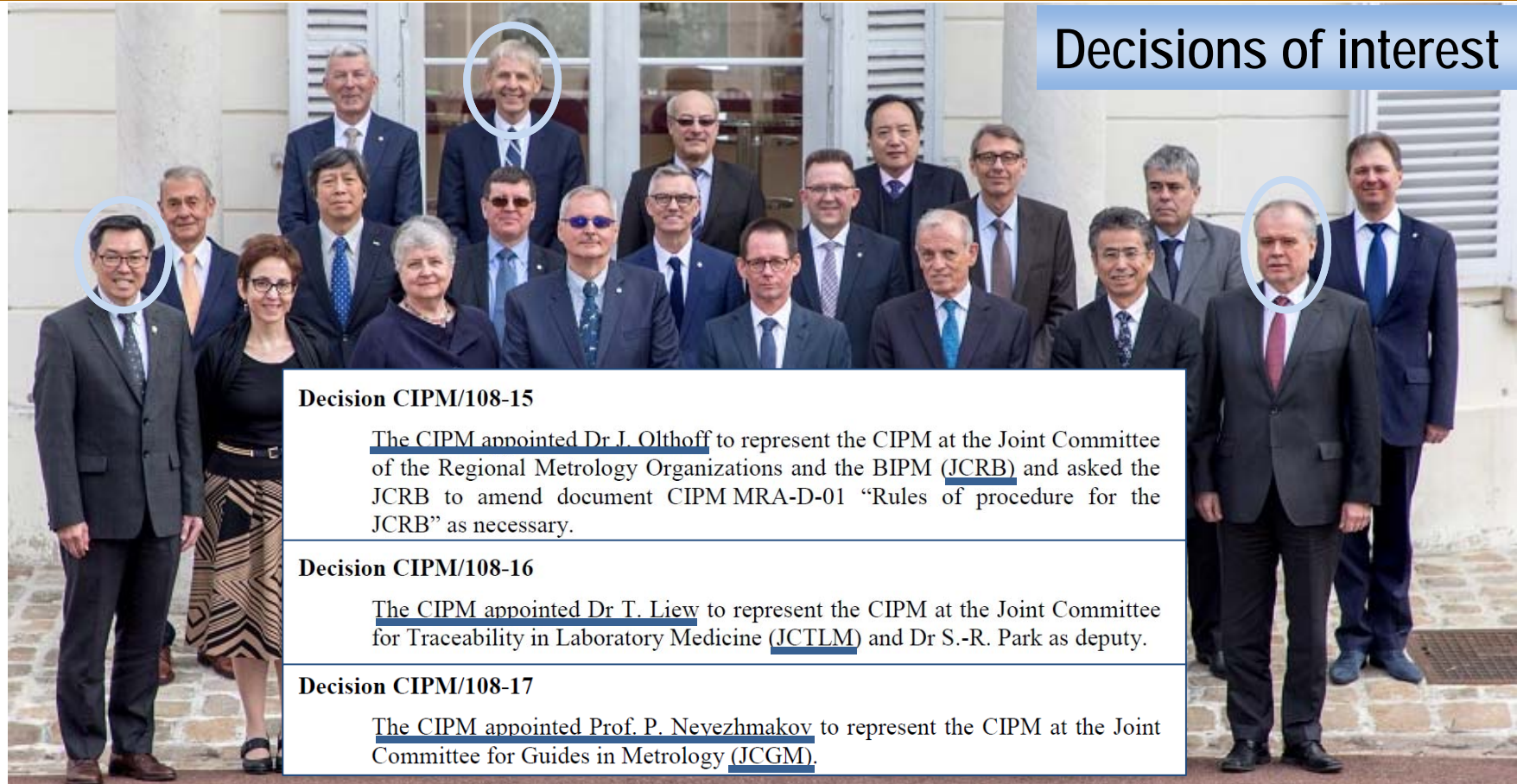


– CIPM Sub-Committee on Strategy: Dr M. Milton (Chair), Dr D. del Campo Maldonado, Dr T. Liew, Dr W. Louw, Prof. P. Neyezhnikov, Dr J. Olthoff, Dr M.L. Rastello, Dr G. Rietveld, Dr A. Steele, Prof. J. Ullrich.

– CIPM Sub-Committee on Awards: Dr F. Bulygin (Chair), Dr T. Liew, Dr S.-R. Park.

– CIPM *ad hoc* Working Group on the Reproducibility of Research Data and Related Topics: Dr T. Liew (Chair), Dr F. Bulygin, Dr I. Castelazo, Dr H. Laiz, Dr M.L. Rastello, Dr M. Sené, Prof. J. Ullrich.

1.5 Update from the CIPM / 108 / March 2019



Decisions of interest

Decision CIPM/108-15

The CIPM appointed Dr. J. Olthoff to represent the CIPM at the Joint Committee of the Regional Metrology Organizations and the BIPM (JCRB) and asked the JCRB to amend document CIPM MRA-D-01 “Rules of procedure for the JCRB” as necessary.

Decision CIPM/108-16

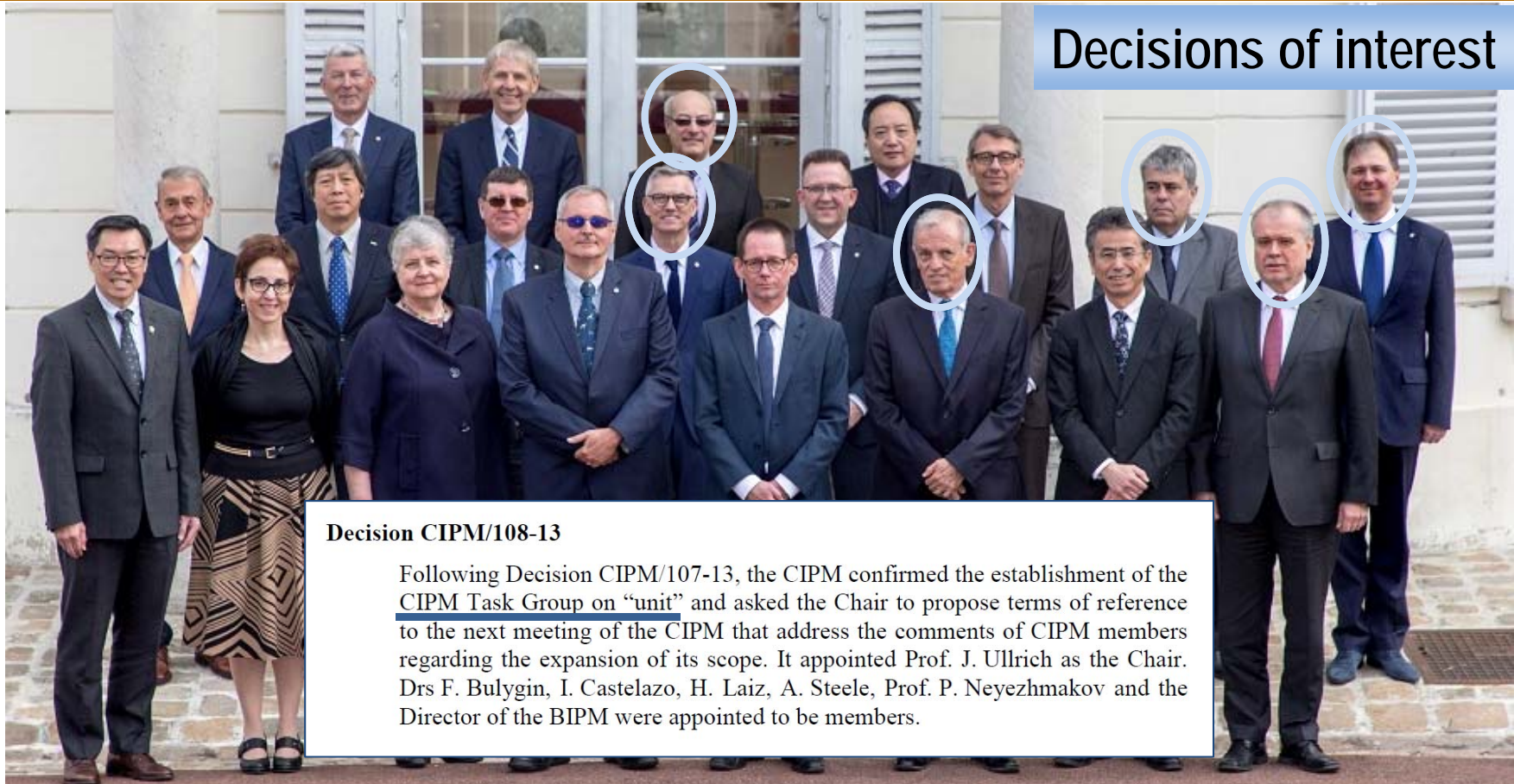
The CIPM appointed Dr T. Liew to represent the CIPM at the Joint Committee for Traceability in Laboratory Medicine (JCTLM) and Dr S.-R. Park as deputy.

Decision CIPM/108-17

The CIPM appointed Prof. P. Nevezhnikov to represent the CIPM at the Joint Committee for Guides in Metrology (JCGM).

1.5 Update from the CIPM / 108 / March 2019

Decisions of interest



Decision CIPM/108-13

Following Decision CIPM/107-13, the CIPM confirmed the establishment of the CIPM Task Group on “unit” and asked the Chair to propose terms of reference to the next meeting of the CIPM that address the comments of CIPM members regarding the expansion of its scope. It appointed Prof. J. Ullrich as the Chair. Drs F. Bulygin, I. Castelazo, H. Laiz, A. Steele, Prof. P. Neyezhnikov and the Director of the BIPM were appointed to be members.

1.5 Update from the CIPM / 107 / June 2018

Decision CIPM/107-12 It was brought to the attention of the CIPM that there is a discrepancy relating to the definition of the term “unit” between the draft 9th edition of the SI Brochure and the 8th edition. The CIPM asked the CCU President to organize a vote by correspondence among the CCU members, with a deadline of the end of August 2018, as to whether to keep the wording of the 8th edition, and to report back

→ “keep the wording of the 8th Edition of the Brochure”

→ Discussion under TOP 7

Decision CIPM/107-13 The CIPM agreed with the proposal from the CCU President to establish a Task Group to review further the issue concerning the definition of the term “unit” in the SI Brochure

Decision CIPM/108-13

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Decisions of interest

1.5 Update from the CIPM / 107 / June 2018

Decision CIPM/107-25 The CIPM noted the letter from the Chair of the JCGM Working Group on the VIM (WG2) on the proposed broader definition of the term “measurement” to include ordinal and nominal properties. It expressed thanks for being given early information about an important topic under discussion by WG2. The CIPM concluded that there is merit in the proposed definition and asked WG2 to keep it informed of future developments with the definition.

→ Terms like “unit”, “measurement”, “traceability”, enter into the legislation of the Member States

→ First Meeting in June 2019

→ CCU-WG on Terminology: AOB

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Decisions of interest

1.5 Update from the CIPM / 107 / June 2018

Decision CIPM/107-15 The CIPM decided to adopt the following definition of consensus (which originates from the ISO/IEC Directives) for use in the Consultative Committees, Sub-committees and ad hoc Working Groups:

Consensus - "General agreement, characterized by the absence of sustained opposition to substantial issues by any important part of the concerned interests and by a process that involves seeking to take into account the views of all parties concerned and to reconcile any conflicting arguments. Consensus need not imply unanimity."

Document CIPM-D-01 will be updated accordingly.

Decision CIPM/107-16 The CIPM agreed the revised version of CIPM-D-01.

Decision CIPM/107-25 The CIPM noted the letter from the Chair of the JCGM Working Group on the VIM (WG2) on the proposed broader definition of the term "measurement" to include ordinal and nominal properties. It expressed thanks for being given early information about an important topic under discussion by WG2. The CIPM concluded that there is merit in the proposed definition and asked WG2 to keep it informed of future developments with the definition.

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→ AOB: WG on Terminology

Decisions of interest

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CIPM-D-01

Consultative Committees (CCs)

CC working groups and CC workshops

This document was approved by the CIPM in July 2018.

It cancels and replaces CIPM/2005-10, CIPM/2009-66 and CIPM/2012-03 adopted by the CIPM in 2005, 2009 and 2012.

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Decisions of interest

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Consensus - "General agreement, characterized by the absence of sustained opposition to substantial issues by any important part of the concerned interests and by a process that involves seeking to take into account the views of all parties concerned and to reconcile any conflicting arguments. Consensus need not imply unanimity."

5.10 The operation of the CC is by consensus amongst all present at the meeting which is understood to be:

CIPM-D-01
Version 3

"General agreement, characterized by the absence of sustained opposition to substantial issues by any important part of the concerned interests and by a process that involves seeking to take into account the views of all parties concerned and to reconcile any conflicting arguments. Consensus need not imply unanimity³"

If no consensus is reached on a substantial issue, the CC President will refer the issue to the CIPM and report the differing views.

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Decisions of interest

1.5 Update from the CIPM / 106 / October 2017

Decision CIPM/106-18 The CIPM decided that, in order to further emphasize the consultative nature of the Consultative Committees and the importance of the consensus-based decision-making processes, Document CIPM-D-01 should be updated so as not to make any reference to voting taking place in CCs.

Decision CIPM/106-19

The CIPM accepted the following changes to the membership and observership of the Consultative Committees:

•••

- CCU
 - o LNE (France) as a member.

**Request by INRIM:
under AOB**

Decision CIPM/105-28

The CIPM decided that the CCU will adopt the same criteria for participation as the other CCs for all meetings in 2018 and beyond. Document CIPM-D-01 will be updated accordingly.

after the revision of the SI: now!

CIPM-D-01

www.

Decisions of interest

1.5 Update from the CIPM / 106 / October 2017

Decision CIPM/106-17 Following Decision CIPM/105-27 (on the engagement of international organizations as “liaisons” at the Consultative Committees), the CIPM decided that the status of liaison within the context of the Consultative Committees will be decided upon in each case by the CIPM.

The CIPM will base its decision on the extent to which the international organization concerned meets the following criteria:

- being international in structure and scope of activity, and representative of the specialized field of interest in which they operate;
- being concerned with matters covering a part, or all, of the field of activity of the BIPM;
- having aims and purposes in conformity with the Vision, Mission and Objectives of the BIPM;
- having a permanent directing body and secretariat, authorized representatives and systematic procedures and machinery for communicating with its membership in various countries;
- allowing its members to exercise voting rights in relation to its policies or action or having other appropriate mechanisms to express their views; and
- having been established at least three years before they apply for liaison status.

Organizations that are not offered liaison status within the context of the Consultative Committees will be known as “organizations in cooperation”.

Document CIPM-D-01 will be updated accordingly.

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Decisions of interest

1.5 Update from the CIPM / 105 / October 2016

Request by
Ukraine:
under AOB

Decision CIPM/105-26

The CIPM decided to revise the Rules for Membership of the Consultative Committees as follows; all Member States will have the right for one national laboratory charged with establishing national standards in the field to be an Observer at the applicable Consultative Committee and to send one person (only) and following their request for each meeting. Document CIPM-D-01 will be updated accordingly.

Decision CIPM/105-27

The CIPM decided that for all Consultative Committee meetings in 2017 and thereafter:

- International organizations will be referred to as « liaisons » and will not be offered membership.
- Named individuals will be « guests » or « experts » and will not be offered membership.

Document CIPM-D-01 will be updated accordingly.

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Decisions of interest

1.5 Update from the CIPM / 105 / October 2016

Decision CIPM/105-28

CIPM-D-01

The CIPM decided that the CCU will adopt the same criteria for participation as the other CCs for all meetings in 2018 and beyond. Document CIPM-D-01 will be updated accordingly.

Member status

4.2 Membership of the CCs is decided by the CIPM in accordance with the following established criteria.

Membership of a Consultative Committee is open to institutions of Member States that are recognized internationally as most expert in the field. This normally requires that they:

- be national laboratories charged with establishing national standards in the field;*
- be active in research and have a record of recent publications in research journals of international repute;*
- have demonstrated competence by a record of participation in international comparisons organized either by the Consultative Committee, the BIPM or a regional metrology organization.*

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Decisions of interest

1.5 Update from the CIPM / 106 / October 2017

Decisions of interest

Decision CIPM/106-09 The CIPM requested the CCM to provide, for the next meeting of the CIPM, a formally approved note on the dissemination process after the redefinition of the kilogram, addressing in particular the definition of the consensus value, as well as an updated *mise en pratique*, taking into account the comments made at the 106th meeting of the CIPM.

Decision CIPM/106-10 The International Committee for Weights and Measures (CIPM) welcomed recommendations regarding the redefinition of the SI from its Consultative Committees.

The CIPM noted that the agreed conditions for the redefinition are now met and decided to submit Draft Resolution A to the 26th meeting of the General Conference on Weights and Measures (CGPM) and to undertake all other necessary steps to proceed with the planned redefinition of the kilogram, ampere, kelvin and mole.

Decision CIPM/106-11 The CIPM authorized the CIPM President to convey its support for the publication of the final numerical values for the defining constants to the Task Group for Fundamental Constants convened by CODATA.

1.5 Update from the CIPM / 106 / October 2017

Decisions of interest

Decision CIPM/106-12 The CIPM accepted the revised Draft Resolution A as presented at the 106th meeting of the CIPM, which included modifications:

- to the wording for the definition of the mole as suggested by the CCU and based on proposals by the CCQM and IUPAC,
- to include the final CODATA LSA values for the defining constants,
- to rearrange the order of the sentence in the definition of the luminous efficacy, and
- to include explanatory text on the hertz, joule, coulomb, lumen and watt.

Decision CIPM/106-13 The CIPM approved the edited version of the 9th edition of the SI Brochure, as approved by the CCU, changed by adding the preface on “The BIPM and the Metre Convention” used in the 8th edition of the SI Brochure modified only by correcting the numbers of Member States and Associate States/Economies and simultaneously deleting what was Appendix 1 on “The Metre Convention and its Organs”.

1.5 Update from the CIPM / 106 / October 2017

Decision CIPM/106-14

The CIPM welcomed the excellent progress on the promotion of the revised SI by the CIPM Task Group for Promotion of the SI and encouraged all NMIs to take advantage of the material they develop.

Decision CIPM/106-15

The CIPM decided that the *mises en pratique* prepared by the CCs for each of the base units should be presented in a common format to be developed by the BIPM editing team.

1.5 Update from the CIPM / 106 / October 2017

Decision CIPM/106-16

The CIPM decided the following text for inclusion in CIPM-D-01:

In order to be informed of technical developments and evolving stakeholder needs in different areas of metrology, the CIPM has Consultative Committees with agreed scopes and the following three objectives:

- to progress the state-of-the art by providing a global forum for NMIs to exchange information about the state of the art and best practices,

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Decisions of interest

2.0 Presidents Report

- ◆ **Update of decisions of the 23rd meeting of the CCU**
- ◆ Decision on “unit”
- ◆ Corrections to the 9th Edition of the SI Brochure
- ◆ Report on the Working Group on Strategy

Decisions of the 23rd meeting of the CCU

1. Recommends to the CIPM to proceed with the revision of the SI in 2018 according to the CCM-CCU roadmap.
2. Notes that CODATA will make a decision before the CIPM meeting on the inclusion of the Russian measurement of k , and the CCT will decide on the final number of digits to be assigned to the numerical value of the Boltzmann constant to be fixed.
3. Accepts the edited draft 9th SI Brochure and some of the modifications proposed by the editing team as agreed during the CCU meeting and recorded in the minutes.
4. Decides to include a side note concerning the var and the gal in the draft 9th SI Brochure.
5. Decides to reject all requests to include further non-SI units into the 9th SI Brochure.
6. Decides to accept the modified wording for the definition of the mole as agreed during the CCU meeting in the draft 9th SI Brochure.
7. Decides to accept the modifications to the draft 9th SI Brochure agreed with the CCPR.
8. Decides to accept Appendix 3 as proposed by the CCPR as an online appendix in the draft 9th SI Brochure.

Decisions

Decisions of the 23rd meeting of the CCU

Prof. Ullrich commented that the CCU has organized its members into international unions, international commissions and committees and international bodies. He asked if the CCU should retain its classification and criteria for 'liaison organizations'. The Director replied that the CCU classification is informal but there is no need to change it as the type of member organizations that the CCU interacts with are included under the proposed criteria for 'liaison organizations'. Mr Henson added that the term 'liaison organizations' is generic and that in this context it is more important how an organization interacts with the CCs rather than how it is categorized.

12. Agrees to communicate to the CIPM the views expressed by international scientific unions, organizations and other members of the CCU about the change of their memberships to liaison status.

Decision CIPM/106-18 The CIPM decided that, in order to further emphasize the consultative nature of the Consultative Committees and the importance of the consensus-based decision-making processes. Document CIPM-D-01 should be updated so as not to make any reference to voting taking place in CCs.

2.0 Presidents Report

- ◆ Update of decisions of the 23rd meeting of the CCU
- ◆ Decision on “unit”

Decision CIPM/107-12 It was brought to the attention of the CIPM that there is a discrepancy relating to the definition of the term “unit” between the draft 9th edition of the SI Brochure and the 8th edition. The CIPM asked the CCU President to organize a vote by correspondence among the CCU members, with a deadline of the end of August 2018, as to whether to retain the wording of the draft 9th edition or to revert to the wording of the 8th edition, and to report back to the CIPM President for further action (if necessary).

→ “keep the wording of the 8th Edition of the Brochure”

→ Discussion under TOP 7

→ CIPM Task Group on units: first meeting in June 2019

→ CCU-WG on Terminology: Any other business

Corrections to the 9th Edition of the SI Brochure

Decision CIPM/106-13

The CIPM approved the edited version of the 9th edition of the SI Brochure, as approved by the CCU, changed by adding the preface on “The BIPM and the Metre Convention” used in the 8th edition of the SI Brochure modified only by correcting the numbers of Member States and Associate States/Economies and simultaneously deleting what was Appendix 1 on “The Metre Convention and its Organs”.

Corrections to the 9th Edition of the SI Brochure

20. Dezember 2018

Not in the French version?

Dear CCU Members, dear Colleagues,

You will find attached the updated version of the draft 9th SI Brochure, **incorporating the same definition of the term "unit" that is present in the 8th SI Brochure**, following the approval of the CIPM. This version is now publicly available in the BIPM open webpages:

<https://www.bipm.org/en/measurement-units/rev-si/#communication>

The text incorporates as well some minor editorial updates. You will find the tracked version in our restricted-access website:

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along with the updated Concise summary, the updated Appendix 1 and Appendix 3.

Kind regards,

Estefanía

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Corrections to the 9th Edition of the SI Brochure

- ◆ Peter Blattner



“We will eliminate “numerical value” from 2.2.1 and we will update the concise summary to harmonize Table 2 with the one in the Brochure and we will add back the footnote.”

- ◆ Brian Leonard: Consistent use of proportionality constant



- The Avogadro constant N_A is a proportionality constant between the quantity amount of substance (with unit mole) and the quantity for counting entities (with unit one, symbol 1). Thus it has the character of a constant of proportionality similar to the Boltzmann constant k .
- I am referring strictly to the formal definitions of kelvin and candela—both of which mention c in their statements, along with other constants. However, c does not appear in the explicit unit expression for either of these units (it “cancels out”). I just think this is worth emphasising in the discussion immediately following the explicit-unit formulas, in both cases.

Corrections to the 9th Edition of the SI Brochure

- ◆ Dr. Prazak:

- In Chapter 2.2.1, the elementary charge is defined as „a coupling strength of the electromagnetic force via the fine-structure constant.“

Taken up by the strategy group

- ◆ Relating to ISO/IEC 80000

- “Nevertheless, the concept of base and derived units is maintained because it is useful and historically well established, noting also that the ISO/IEC 80000 series of Standards specify base and derived quantities which necessarily correspond to the SI base and derived units defined here.”
- Comments by Sven Radke ISO/TC 12 Secretariat: commas as decimal marker, mol/mol

Corrections to the 9th Edition of the SI Brochure

All the old versions of the SI Brochure have been scanned and are publicly available at

<https://www.bipm.org/fr/publications/si-brochure/#previous>

◆ Dr. Emilio Prieto:



➤ number of member states: in the English version one country, Uzbekistan, is missing

➤ Foot note for the dalton

(f) The dalton (Da) and the unified atomic mass unit (u) are alternative names (and symbols) for the same unit, equal to 1/12 of the mass of a free carbon 12 atom, at rest and in its ground state. This value of the dalton is the value recommended in the CODATA 2014 adjustment. It will be updated in the CODATA 2018 adjustment to take into account the, now fixed, 2017 value of the Planck constant h . This will reduce the 2014 uncertainty by an order of magnitude.

2.0 Presidents Report

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- ◆ **Report on the Working Group on Strategy**

CCU Working Group on Strategy

11.1 Reappointment of the CCU working group on strategy with new members

Prof Ullrich stated his intention to reform the CCU working group on strategy with new members. He also proposed some terms of reference for the working group, which he stated may need some discussion by the working group, and would be brought to the next CCU meeting for a decision. He commented that it was important that the working group comprised those with different backgrounds from both inside and outside the metrology community.

Prof Ullrich proposed that the working membership would be:

Dr Arias, Dr Brown, Dr de Mirandés, Dr Karshenboim, Prof W. Phillips, Dr Prieto Esteban, Dr Richard, Dr Rietveld and Prof Ullrich (chairman).

Prof Ullrich proposed an initial term of four years for members with a maximum of two terms.

The proposal was approved by the CCU.

CCU Working Group on Strategy

- ◆ **First meeting:** 19 January 2018
- ◆ **Second meeting:** 25 January 2019
- ◆ **Members:**

Next meeting January 2020

Report of the meeting of the CCU Working Group on Strategy (CCU WG-S)
held at the BIPM the 25 January 2019

Available on the web

Presents: Felicitas Arias (former CCTF executive secretary), Richard Brown (NPL), Savely Karshemboim (CODATA), Martin Milton (BIPM director), Estefanía de Mirandés (CCU executive secretary), Emilio Prieto (CEM), Philippe Richard (CCM President) and Joachim Ullrich (CCU President and Chair of the meeting)

Excused: Gert Rielveld (CCEM President)

CCU Working Group on Strategy

The terms of reference of the CCU-WG-S are to:

1. Ensure that relevant developments in science, particularly in areas not covered by other CCs, are monitored by the CCU and propose suitable actions.
2. Propose a long-term vision for the CCU covering the next ten years and to establish and maintain a strategic planning document.
3. Advise the CCU on the optimal operational structure of the CCU and its working groups.
4. Establish practices to ensure an effective linkage between organizations in liaison and in cooperation with the CCU.
5. Suggest to the CCU possible future revisions, additional Annexes to the SI Brochure or other supporting documents, as appropriate.

To be approved

6.0 Questionnaire for CCU members

A. Questions for National Metrology Institutes (1/2)

1. Did you experience any difficulties in implementing the revised SI in your institute?
If yes, please describe.
2. Did you use this event to promote metrology and the SI in your country? If yes, how?
3. Did you find all the information required to implement the revised SI?
Has the information campaign organized by the BIPM and the CIPM been effective?
If not, what was missing and what should be provided in the future?
4. Was the information provided sufficiently in advance of the implementation date?
5. Were any of your customers affected by the changes?
If yes, how did you inform them and how did they react?

6.0 Questionnaire for CCU members

A. Questions for National Metrology Institutes (2/2)

6. Did you receive any questions or comments from customers?
7. Did the revision of the SI influence the future realization and dissemination strategy at your institute?
If yes, which new directions and means have been implemented?
8. Do you see new possibilities for innovative approaches and technologies to be implemented based on the revised SI? If yes, what are those?
9. Are you aware of any activities in industry to develop innovative measurement instruments based on the revised SI?
If yes, which ones and will they “shorten” the traceability chain?
10. Do you have any other comments?

6.0 Questionnaire for CCU members

B. Questions for liaison organizations of the CCU

1. Was the work of your organization impacted by the revision, and if yes, in which way?
2. Did you find all the information required to implement the revised SI?
Has the information campaign organized by the BIPM and the CIPM been effective?
If not, what was missing and what should be provided in the future?
3. Was the information provided sufficiently in advance of the implementation date?
4. Do you consider that your organization was sufficiently consulted in the process towards the revision?
5. Did you receive any questions or comments from your member organizations?
6. Would you need additional information on the revised SI? If yes, which one?
7. Do you have any other comments?

6.0 Questionnaire for CCU members

C. Questions for academic institutions

1. Did the revision of the SI have any impact on your curriculum?
2. Did you find all the information required to understand the revised SI?
Has the information campaign organized by the BIPM and the CIPM been effective?
If not, what was missing and what should be provided in the future?
3. Did you experience any difficulties in teaching the principles of the revised SI?
4. Did you receive any questions or comments from students?
5. Would you need other, more or better teaching material?
If yes, what should be provided?
6. Do you have any other comments?

7.0 / 8.0 “unit” & “dimensionless quantities”

“Left-overs” from the preparation of the 9th Edition of the SI Brochure, where CCU was not able to reach consensus.

24th CCU (2019):

- Restart the discussion with the goal to reach consensus
- Material has been provided by the Members and Liaison of CCU in advance
- We will have at least 2 presentations on the different views for each topic
- Open scientific discussion within the CCU plenum: personal opinions are welcome

After the meeting:

Based on this discussion, Members and Liaisons are asked

→ to seek **the official opinion of the Organization** which they represent.

7.0 / 8.0 “unit” & “dimensionless quantities”

“Left-overs” from the preparation of the 9th Edition of the SI Brochure, where CCU was not able to reach consensus.

25th CCU (2020 or 2021):

- Member and Liaison Organizations represent *their respective official opinions*, *explaining the process* within their organization to come to this opinion, and *elucidating the scientific rational* behind the respective decision
- Discussion within the CCU plenum to achieve consensus

After the meeting:

- Report of the CCU President to the CIPM
- Decision by the CIPM, potentially resulting in draft resolution(s) to the CGPM
- CGPM Resolution(s) in the next meeting in 2022

11.0 CCU strategy for the next 10 years

To be approved

◆ General Information

- **Name:** Consultative Committee for Units (CCU)
- **Working Groups:** CCU Working group on Strategy (CCU-WG-S) and ad-hoc Working Groups and Task Groups when necessary on a temporary basis
- **Date established:** 1964, to replace the "Commission for the System of Units", set up by the CIPM in 1954
- **Number of Members:** 11 Members, No Observers, 10 Liaisons and 3 Honorary Members
- **Number of participants at last meeting:** 65
- **Periodicity of meetings:** 1 to 3 years
- **Date of last meeting:** 5 and 6 September 2017, its 23rd meeting
- **President:** Prof Joachim Ullrich, from 1st January 2014

11.0 CCU strategy for the next 10 years

◆ Terms of reference

The work of the CCU is concerned with matters related to:

- Providing advice to the CIPM about units of measurement, in general, overall consistency and harmonisation
- The development and improvement of the International System of Units (SI), the preparation of successive editions of the SI Brochure and supportive documents, and any other summaries relevant for metrology institutes, industry, academia and schools, etc.
- Providing information and advice on units and their use to a wide range of stakeholders

11.0 CCU strategy for the next 10 years

◆ Description of activities and achievements up to and including 2019

- CCU's main task since its creation in 1964 has been to oversee **development of the SI and prepare SI reference documents**, i.e., the “SI Brochure”; the **SI Brochure**, now published in French and many other languages*, is the most important and widely used BIPM publication; 9th edition was published in 2019 and contains a concise 4-page summary
- Preparation of a **revision of the SI**, including new definitions of kilogram, ampere, kelvin, and mole (and rewording of definitions of second, metre, and candela); adopted by 26th CGPM on 16/11/18 and in force since 20/05/19 basing the revised SI on a set of seven “defining constants”
- Guiding **discussions** about SI revision of individual Consultative Committees and negotiating a **consensus** → in 2017, CCU supported decision of revising the SI forming the basis for **Resolution 1** of the 26th CGPM
- **Informing the public** and creating awareness about **SI revision**: dedicated **BIPM webpage** with FAQs, rationale of SI revision, and SI Brochure with Concise Summary
- CCU WG on angles and dimensionless quantities (WGADQ) discussing treatment of **dimensionless quantities**, e.g., angles, frequencies, and counting quantities → **no consensus** reached (9th edition of SI Brochure published in current form, in line with CIPM decision)

*The French copy, however, remains the legally binding version.
www.bipm.org

11.0 CCU strategy for the next 10 years

◆ Stakeholders

Bodies having a direct interest and concern in CCU activities:

- **CIPM**, which must be properly advised on matters related to the SI
- **National Metrology Institutes** and **Designated Institutes**, which use the SI everyday in their business
- **International organisations** in *liaison* with the CCU, which disseminate the SI to their members
- Accurate, clear, and accessible SI definitions also essential for **scientific, technical, industrial, and educational communities**, as well as **society** as a whole (e.g., regarding research and development, manufacturing, trade, medicine, environmental protection, consumer protection)

11.0 CCU strategy for the next 10 years

- ◆ **Future Scan (2019-2030):** Monitoring implementation of revised SI and otherwise reorient CCU scope and activities (1/3).

Specific Tasks:

- **Time and frequency metrology** in close collaboration with CCTF:

Joint workshop

- optical clocks outperform best primary caesium clock fountains (with persisting potential for improvement); CCU to provide input to CCTF roadmap and timeline/milestones; ***optical frequency ratios, time unit ↔ time scale***

- **Monitoring implementation of revised SI** in close collaboration with other CCs:

- CCU to conduct a survey among CCU members, liaisons, NMIs, and stakeholders to gather feedback about implementation; CCU to collect FAQ from stakeholders related to changes resulting from SI revision; long-term: new proposals for *mises en pratique*; CCU to monitor developments, document improvements, and provide scientific advice to CIPM; CCU to propose updates to SI Brochure to CIPM

survey

- CCU and President to ensure general acceptance of SI revision;

11.0 CCU strategy for the next 10 years

- ◆ **Future Scan (2019-2030):** Monitoring implementation of revised SI and otherwise reorient CCU scope and activities (2/3):
 - **Several issues have been object of debate** and for some of them further consideration may be needed. In particular:
 - CCU to review advantages and drawbacks of **distinction between base units and derived units**
 - CCU to interrogate pertinence of **formal hierarchy within the SI** and the distinction between **units for physical and physiological quantities**
 - CCU to once more review the **role of dimensionless units**, e.g., radians, counts, frequencies, and unit “one”

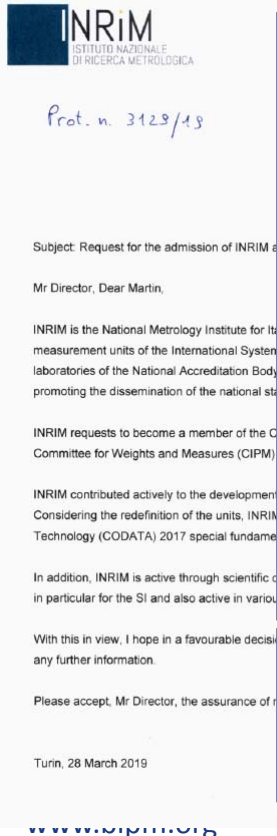
TOP 8

11.0 CCU strategy for the next 10 years

- ◆ **Future Scan (2019-2030):** Monitoring implementation of revised SI and otherwise reorient CCU scope and activities (3/3):
 - CCU to examine the need for a **standard ontology language** used to formulate **machine-readable descriptions** of relevant SI concepts and provide platform for automatic semantic interpretation of textual information related to units of measurement (facilitating exchange of data and knowledge between machines; readable by both human experts and machines) **TOP 9**
 - CCU to re-examine the **definition of the term “unit”** in the SI Brochure (and potentially definitions of other metrological terms if requested by CIPM) **TOP 7**
 - CCU to provide advice on **new SI prefixes** accounting for the expanding range of measurements **TOP 10**

12.1 Membership of INRIM

CIPM-D-01



Member status

4.2 Membership of the CCs is decided by the CIPM in accordance with the following established criteria.

Membership of a Consultative Committee is open to institutions of Member States that are recognized internationally as most expert in the field. This normally requires that they:

- *be national laboratories charged with establishing national standards in the field;*
- *be active in research and have a record of recent publications in research journals of international repute;*
- *have demonstrated competence by a record of participation in international comparisons organized either by the Consultative Committee, the BIPM or a regional metrology organization.*

12.1 Membership of INRIM

INRIM publications

References

- [1] D. Mari, M. Pisani, and M. Zucco, "Towards the realization of an optical pressure standard," *MEASUREMENT*, vol. 132, pp. 402–407, JAN 2019.
- [2] E. Moreva, P. Traina, R. A. Kirkwood, M. Lopez, G. Brida, M. Gramegna, I. Ruo-Berchera, J. Forneris, S. D. Tchernij, P. Olivero, C. J. Chunnilall, S. Kueck, M. Genovese, and I. P. Degiovanni, "Feasibility study towards comparison of the $g((2))(0)$ measurement in the visible range," *METROLOGIA*, vol. 56, FEB 2019.
- ● ● INRIM requests to become a member of the Consultative Committee for Units (CCU) of the International Committee for Weights and Measures (CIPM) with full rights.
- [257] C. E. Calosso, E. Bertacco, D. Calonico, C. Clivati, G. A. Costanzo, M. Frittelli, F. Levi, A. Mura, and A. Godone, "Frequency transfer via a two-way optical phase comparison on a multiplexed fiber network," *OPTICS LETTERS*, vol. 39, pp. 1177–1180, MAR 1 2014.
- [258] S. R. Jefferts, T. P. Heavner, T. E. Parker, J. H. Shirley, E. A. Donley, N. Ashby, F. Levi, D. Calonico, and G. A. Costanzo, "High-Accuracy Measurement of the Blackbody Radiation Frequency Shift of the Ground-State Hyperfine Transition in Cs-133," *PHYSICAL REVIEW LETTERS*, vol. 112, FEB 7 2014.

Turin, 28 March 2019



INRIM is the National Metrology Institute for Italy, responsible for the national reference standards of the measurement units of the International System (SI) and supports the traceability of the calibration laboratories of the National Accreditation Body by ensuring the quality of the measurement standards and promoting the dissemination of the national standards of the SI measurement units.

INRIM requests to become a member of the Consultative Committee for Units (CCU) of the International Committee for Weights and Measures (CIPM) with full rights.

INRIM contributed actively to the development of the International System of Units and its implementation. Considering the redefinition of the units, INRIM contributed to the Committee on Data for Science and Technology (CODATA) 2017 special fundamental constants adjustment.

In addition, INRIM is active through scientific contributions to the measurement science and technology and in particular for the SI and also active in various Consultative Committees.

12.2 Observer Status for NSC-IM, Ukraine

Observer status

- 4.3 Observer status on a CC may be granted to those institutes of Member States that participate actively in the activities organized under the auspices of the CC and its working groups but do not yet fulfil all the criteria for membership. Observer status is decided by the CIPM. Observers qualified under this paragraph may send one delegate who may be accompanied by one expert.
- 4.4 Observer Status on a CC may also be granted to those institutes of an Associate of the CGPM that is not eligible to become a Member State when those institutes participate actively in the activities organized under the auspices of the CC and its working groups. Observer status is decided by the CIPM. Observers qualified under this paragraph may send one delegate who may be accompanied by one expert.
- 4.5 Member States have the right for one national laboratory charged with establishing national standards in the field to be an Observer at the applicable CC and to send one person (only) and following their request to the BIPM Director for each meeting.

[ref Decision CIPM/105-26]

12.3 Recommendation: establish a CCU WG

- To be reported to the CIPM
- Recommendations to be decided by the CIPM to establish a CCU working group dedicated to the examination of definitions of selected metrological terms
- CIPM President: undertake all preparations for establishing the CCU WG

Report of the first meeting of the CIPM Task Group on “unit”

Date of the meeting: 20 June 2019, 2-6 pm

Venue: BIPM

Present: Joachim Ullrich (CIPM, Chair), Martin Milton (BIPM director), Héctor Laiz (CIPM), Takashi Usuda (CIPM), Fedor Bulygin (CIPM), Ismael Castelazo (CIPM), Alan Steele (CIPM), Pavel Neyezhmakov (CIPM), Thomas Liew (CIPM), Wynand Louw (CIPM President), Estefanía de Mirandés (CCU executive secretary)

12.3 Recommendation: establish a CCU WG

Participation in Working Groups

... outside expertise is welcomed!

- 6.6 Membership of the WG is normally restricted to NMIs and DIs from Member States who participate in the relevant CC as Members, Observers or Liaisons. However, institutes that are not Members or Observers of the CC because of narrow expertise may nevertheless become members of a WG whose terms of reference coincide with their particular expertise.
- 6.7 In addition, the CC WG chairperson may invite guests on a one-off basis from other Member States or Associate States/Economies, and, after consultation with the relevant NMI, the participation of a third-party institute from a Member State when this participation will aid or improve the work of the WG.
- 6.8 In particular circumstances, representatives of industrial groups, or government advisers, may also be invited. The President of the CC and the BIPM Director should be informed in advance. For any invited guest, the chairperson of the WG should normally contact the NMI or DI of the Member State to confirm the participation. Hence working groups are normally comprised of members and guests. NB Industrial or commercial representatives may not be invited to participate unless they represent the institute designated as the holder of the particular national standard.

12.3 Recommendation: establish a CCU WG

- ◆ **Proposed name of WG:**

WG on Core Metrological Terms (WG-CMT)

- ◆ **Proposed Terms of Reference:**

- Identify core metrological terms that enter into CGPM Resolutions and national legislation such that they are in the very interest of Member States
- Establish definitions for these core metrological terms in close collaboration with OIML and other NGO stakeholders
- Ensure proper representation in the JCGM WG2 (VIM)



END