

**IUPAP report to the 24th meeting of the
Consultative Committee for Units (CCU)**
8-9 October 2019

The topic of units in the IUPAP is the domain of Commission C2, the IUPAP Commission on Symbols, Units, Nomenclature, Atomic Masses, and Fundamental Constants.

Membership of this commission is[†]

Chair: Peter Mohr, Vice-Chair: Marc Himbert;

Members: Xing Zhu, Kazuhiko Sugiyama, Michael Krystek, Alexander Potekhin, Antti Manninen, Anna (Ania) Kwiatkowski, Isabel Godinho, Kyong Hon Kim, Daniel Varela Magalhaes, Dinesh Kumar Aswal, Martin Milton (ex-officio);

Associate Members: Vanderlei Bagnato, William Phillips, John Rumble, Stephan Schlamminger, Eric Shirley, Carl Williams.

1. Recommendation to the BIPM.

On August 21, 2018, the International Committee on Weights and Measures (CIPM), through the Consultative Committee on Units (CCU), requested input from IUPAP concerning a possible change of wording in the new edition of the International System of Units (SI) Brochure. The question concerned a possible change in the definition of units. Members of Commission C2, which is relevant for questions regarding units, were asked for input, and the opinion of the majority of nine current members who voted was transmitted in reply to the request. Two former members of the commission also gave opinions consistent with the majority. The recommendation, not to change the definition for the new edition, transmitted to the BIPM before the end of August 2018, agreed with the conclusion of the overwhelming majority of National Metrology Institutes and other international organizations, e.g., IUPAC, who were also consulted.

2. Publicity for the new SI.

The International System of Units (SI) was redefined on 20 May 2019 based on fixed values of certain physical constants. Former Chair and Vice Chair Vanderlei Bagnato and William Phillips have been giving talks and have produced videos that explain the new SI for a general audience. William Phillips and Peter Mohr, together with a retired high-school physics teacher, have written a paper for *The Physics Teacher* [Phys. Teach. **55**, 16 (2017)] to help explain the new SI to high school students. Associate member Stephan Schlamminger has given many talks including demonstrations with a model Kibble balance made from Lego parts to help broaden understanding of the new definition of the kilogram in terms of the Planck constant.

[†] One member asked to be omitted from this list.

3. Revision the Red Book.

IUPAP has provided physicists with authoritative guidance on the use of symbols, units, and nomenclature, approved by successive IUPAP General Assemblies for over 70 years. The 1987 revision of the SUNAMCO “Red Book” has carried on this tradition for over 30 years. As such, it is cited as a reference by the IUPAC “Green Book” (*Quantities, Units and Symbols in Physical Chemistry*, 3rd edition, E. R. Cohen et al., RSC Publishing, Cambridge, 2007) and the SI Brochure (*The International System of Units (SI)*, 9th edition, BIPM, Sevres, 2019). The Red Book was reprinted on the web in 2010, accessible at:

<http://iupap.org/wp-content/uploads/2014/05/A4.pdf>

Commission C2 expects to update this publication, which is particularly timely in view of the recent redefinition of the SI. A subcommittee to work on the Red Book revision, consisting of Marc Himbert, Martin Milton, Peter Mohr, and William Phillips, has been formed.

4. Resumption of discussion of the SI, e.g., questions about how to treat the radian and other so-called dimensionless units.

The SI was originally recommended to be an international system of units by IUPAP in 1960, and Commission C2 has maintained a role in recommending further improvements, including IUPAP General Assembly (GA) resolutions supporting the choice of constants to define the new SI and supporting the decision to proceed with the redefinition in May 2019. Other issues for possible resolutions to be considered by the IUPAP GA include the role of angles in the SI, the nature of frequency units, the treatment of counting quantities, and the definition of units. These questions have been under discussion by the members of C2 and the discussions will continue in order to arrive at an agreeable resolution of the problems from a physics perspective. Recent opinions expressed within C2 favor the interpretation that angles have an independent dimension and that it would be preferable to express frequencies in unambiguous units such as Hz = cycles/second or radians/second, rather than simply as second⁻¹ that may introduce an ambiguous factor of 2π . The SI unit of frequency is rad/s since rad is the SI unit of angle. Also, it should be recognized that frequency for periodic phenomena is a general concept, not unlike energy, and that using different names to imply that there are different types of frequency each with its own unit should be discouraged as a poor practice. This is analogous to the fact that different forms of energy such as potential, kinetic, electromagnetic, etc. are all expressed in the same unit joule.