The SI in the next ten years

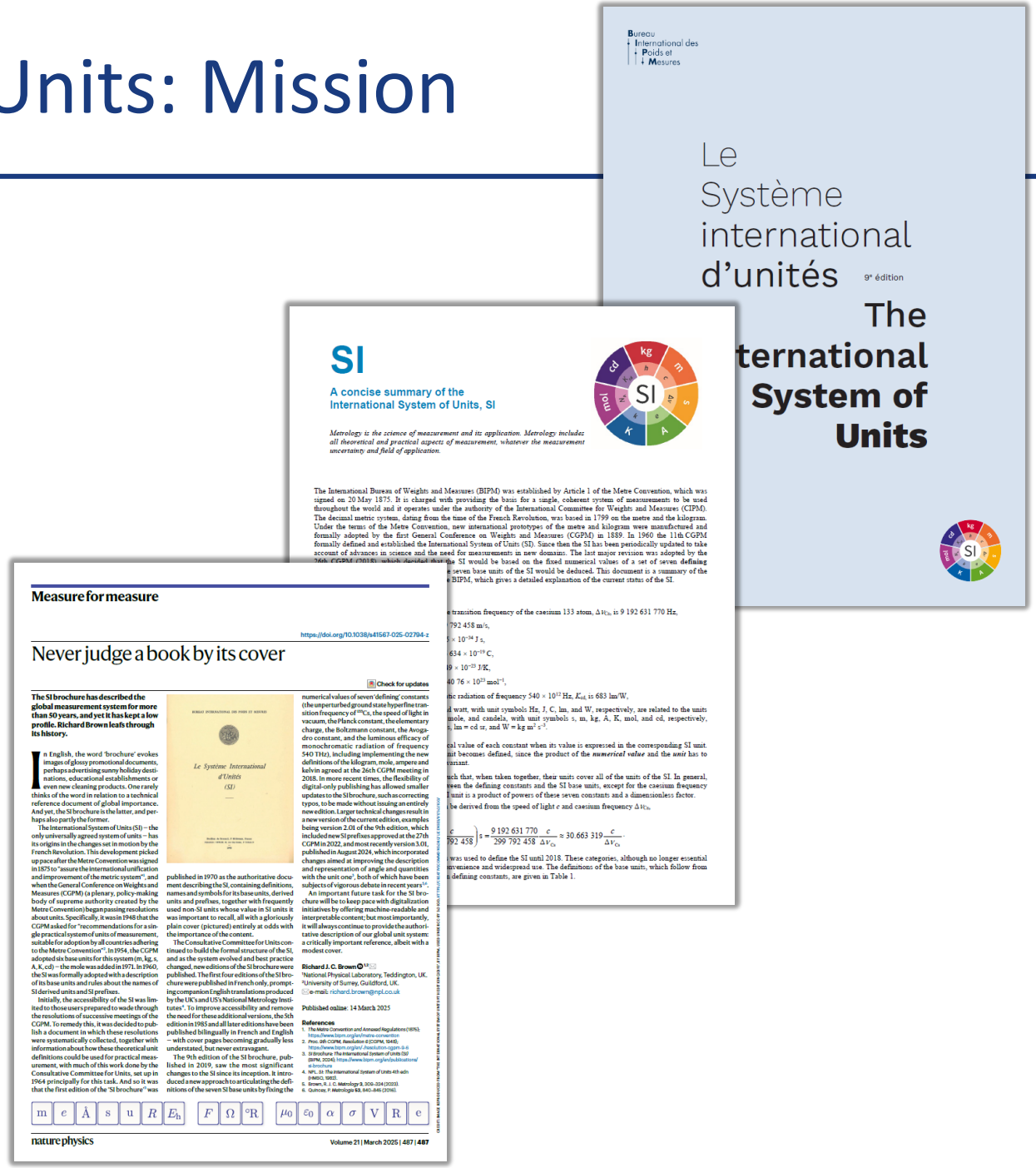
Prof. Richard J. C. Brown
CCU President

Dr Michael Stock
CCU Executive Secretary

CCU

Consultative Committee for Units: Mission

- Maintenance and development of the International System of Units (SI)
- Preparation of successive editions & versions of the SI brochure
- Advice to CIPM and stakeholders on units of measurement
- Preparation of documents to promote and explain the SI



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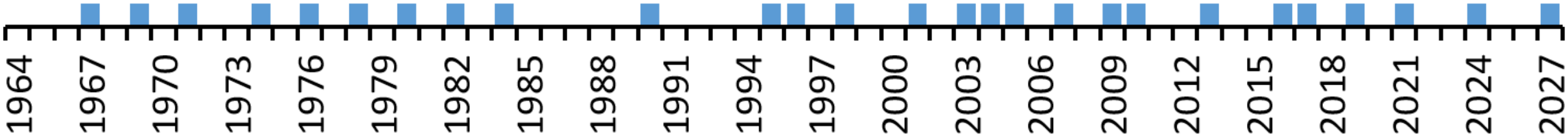
The Consultative Committee for Units – the first 60 years

- The CCU was established in 1964
- Replaced the “Commission for the System of Units”, set up by the CIPM in 1954
- The 1st meeting of the CCU was not until April 1967
- The 25th meeting of the CCU in 2021 was entirely online
- The 26th meeting of the CCU in 2024 was its first hybrid meeting
- The 27th meeting of the CCU is planned for 2027



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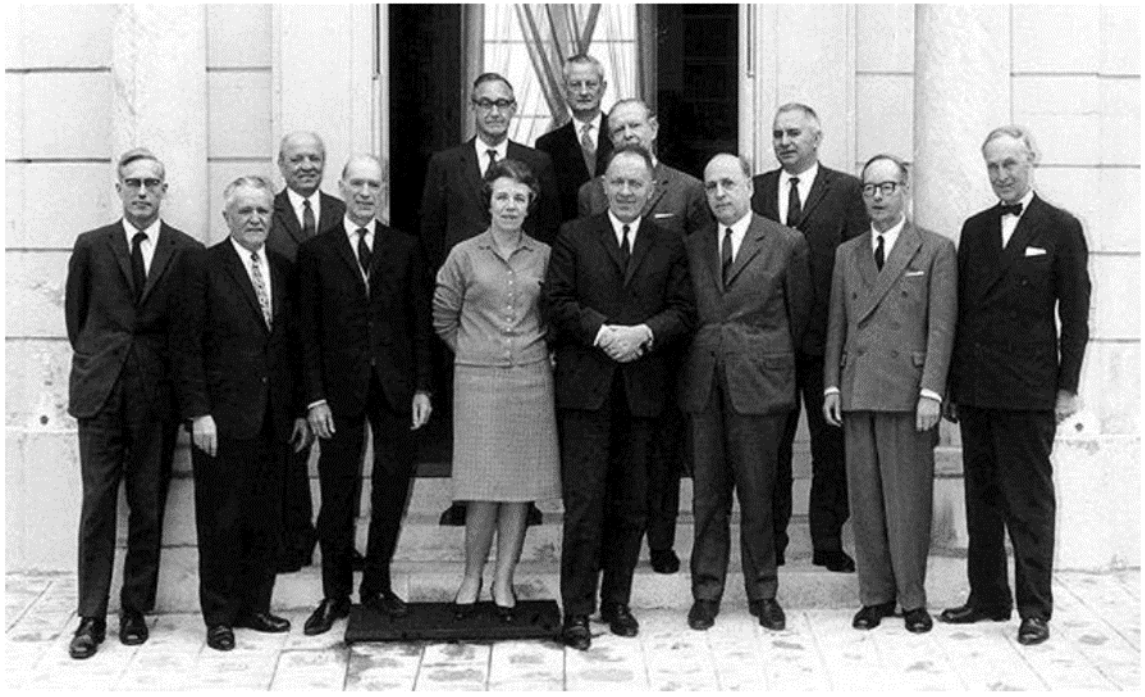
Photographs: 1967 → 2024



1st Meeting (0 online attendees!)

- 6 Members
- 5 Liaison organizations: CIE, ICRU, IEC, ISO, IUPAP

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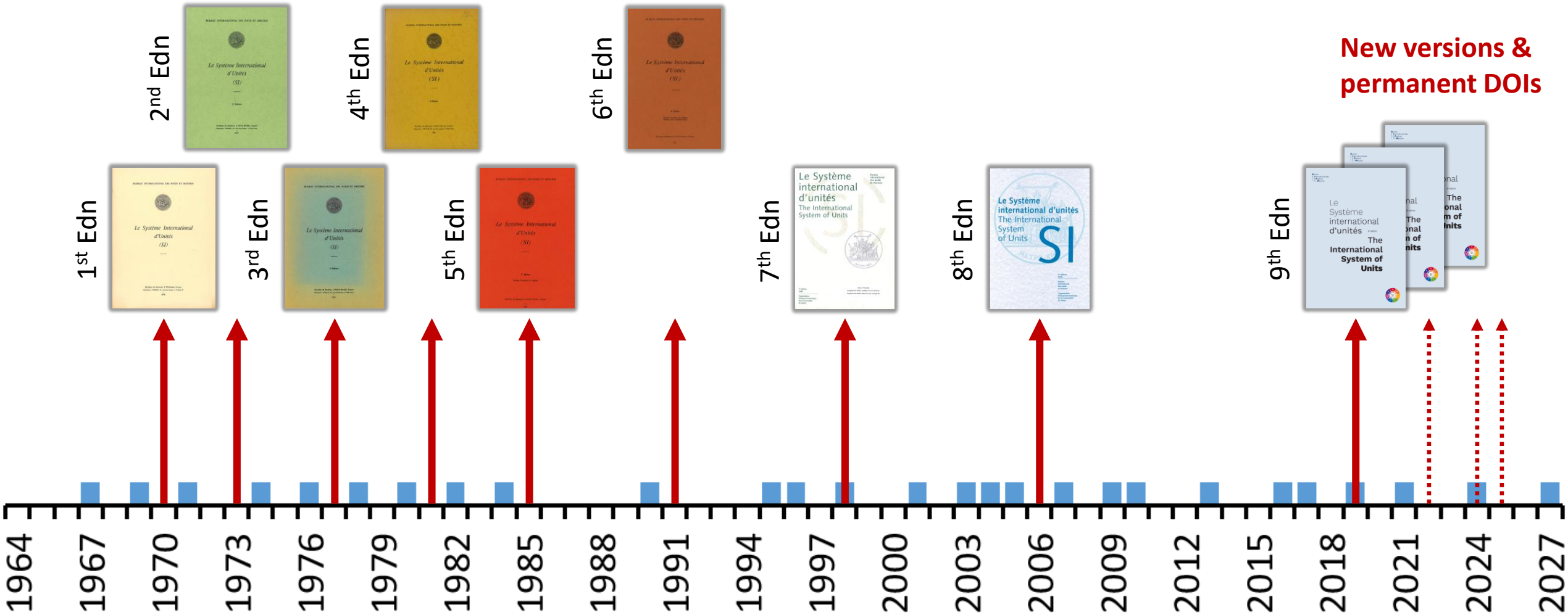
26th Meeting (23 online attendees)

- 13 Members
- 11 Liaison organizations: CIE, CODATA-TGFC, IAU, ICRU, IEC, IFCC, IMU, ISO, IUPAC, IUPAP, OIML

SI Brochures



New versions & permanent DOIs

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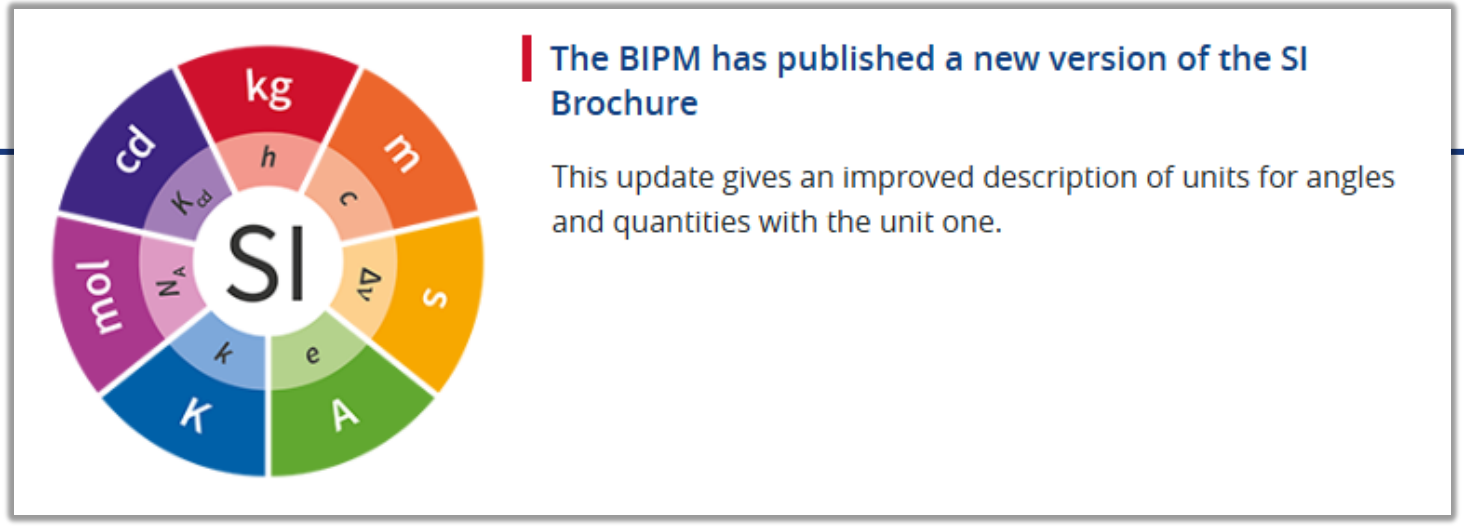
Digital publishing



- Digital publishing facilitates updates to the SI Brochure without issuing a new edition
- Larger changes result in the production of a new version of the current edition
- Since the 9th edition was first published in 2019, new versions have included:
  - v2.01 contained new SI prefixes approved by the 27th CGPM (2022)
  - v3.01 improved descriptions of angle and quantities with the unit one (2024)
    (Subsequently, v3.02 updated the value of the dalton & the binary prefixes, 2025)
- Future work will rethink how non-SI units are presented in the SI Brochure

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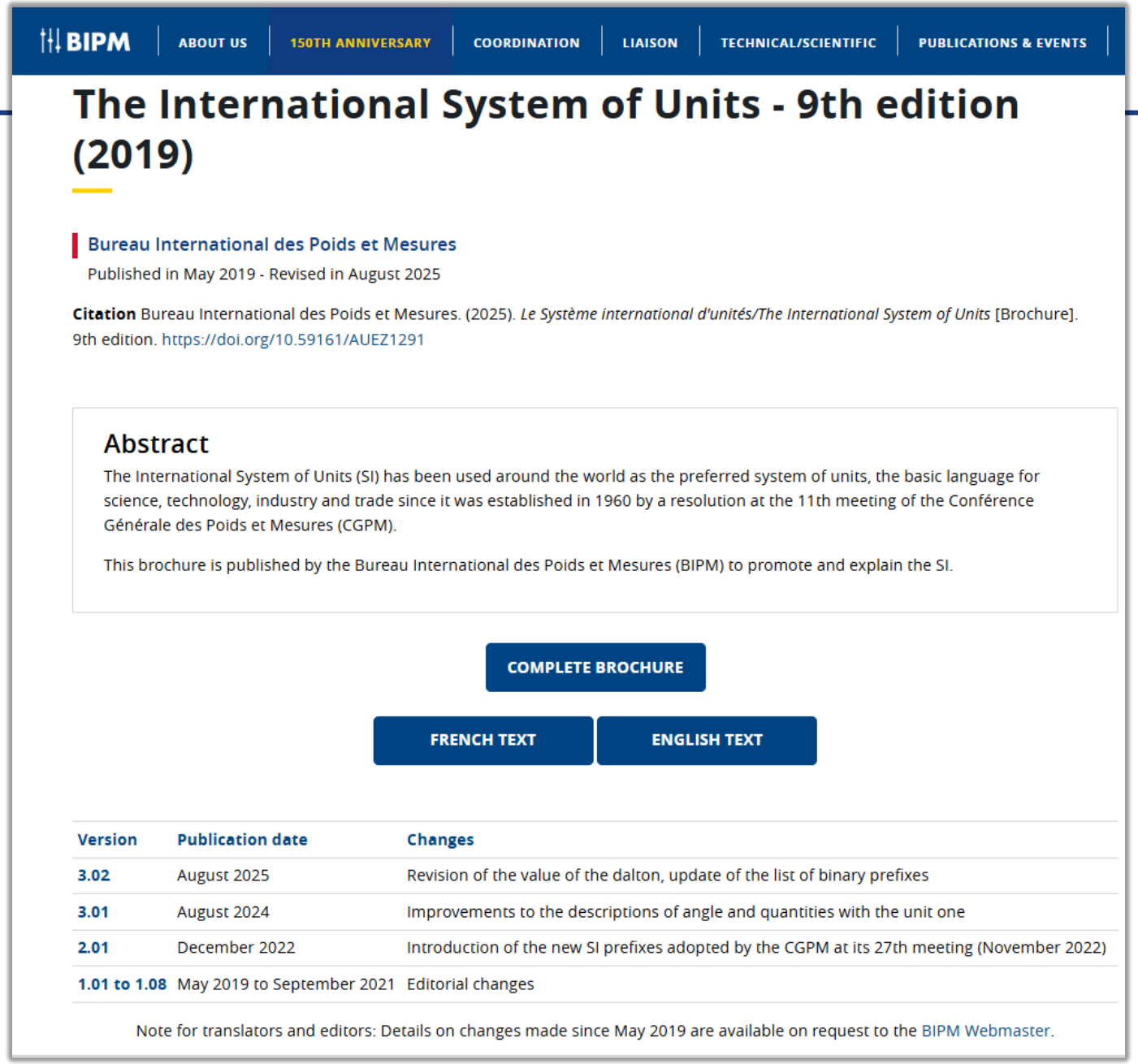
DOIs for the SI Brochure

- Each SI Brochure edition now has its own DOI and landing page
- Great improvement for referencing and citation
- For the 9th Edition the page also includes the version history
- Many thanks to Michael Stock and the BIPM Publications Team



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The International System of Units - 9th edition (2019)

Bureau International des Poids et Mesures

Published in May 2019 - Revised in August 2025

Citation Bureau International des Poids et Mesures. (2025). *Le Système international d'unités/The International System of Units* [Brochure]. 9th edition. https://doi.org/10.59161/AUEZ1291

Abstract

The International System of Units (SI) has been used around the world as the preferred system of units, the basic language for science, technology, industry and trade since it was established in 1960 by a resolution at the 11th meeting of the Conférence Générale des Poids et Mesures (CGPM).

This brochure is published by the Bureau International des Poids et Mesures (BIPM) to promote and explain the SI.

COMPLETE BROCHURE

FRENCH TEXT | ENGLISH TEXT

Version	Publication date	Changes
3.02	August 2025	Revision of the value of the dalton, update of the list of binary prefixes
3.01	August 2024	Improvements to the descriptions of angle and quantities with the unit one
2.01	December 2022	Introduction of the new SI prefixes adopted by the CGPM at its 27th meeting (November 2022)
1.01 to 1.08	May 2019 to September 2021	Editorial changes

Note for translators and editors: Details on changes made since May 2019 are available on request to the BIPM Webmaster.

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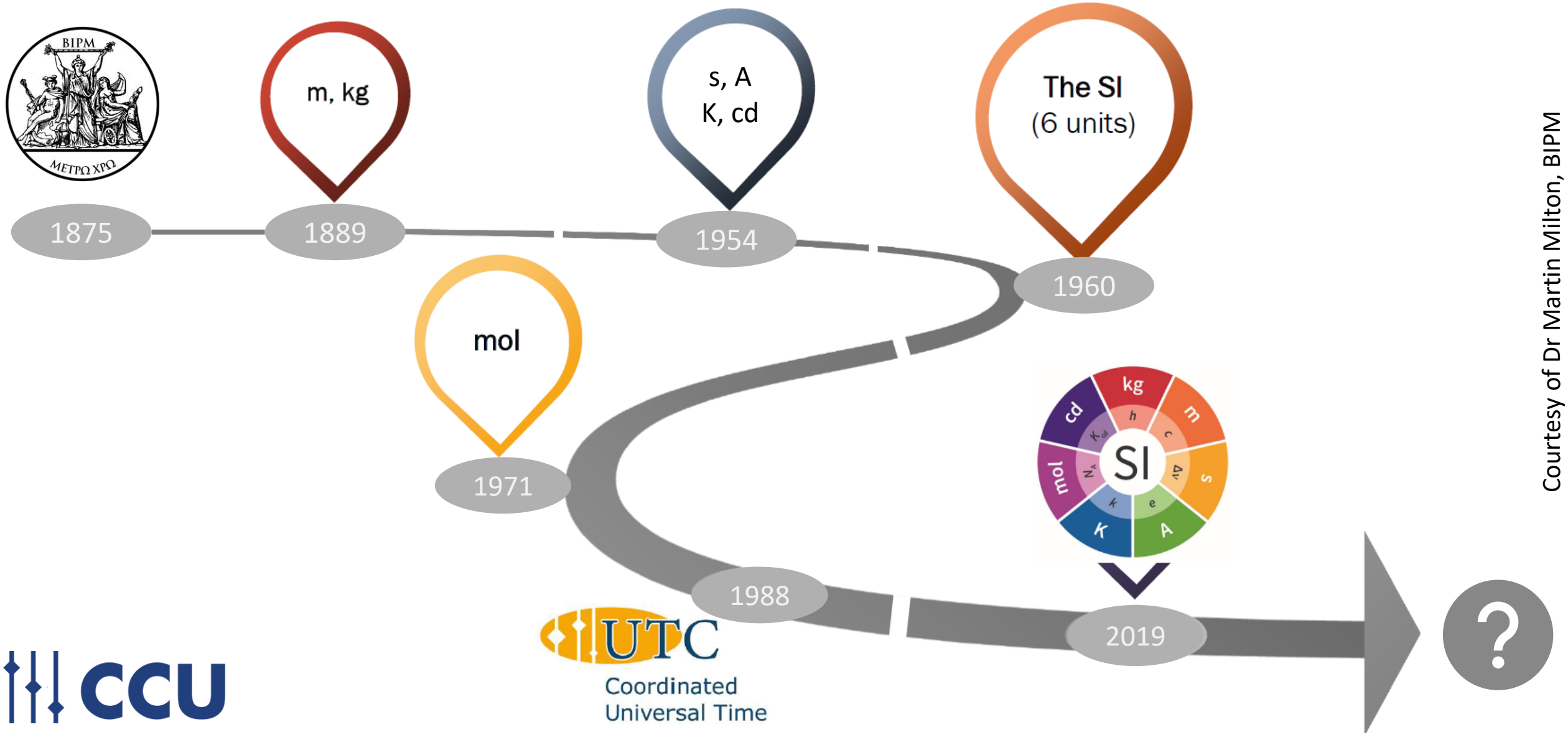
The development of the SI Base Units



Courtesy of Dr Martin Milton, BIPM

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The next ten years

"The SI has developed not only through technological advance but also as a result of cultural and political compromise. It must continue to evolve to meet stakeholder needs whilst recognizing that its most important qualities are stability and consistency."

Richard J. C. Brown, President's Report to 26th CCU, April 2024

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CCU Strategy

5. Future Scan (2023-2030)

The decision for the revision of the SI that took place in November 2018 and came into force in May 2019 has closed a very intense phase of activity over the last decade in which the CCU was mostly devoted to this revision. Therefore, in the years following the redefinition, the CCU was expected to reorient its scope and activities, within its terms of reference, to fulfil its mission of developing and improving the SI in all areas. In parallel, the CCU will naturally monitor the implementation of the revised SI.

Strategy for the Consultative Committee for Units, CCU, for the period up to 2030

1. General Information:

***Name*:**
Consultative Committee for Units (CCU)

***Working Groups*:**
Working Group on Strategy (CCU WG-S) and task groups when necessary, on a temporary basis, currently Task Group on Fundamental Concepts in Metrology (TG-FCM, formerly Task Group on Core Metrological Terms (TG-CMT)) and Task Group on Key Topics in the SI Brochure (TG-KTSIB)

***Date established*:**
1964, to replace the Commission for the System of Units, set up by the CIPM in 1954

***Number of Members*:**
13 Members, 11 Liaisons, 2 Personal Members

***Number of participants at last meeting*:**
58 (35 on site, 23 online)

***Periodicity of meetings*:**
2 to 3 years

***Date of last meeting*:**
9-10 April 2024, 26th meeting (hybrid meeting)

***President*:**
Prof. R.J.C. Brown (from June 2024)

2. Terms of Reference

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

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

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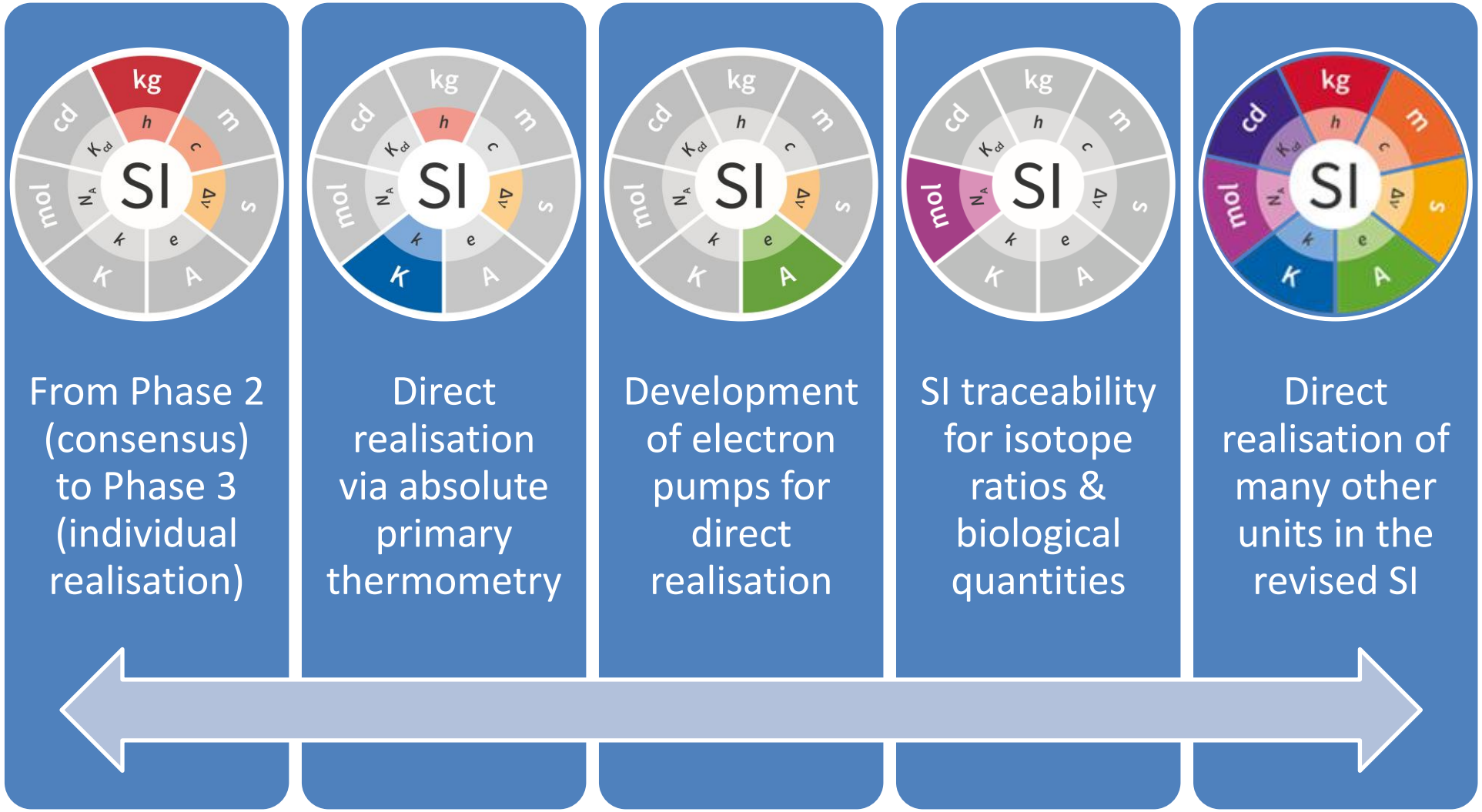
Monitoring implementation of the revised SI



The direct linking of SI units with defining constants

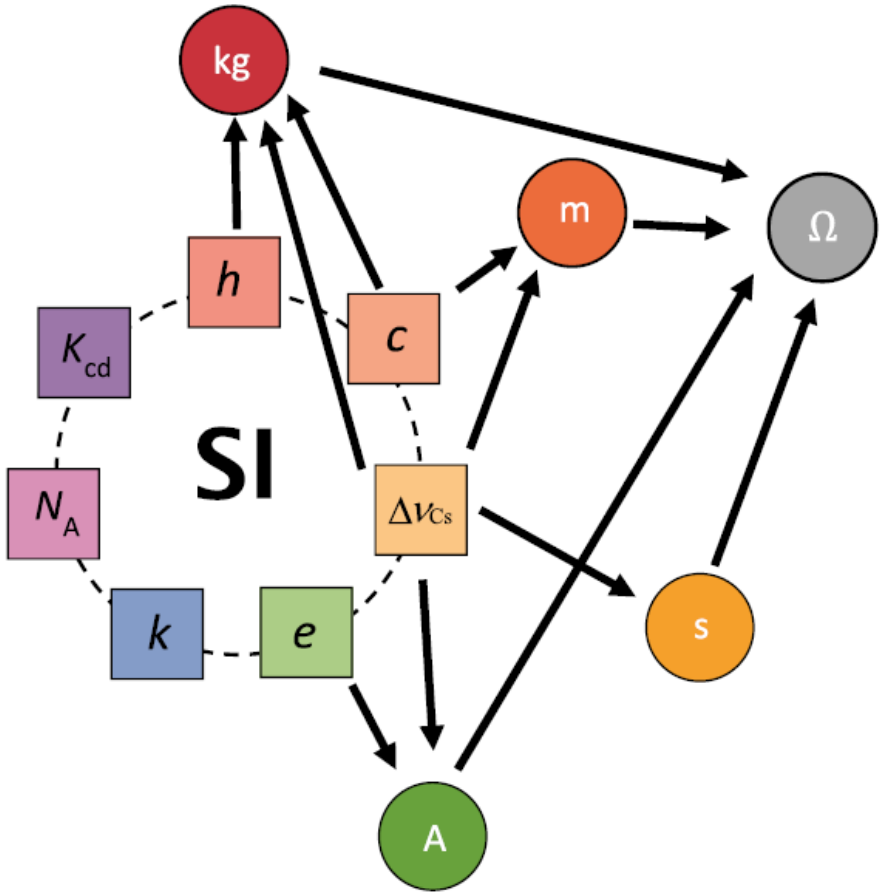


Figure 1. Schematic representation of the relationship between the ohm and the SI base units, $\Omega = \mathrm{kg\,m^2\,s^{-3}\,A^{-2}}$.

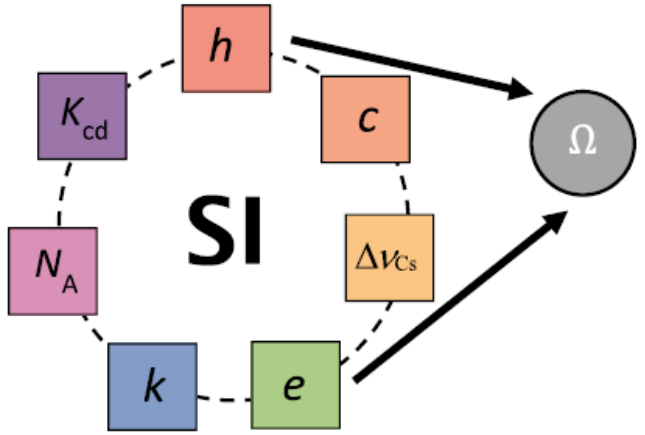
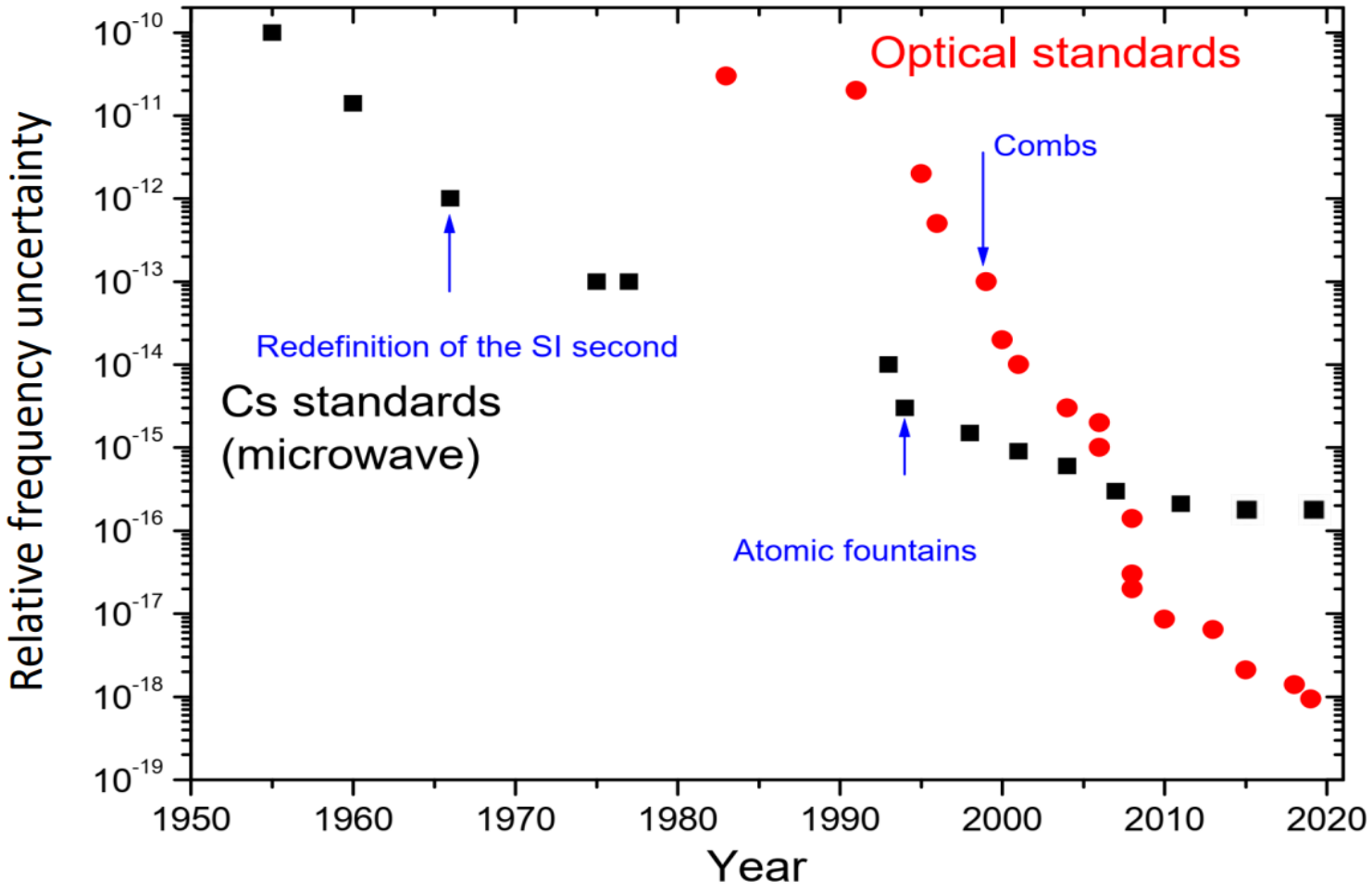


Figure 2. Schematic representation of the relationship between the ohm and the defining constants, $\Omega = [h]\,[e]^{-2}$.

P Blattner & R J C Brown 2024 Metrologia 61 043001

Re-definition of the second

- Discussions are ongoing within CCTF
- A re-definition of the second is expected on or after 2030
- CCU will provide input and review impact on other metrology areas
- It is likely that this will trigger the 10th Edition of the SI Brochure



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Discussions about the future of the candela

- A workshop in 2024 considered future scenarios for the candela

$V(\lambda)$ change

- No changes to the current definition of the candela
- Adopt Cone Fundamentals to the K_{cd} definition.

Unit size

- Adopt a set of K_{cd} values, each value corresponding to a given standardised Illumination/observer condition.

Unit system

- Go back to the definition using a source like a blackbody instead of the spectral responsivity of the human eye.
- Photon-based candela
- Removing the candela from the 7 base SI units

Increasingly strong drivers, problem statements & evidence bases required for making a change

- Research needed to understand the requirements, benefits and impact across application areas

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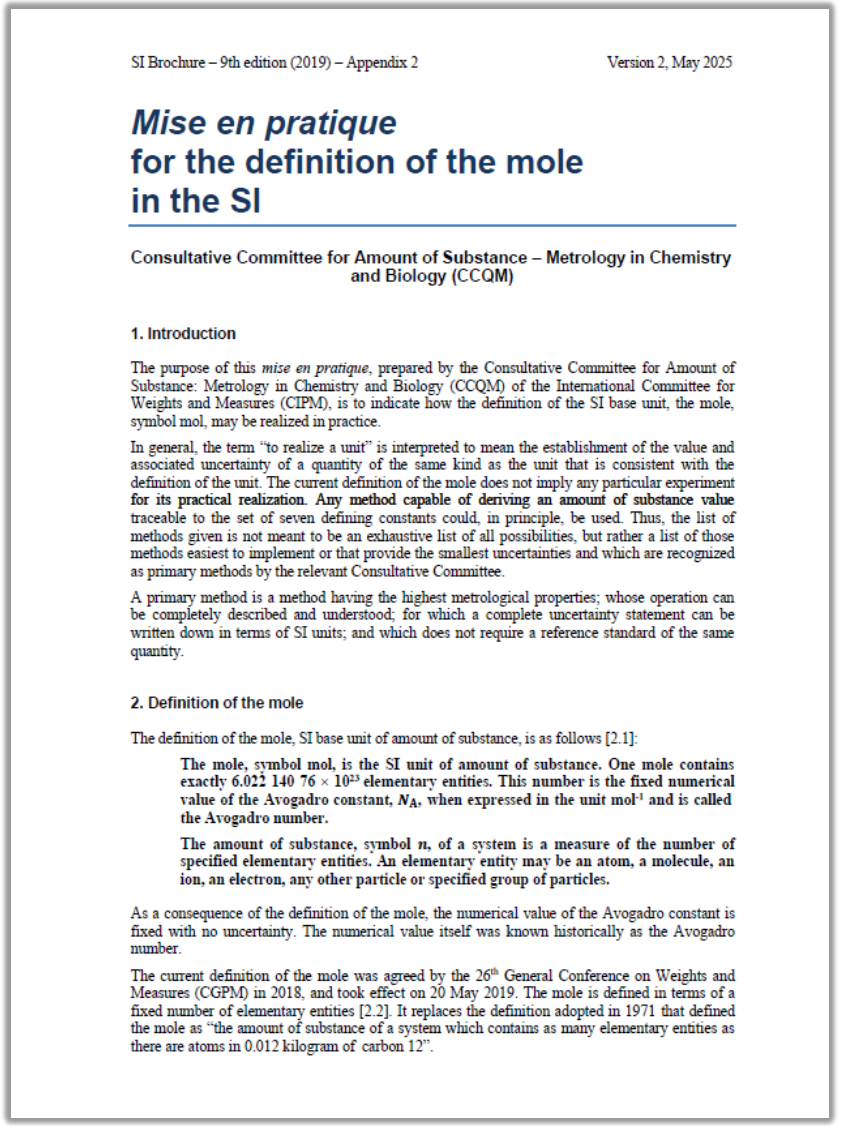
Mises-en-pratique (practical realisations)

- Appendix 2 of the SI Brochure contains the practical realization of the definition of important units
- New versions were produced for the 2019 revision of the SI
- Continually updated as technologies and methods of realisation develop
- Most recently, the MeP for the definition of the mole was updated in 2025
- Updates for all units expected over the next 10 years



SI Brochure – 9th edition (2019) – Appendix 2 Version 2, May 2025

Mise en pratique
for the definition of the mole in the SI

Consultative Committee for Amount of Substance – Metrology in Chemistry and Biology (CCQM)

1. Introduction

The purpose of this *mise en pratique*, prepared by the Consultative Committee for Amount of Substance: Metrology in Chemistry and Biology (CCQM) of the International Committee for Weights and Measures (CIPM), is to indicate how the definition of the SI base unit, the mole, symbol mol, may be realized in practice.

In general, the term "to realize a unit" is interpreted to mean the establishment of the value and associated uncertainty of a quantity of the same kind as the unit that is consistent with the definition of the unit. The current definition of the mole does not imply any particular experiment **for its practical realization. Any method capable of deriving an amount of substance value** traceable to the set of seven defining constants could, in principle, be used. Thus, the list of methods given is not meant to be an exhaustive list of all possibilities, but rather a list of those methods easiest to implement or that provide the smallest uncertainties and which are recognized as primary methods by the relevant Consultative Committee.

A primary method is a method having the highest metrological properties; whose operation can be completely described and understood; for which a complete uncertainty statement can be written down in terms of SI units; and which does not require a reference standard of the same quantity.

2. Definition of the mole

The definition of the mole, SI base unit of amount of substance, is as follows [2.1]:

> **The mole, symbol mol, is the SI unit of amount of substance. One mole contains exactly 6.022 140 76 × 10^{23} elementary entities. This number is the fixed numerical value of the Avogadro constant, N_A, when expressed in the unit mol^{-1} and is called the Avogadro number.**
>
> **The amount of substance, symbol *n*, of a system is a measure of the number of specified elementary entities. An elementary entity may be an atom, a molecule, an ion, an electron, any other particle or specified group of particles.**

As a consequence of the definition of the mole, the numerical value of the Avogadro constant is fixed with no uncertainty. The numerical value itself was known historically as the Avogadro number.

The current definition of the mole was agreed by the 26th General Conference on Weights and Measures (CGPM) in 2018, and took effect on 20 May 2019. The mole is defined in terms of a fixed number of elementary entities [2.2]. It replaces the definition adopted in 1971 that defined the mole as "the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon 12".

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Digitalisation

- The SI Reference Point & SI Digital Framework continue to develop
- Provides the authoritative digital reference for the SI and PIDs for the named SI units, SI prefixes, and defining constants
- Will affect how values of quantities are controlled, represented and communicated, for instance via DCCs

- Digital connectivity offers new ways to represent and process data
- Opportunities to embed the SI digital framework in other parts of the global QI via the ‘Joint Statement of Intent’ with partners
- It is important for the SI to ensure its own digital references are FAIR

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New developments in science and technology

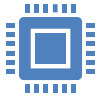
The CCU will continue to monitor new developments in science and technology that could challenge the orthodoxy surrounding measurement units and traceability


Local realisation of measurement units and shortening of traceability chains


Portable & ultra-stable standards replacing traditional calibration artefacts


Measurement units adapting to local environments (e.g. timing in space)


AI models used for predictive calibration and uncertainty estimation


Digital twins and modelling used to describe complex systems


Biometric and personalized ‘pseudo-units’ in healthcare and personal medicine


Real-time global comparison & synchronization of standards via cloud platforms

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Thank you

Prof. Richard J. C. Brown
CCU President
Chief Metrologist, National Physical Laboratory

t: 020 8943 6409
e: richard.brown@npl.co.uk
w: www.npl.co.uk/people/richard-brown

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