# Report on recent CCU activities

Estefanía de Mirandés
CCU executive secretary

**17th CCM Meeting, 16 May 2019**

Bureau International des Poids et Mesures


# Outline

- The CCU last met in October 2017
- Next CCU meeting scheduled for 8-9 October 2019
- 10 October 2019
  - *BIPM Workshop on Advanced Time and Frequency Transfer (ATFT): the ultimate frontier for remote comparison methods*
  - jointly organized between the CCTF-ATFT-WG and the CCU
- Main activities during this period:
  - Preparations for the General Conference
  - Edition and translation to French of the 9$^{th}$ edition of the SI Brochure
  - Development of the CCU strategy for 2019-2030 by the CCU-WG-Strategy
  - Publication in the open web of the most recent versions of the draft SI Brochure, draft Concise Summary, Draft Resolution 1, Draft Appendix 1 and Draft Appendix 3
- Task group for the Promotion of the SI

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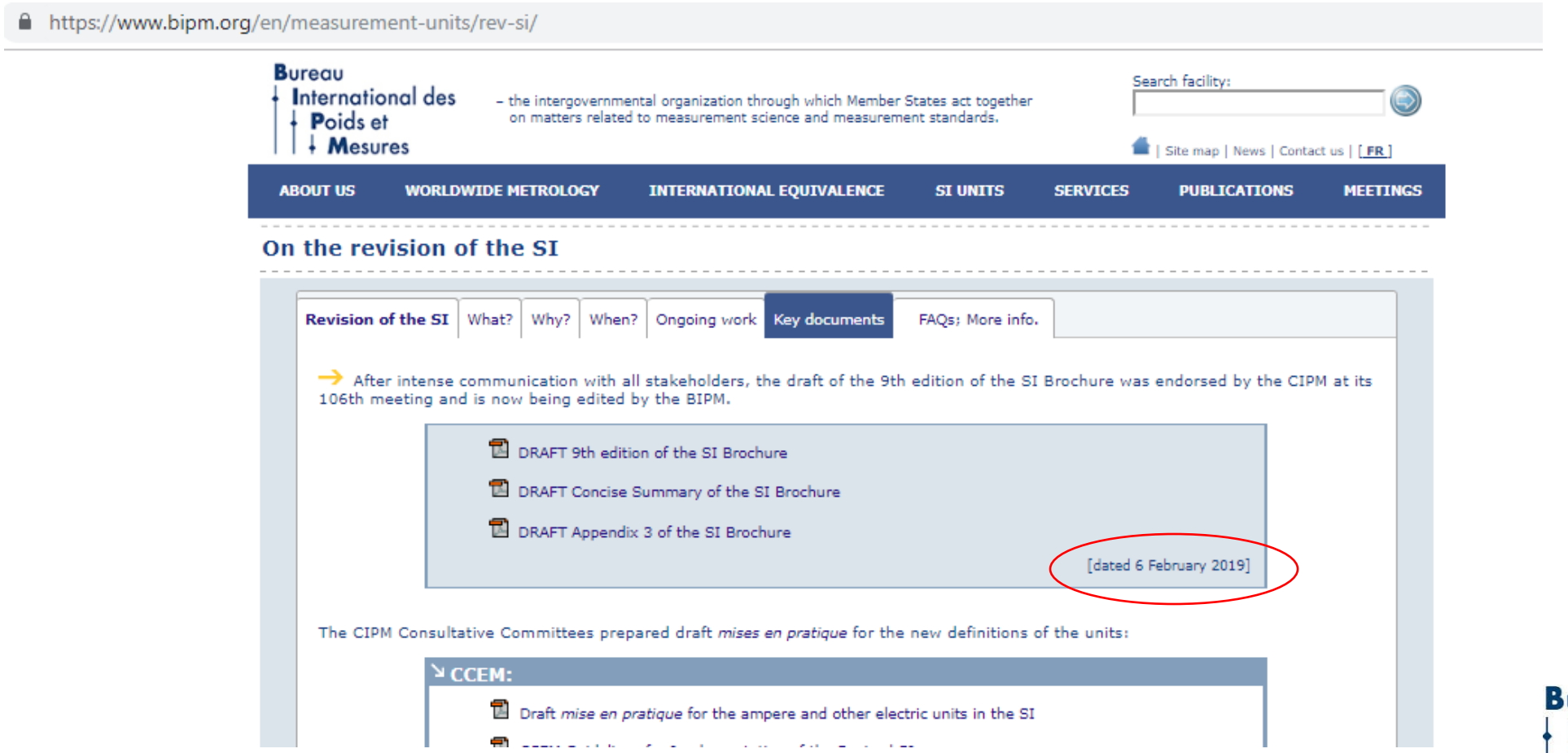
# Documents on the open web updated on the 6 February 2019

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# 9th Edition of the SI Brochure

- Final draft available on the BIPM open website (dated 6 February 2019). Includes
  - Preface (co-signed by the CIPM President, the CCU President and the BIPM Director) NEW
  - Appendix 1 UPDATED
  - Appendix 3 UPDATED
  - List of acronyms NEW
- French translation completed by the BIPM, now under external validation.

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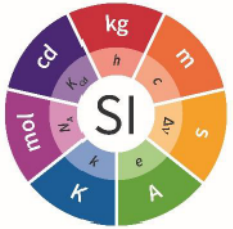
# Concise Summary

- Final editing completed
- Translation to French completed



**S I**
**Résumé de la Brochure**
**sur le Système international d'unités (SI)**

*La métrologie est la science de la mesure et son application. La métrologie embrasse tous les aspects théoriques et pratiques des mesures, indépendamment de leur incertitude ou de leur champ d'application.*




Le Bureau international des poids et mesures (BIPM) a été établi en vertu de l'article 1 de la Convention du Mètre, signée le 20 mai 1875 ; il est chargé d'établir les fondements d'un système de mesures unique et cohérent, pour le monde entier, et fonctionne sous l'autorité du Comité international des poids et mesures (CIPM). Le système métrique décimal, qui date de l'époque de la Révolution française, a été fondé en 1799 sur le mètre et le kilogramme. Selon les termes de la Convention du Mètre, de nouveaux prototypes internationaux du mètre et du kilogramme furent fabriqués et approuvés officiellement en 1889 par la Conférence générale des poids et mesures (CGPM) à sa première réunion. En 1960, la CGPM à sa 11e réunion a officiellement défini et établi le Système international d'unités (SI). Depuis, le SI a régulièrement été mis à jour afin de tenir compte des avancées de la science et des besoins en matière de mesure dans de nouveaux domaines. La dernière révision majeure du SI a été adoptée par la CGPM à sa 26e réunion (2018) : il a ainsi été décidé que le SI serait fondé sur les valeurs numériques fixées d'un ensemble de sept **constantes** à partir desquelles les définitions des sept unités de base du SI seraient déduites. Le présent document est un résumé de la **Brochure sur le SI**, la publication produite par le BIPM décrivant en détail l'actuel Système international d'unités.

Le SI est le système d'unités selon lequel :

- la fréquence de la transition hyperfine de l'état fondamental de l'atome de césium 133 non perturbé, $\Delta\nu_{Cs}$, est égale à 9 192 631 770 Hz,
- la vitesse de la lumière dans le vide, $c$, est égale à 299 792 458 m/s,
- la constante de Planck, $h$, est égale à $6{,}626\,070\,15 \times 10^{-34}$ J s,
- la charge élémentaire, $e$, est égale à $1{,}602\,176\,634 \times 10^{-19}$ C,
- la constante de Boltzmann, $k$, est égale à $1{,}380\,649 \times 10^{-23}$ J/K,
- la constante d'Avogadro, $N_A$, est égale à $6{,}022\,140\,76 \times 10^{23}$ mol$^{-1}$,
- l'efficacité lumineuse d'un rayonnement monochromatique de fréquence $540 \times 10^{12}$ Hz, $K_{cd}$, est égale à 683 lm/W,

où les unités hertz, joule, coulomb, lumen et watt, qui ont respectivement pour symbole Hz, J, C, lm et W, sont reliées aux unités seconde, mètre, kilogramme, ampère, kelvin, mole et candela, qui ont respectivement pour symbole s, m, kg, A, K, mol et cd, selon les relations Hz = s$^{-1}$, J = kg m$^2$ s$^{-2}$, C = A s, lm = cd m$^2$ m$^{-2}$ = cd sr, et W = kg m$^2$ s$^{-3}$.



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# Appendix 1 of the SI Brochure:

## “Decisions of the CGPM and the CIPM”

- Has been updated to incorporate
  - recent CIPM recommendations and decisions
  - Recent CGPM decisions including those taken in November 2018
  - References to CIPM “procès verbaux” and Metrologia publications
  - Side notes on abrogations of previous definitions
- Translation to French completed

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# Final draft Appendix 3 agreed with the CCPR and published in the BIPM open webpages

- Translation to French completed, in collaboration with the CCPR



## Appendix 3. Units for photochemical and photobiological quantities.

Optical radiation is able to cause chemical changes in certain living or non-living materials: this property is called actinism, and radiation capable of causing such changes is referred to as actinic radiation. Actinic radiation has the fundamental characteristic that, at the molecular level, one photon interacts with one molecule to alter or break the molecule into new molecular species. In addition, optical radiation at infrared wavelengths is able to cause thermal damage to living or non-living materials at high exposure levels, although in this case the interaction is not at the single photon level. These interactions between incident optical radiation and the material being irradiated can be described by defining specific photochemical or photobiological quantities in terms of the result of optical radiation on the material in question and the associated chemical or biological receptors.

In the field of metrology, the only photobiological quantity which has been formally defined for measurement in the SI relates to the interaction of light with the human eye in vision. An SI base unit, the candela, has been defined for this important photobiological quantity. Several other photometric quantities with units derived from the candela have also been defined (such as the lumen and the lux, see Table 3 in section 2.2.3.

Marginal note: The definition of photometric quantities and units can be found in the *ILV: International Lighting Vocabulary*, CIE publication S 017/E:2011 or in the *International Electrotechnical Vocabulary*, IEC publication 60050 (IEV), chapter 845: Lighting. The practical realization of these definitions can be found in the *mise-en-pratique* for the candela, and further details of the basic conventions and how to apply these definitions can be found in the BIPM monographie/CIE 18.2-1983 *Photometry – The CIE system of physical photometry*.

### 1 Action spectrum

Optical radiation can be characterized by its spectral distribution. The mechanisms by which optical radiation is absorbed by chemical or biological systems are usually very complicated, and are always wavelength (or frequency) dependent. For metrological purposes, however, the complexities of the absorption mechanisms can be ignored and the effect is characterized simply by an action spectrum linking the photochemical or the photobiological response to the incident radiation. This action spectrum (or weighting function) describes the relative effectiveness of monochromatic optical radiation at wavelength $\lambda$ to elicit a given response. It is given in relative values, normalized to one at the wavelength at which the efficacy is a maximum. Action spectra are defined and recommended by international scientific or standardizing organizations, particularly the International Commission on Illumination (CIE). The weighting function may be combined with an efficacy constant relating the absolute photochemical or photobiological response to the units of optical radiation; in photometry this is the spectral luminous efficacy, expressed in lm $W^{-1}$.



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26e CGPM
Versailles
13-16 novembre 2018

# Draft Resolution 1 unanimously adopted by the CGPM on November 2018


## 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 atom $\Delta\nu_{Cs}$ 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 $540 \times 10^{12}$ Hz, $K_{cd}$, is 683 lm/W,

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# FAQs in the open web updated

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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> You are here: measurement units > future revision of the SI > FAQs

## FAQs: Frequently Asked Questions about the Revised SI

Frequently Asked Questions | Future revision of the SI

**Frequently asked questions about the proposed Revised SI**

(Updated February 2018)

**Q1:** Are the seven base quantities and base units in the current SI going to change in the Revised SI?

No, the seven base quantities and base units will remain unchanged.

**Q2:** Are the 22 coherent derived units with special names and symbols going to change?

**Q3:** Are the names and symbols of the multiple and sub-multiple prefixes (kilo for $10^3$, milli for $10^{-3}$, etc.) going to change in the Revised SI?

**Q4:** Will the magnitudes of any of the units change in the Revised SI?

**Q5:** In that case what is going to change?

**Q6:** So what is the point of changing to new definitions?

**Q7:** What about the definitions of the second, s, metre, m, and candela, cd?

**Q8:** How can you fix the value of a fundamental constant like *h* to define the kilogram, and *e* to define the ampere, and so on? How do you know what value to fix them to? What if it emerges that you have chosen the wrong value?

**Q9:** OK, you actually only fix the *numerical value* of the constant expressed in *its unit*. For the kilogram, for example, you choose to fix the numerical value {*h*} of the Planck constant expressed in its unit [*h*] = kg $m^2$ $s^{-1}$. But the question remains: suppose a new experiment shortly after you change the definition suggests that you chose a wrong numerical value for {*h*}, what then?

**Q10:** Each of the fundamental constants used to define a unit has an uncertainty; its value is not known exactly. But it is proposed to fix its numerical value exactly. How can you do that? What has happened to the uncertainty?

**Q11:** The unit of the Planck constant is equal to the unit of action, J s = kg $m^2$ $s^{-1}$. How does fixing the numerical value of the Planck constant define the kilogram?

**Q12:** Are not the proposed definitions of the base units in the Revised SI circular definitions, and therefore unsatisfactory?

**Q13:** In the Revised SI the reference constant for the kilogram is the Planck constant *h*, with unit J s = kg $m^2$ $s^{-1}$. It would be much easier to comprehend if the reference constant had the unit of mass, the kg. Then we could say: "The kilogram is the mass of *<something>*", such as perhaps the mass of a specified number of carbon or silicon atoms. Would that not be a better definition?

**Summary**

- FAQs: Frequently Asked Questions about the Revised SI
- What is a *mise en pratique*?
- The "explicit-constant" formulation
- What is the BIPM contributing?
- Discussions on the revised SI in the Consultative Committees

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# CCU new strategy

- The CCU-WG-S has already developed a first draft of the CCU strategy for the years 2019-2030. The final draft will be submitted to the CCU in 2019 for approval.
- The CCU-WG-S has produced an update of the CCU ToR, to be also validated by the CCU in 2019

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# CCTF-CCU Workshop (I)
## 10th October 2019

**BIPM Workshop on Advanced Time and Frequency Transfer (ATFT): the ultimate frontier for remote comparison methods**

| ↘ 10 October 2019 | at the BIPM |
|---|---|
| **Chair:** | |
| Davide Calonico | CCTF-WGATFT Chair |
| **Vice-Chairs:** | |
| Joachim Ullrich | CCU President |
| Luc Érard | CCTF President |
| **Organizing committee:** | |
| Gianna Panfilo | CCTF-WGATFT Secretary |
| Patrizia Tavella | CCTF Executive Secretary |
| Estefanía de Mirandés | CCU Executive Secretary |
| **Agenda** (Soon available) | |

See: https://www.bipm.org/en/conference-centre/bipm-workshops/advanced-time/

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# CCTF-CCU Workshop (II)

**Objective of the workshop:**

The Consultative Committee for Time and Frequency Working Group on Coordination of the Development of Advanced Time and Frequency Transfer Techniques (CCTF-WGATFT), in cooperation with the Consultative Committee for Units (CCU), is organizing a workshop with the aim of bringing together different communities to explore the limits of time and frequency transfer in view of a possible redefinition of the second.

Time and frequency transfer methods are key matters within the time and frequency community. The main goal of the workshop is to explore technical advancements in time and frequency transfer as well as related fields outside of this domain.

Time and frequency transfer is widely used in many scientific fields, such as astronomy, telecommunications, space applications, and geodesy, with different levels of relationships with the time and frequency community. The need for high-performing techniques in the time and frequency domain encourages the exploration of these different fields of application to bring together experiences and knowledge.

The first part of the workshop will be dedicated to invited talks and the second part will be followed by a panel discussion on the ultimate frontier for remote comparison methods.

Proposed discussion topics:

1. Introduction of CCTF-WGATFT activities
2. Optical two-way time and frequency transfer over free space
3. Radio astronomy techniques
4. Synchronization of telecommunication networks
5. Coherent frequency transfer using optical fibres

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# CIPM Task Group for the promotion of the SI

- Last meeting: January 2018
- Wide list of participants, including for the first time guest representatives from RMOs

**Task Group for the Promotion of the SI**

**Meeting of 18 January 2018, BIPM (Sèvres)**

## Participants list

Chair

Prof. Joachim Ullrich, CIPM Vice-President and CCU President

Director of the BIPM

Dr Martin J.T. Milton, BIPM

Executive Secretary

Dr Estefanía de Mirandés, CCU Executive Secretary

Participants

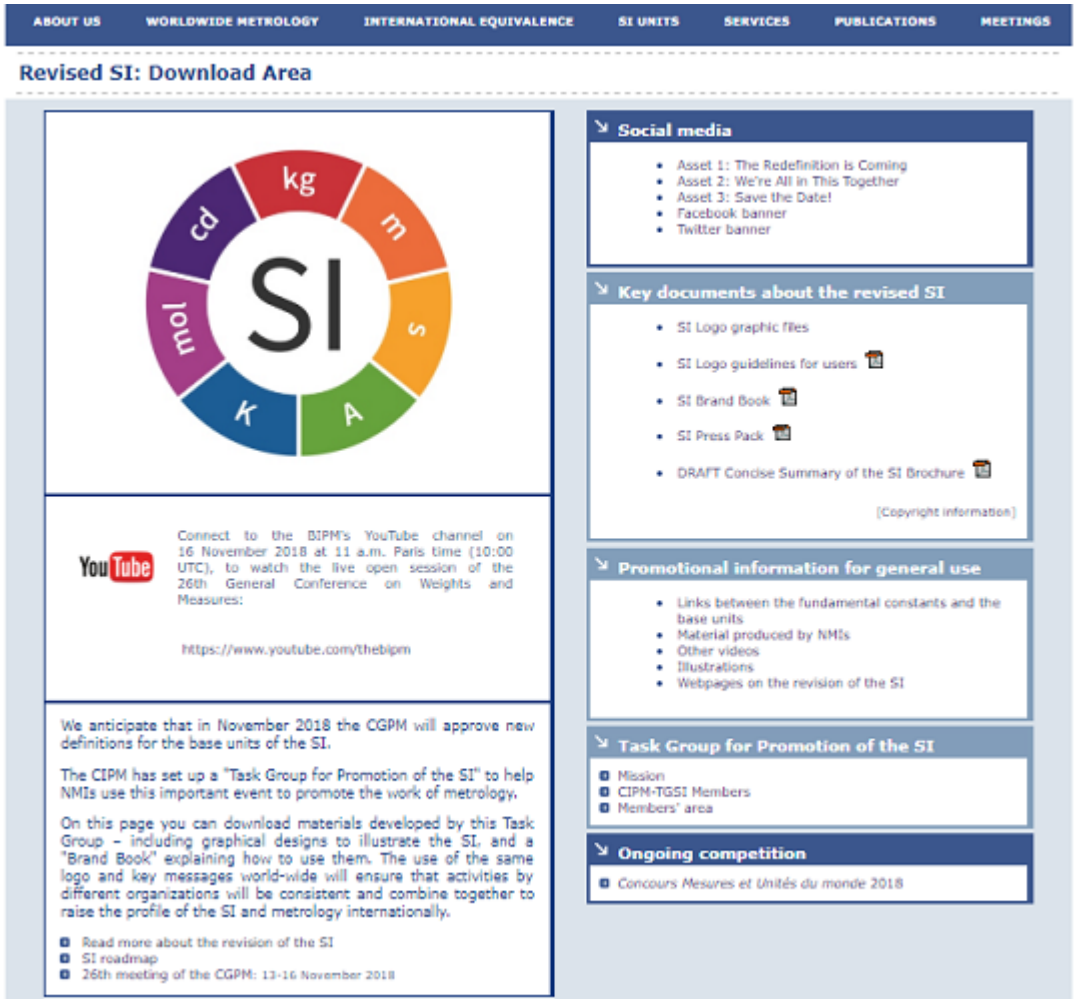
Mrs Fiona Auty, NPL
Dr Christof Gaiser, CCT
Ms Wei Gao, NIM and APMP
Dr Bernd Güttler, CCQM
Ms Amina Hassan Zainal Albastaki, GULFMET
Mr Kevin Kimball, NIST
Dr Michael Krystek, ISO
Dr Ho Seong Lee, KRISS
Dr Georgette Macdonald, SIM
Ms Xolelwa Mfengu, NMISA
Dr Valérie Morazzani, LNE
Ms Zakithi Msimang, NMISA and AFRIMETS
Mr Jon Murthy, ILAC
Mrs Gail Porter, NIST
Dr Philippe Richard, CIPM member and CCM President
Dr Gerrit Rietveld, CIPM member and CCEM President
Dr Jens Simon, PTB
Dr Eun-Jung Sung, KRISS
Dr Naoyuki Taketoshi, NMIJ/AIST
Dr Leonid Vitushkin, VNIIM
Dr Barry Wood, CCEM
Dr Xuelin Xu, NIM

Webex

Dr Peter Blattner, CIE
Dr Ismael Castelazo, CIPM member and CENAM
Ms Anne Trumpfheller, EURAMET e.V.

# BIPM public webpage containing all the promotional material developed by the Task Group

https://www.bipm.org/en/si-download-area/



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**Revised SI: Download Area**

Connect to the BIPM's YouTube channel on 16 November 2018 at 11 a.m. Paris time (10:00 UTC), to watch the live open session of the 26th General Conference on Weights and Measures:

https://www.youtube.com/thebipm

We anticipate that in November 2018 the CGPM will approve new definitions for the base units of the SI.

The CIPM has set up a "Task Group for Promotion of the SI" to help NMIs use this important event to promote the work of metrology.

On this page you can download materials developed by this Task Group – including graphical designs to illustrate the SI, and a "Brand Book" explaining how to use them. The use of the same logo and key messages world-wide will ensure that activities by different organizations will be consistent and combine together to raise the profile of the SI and metrology internationally.

- Read more about the revision of the SI
- SI roadmap
- 26th meeting of the CGPM: 13-16 November 2018

**Social media**

- Asset 1: The Redefinition is Coming
- Asset 2: We're All in This Together
- Asset 3: Save the Date!
- Facebook banner
- Twitter banner

**Key documents about the revised SI**

- SI Logo graphic files
- SI Logo guidelines for users
- SI Brand Book
- SI Press Pack
- DRAFT Concise Summary of the SI Brochure

(Copyright information)

**Promotional information for general use**

- Links between the fundamental constants and the base units
- Material produced by NMIs
- Other videos
- Illustrations
- Webpages on the revision of the SI

**Task Group for Promotion of the SI**

- Mission
- CIPM-TGSI Members
- Members' area

**Ongoing competition**

- *Concours Mesures et Unités du monde 2018*

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# Brand Book updated in April 2018 and sent to NMIs

https://www.bipm.org/utils/common/pdf/SI-Brand-Book.pdf

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**Future Revision of the SI**

## Brand Book V2

**April 2018**

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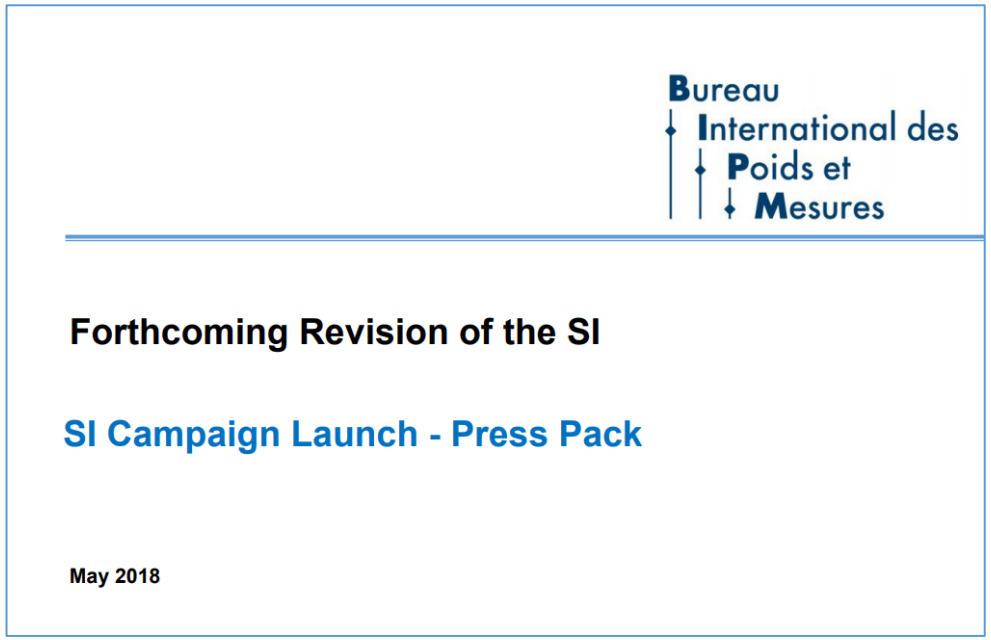
# Press pack updated in May 2018 and sent to NMIs for the launching of the campaign

https://www.bipm.org/utils/common/pdf/SI-Press-Pack.pdf



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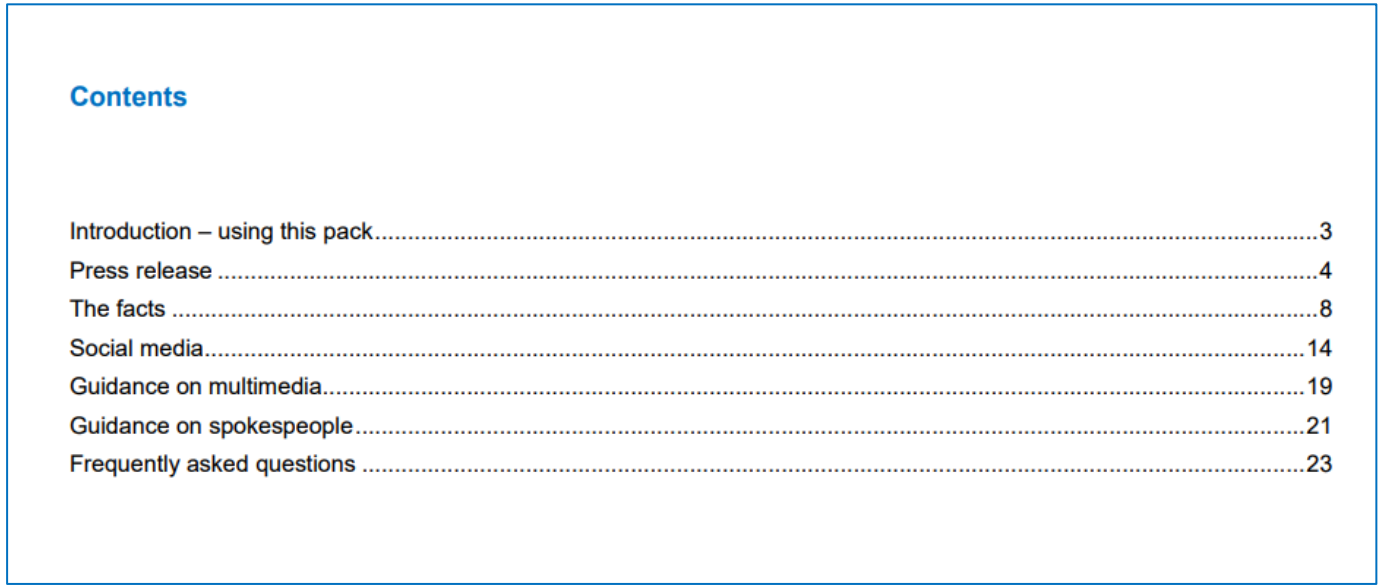
**Forthcoming Revision of the SI**

**SI Campaign Launch - Press Pack**

**May 2018**



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# Speaking Notes and Key Messages produced by the Task Group

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**Task Group for the Promotion of the SI**

**Speaking notes**

**The SI is a worldwide endeavour and approach**

The SI is the universal language of measurement.

The proposed changes to the SI will be the result of worldwide agreement at the General Conference on Weights and Measures (CGPM) in 2018. Metrology is a field where the states and economies of the world work together.

**Speaking notes:**

**What is the SI?**

The International System of Units (SI) is the modern form of the metric system, and forms the basis of the agreement for the system of measurement which is used throughout the world. It is presented as seven coherent system of units – the kilogram, the metre, the second, the ampere, the kelvin, the mole and the candela. These units underpin many other measurements.

How we realise these units is either through a physical artefact (the Kilogram) or a scientific experiment. The SI has been periodically updated to take account of advances in science and the need for measurements in new domains. This proposed revision will decide that the SI would be based on the fixed numerical values of a set of seven defining constants from which the definitions of the seven base units of the SI would be deduced.

*Illustration: The SI units are the foundations of measurement throughout the world. As with a house, if the foundations are unreliable the structure will fail. If the foundations of measurement are not properly established all the other things that rely upon them will adversely impacted. As measurement is all pervasive across science, technology and our everyday life, these foundations are fundamental and give you confidence to build upon them.*

*Illustration: We completely depend on the reliability of the weights displayed on food in shops – we don't take our own scales to check if they're honest. These weights are regulated, but ultimately they are trustworthy because of the underpinning foundation of the SI unit of mass.*

Questions adressed:

- What is the SI?
- Who is involved in agreeing the SI?
- What is wrong with the old system?
- What are the aims of the redefinition of the SI?
- What will future-proofing enable?
- What is the impact of the changes

Each question is fully answered and a key message per question is provided

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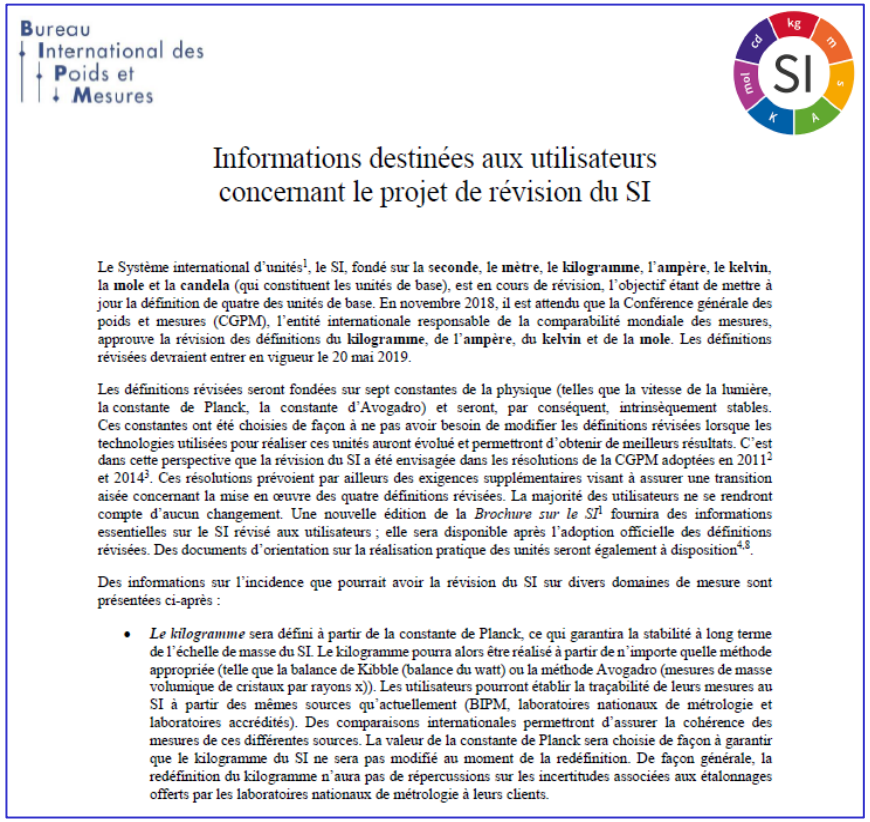
# *Joint CC statement* now translated to French, Spanish and German

## and widely distributed within the NMIs



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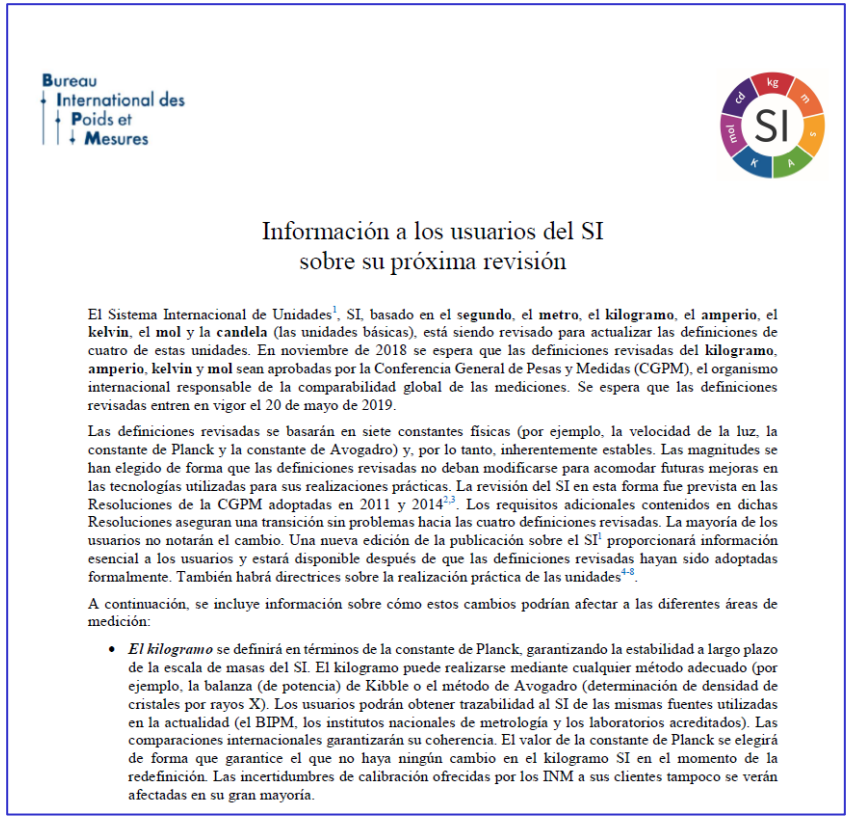
### Informations destinées aux utilisateurs concernant le projet de révision du SI

Le Système international d'unités[1], le SI, fondé sur la **seconde**, le **mètre**, le **kilogramme**, l'**ampère**, le **kelvin**, la **mole** et la **candela** (qui constituent les unités de base), est en cours de révision, l'objectif étant de mettre à jour la définition de quatre des unités de base. En novembre 2018, il est attendu que la Conférence générale des poids et mesures (CGPM), l'entité internationale responsable de la comparabilité mondiale des mesures, approuve la révision des définitions du **kilogramme**, de l'**ampère**, du **kelvin** et de la **mole**. Les définitions révisées devraient entrer en vigueur le 20 mai 2019.

Les définitions révisées seront fondées sur sept constantes de la physique (telles que la vitesse de la lumière, la constante de Planck, la constante d'Avogadro) et seront, par conséquent, intrinsèquement stables. Ces constantes ont été choisies de façon à ne pas avoir besoin de modifier les définitions révisées lorsque les technologies utilisées pour réaliser ces unités auront évolué et permettront d'obtenir de meilleurs résultats. C'est dans cette perspective que la révision du SI a été envisagée dans les résolutions de la CGPM adoptées en 2011[2] et 2014[3]. Ces résolutions prévoient par ailleurs des exigences supplémentaires visant à assurer une transition aisée concernant la mise en œuvre des quatre définitions révisées. La majorité des utilisateurs ne se rendront compte d'aucun changement. Une nouvelle édition de la *Brochure sur le SI*[1] fournira des informations essentielles sur le SI révisé aux utilisateurs ; elle sera disponible après l'adoption officielle des définitions révisées. Des documents d'orientation sur la réalisation pratique des unités seront également à disposition[4-8].

Des informations sur l'incidence que pourrait avoir la révision du SI sur divers domaines de mesure sont présentées ci-après :

- *Le kilogramme* sera défini à partir de la constante de Planck, ce qui garantira la stabilité à long terme de l'échelle de masse du SI. Le kilogramme pourra alors être réalisé à partir de n'importe quelle méthode appropriée (telle que la balance de Kibble (balance du watt) ou la méthode Avogadro (mesures de masse volumique de cristaux par rayons x)). Les utilisateurs pourront établir la traçabilité de leurs mesures au SI à partir des mêmes sources qu'actuellement (BIPM, laboratoires nationaux de métrologie et laboratoires accrédités). Des comparaisons internationales permettront d'assurer la cohérence des mesures de ces différentes sources. La valeur de la constante de Planck sera choisie de façon à garantir que le kilogramme du SI ne sera pas modifié au moment de la redéfinition. De façon générale, la redéfinition du kilogramme n'aura pas de répercussions sur les incertitudes associées aux étalonnages offerts par les laboratoires nationaux de métrologie à leurs clients.



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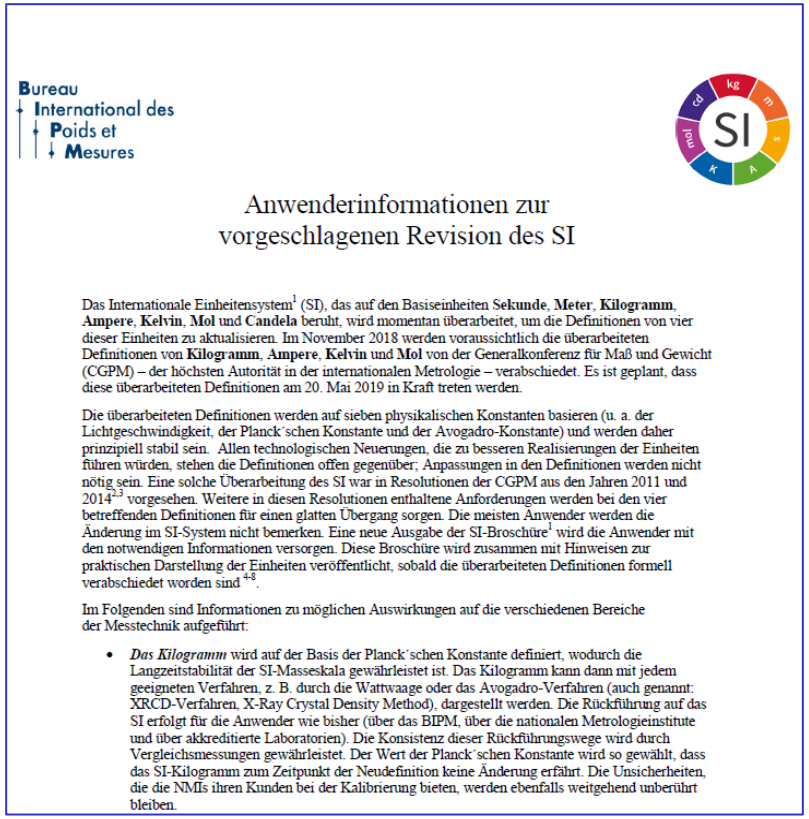
### Información a los usuarios del SI sobre su próxima revisión

El Sistema Internacional de Unidades[1], SI, basado en el **segundo**, el **metro**, el **kilogramo**, el **amperio**, el **kelvin**, el **mol** y la **candela** (las unidades básicas), está siendo revisado para actualizar las definiciones de cuatro de estas unidades. En noviembre de 2018 se espera que las definiciones revisadas del **kilogramo**, **amperio**, **kelvin** y **mol** sean aprobadas por la Conferencia General de Pesas y Medidas (CGPM), el organismo internacional responsable de la comparabilidad global de las mediciones. Se espera que las definiciones revisadas entren en vigor el 20 de mayo de 2019.

Las definiciones revisadas se basarán en siete constantes físicas (por ejemplo, la velocidad de la luz, la constante de Planck y la constante de Avogadro) y, por lo tanto, inherentemente estables. Las magnitudes se han elegido de forma que las definiciones revisadas no deban modificarse para acomodar futuras mejoras en las tecnologías utilizadas para sus realizaciones prácticas. La revisión del SI en esta forma fue prevista en las Resoluciones de la CGPM adoptadas en 2011 y 2014[2,3]. Los requisitos adicionales contenidos en dichas Resoluciones aseguran una transición sin problemas hacia las cuatro definiciones revisadas. La mayoría de los usuarios no notarán el cambio. Una nueva edición de la publicación sobre el SI[1] proporcionará información esencial a los usuarios y estará disponible después de que las definiciones revisadas hayan sido adoptadas formalmente. También habrá directrices sobre la realización práctica de las unidades[1-8].

A continuación, se incluye información sobre cómo estos cambios podrían afectar a las diferentes áreas de medición:

- *El kilogramo* se definirá en términos de la constante de Planck, garantizando la estabilidad a largo plazo de la escala de masas del SI. El kilogramo puede realizarse mediante cualquier método adecuado (por ejemplo, la balanza (de potencia) de Kibble o el método de Avogadro (determinación de densidad de cristales por rayos X). Los usuarios podrán obtener trazabilidad al SI de las mismas fuentes utilizadas en la actualidad (el BIPM, los institutos nacionales de metrología y los laboratorios acreditados). Las comparaciones internacionales garantizarán su coherencia. El valor de la constante de Planck se elegirá de forma que garantice el que no haya ningún cambio en el kilogramo SI en el momento de la redefinición. Las incertidumbres de calibración ofrecidas por los INM a sus clientes tampoco se verán afectadas en su gran mayoría.



Bureau International des Poids et Mesures

### Anwenderinformationen zur vorgeschlagenen Revision des SI

Das Internationale Einheitensystem[1] (SI), das auf den Basiseinheiten **Sekunde**, **Meter**, **Kilogramm**, **Ampere**, **Kelvin**, **Mol** und **Candela** beruht, wird momentan überarbeitet, um die Definitionen von vier dieser Einheiten zu aktualisieren. Im November 2018 werden voraussichtlich die überarbeiteten Definitionen von **Kilogramm**, **Ampere**, **Kelvin** und **Mol** von der Generalkonferenz für Maß und Gewicht (CGPM) – der höchsten Autorität in der internationalen Metrologie – verabschiedet. Es ist geplant, dass diese überarbeiteten Definitionen am 20. Mai 2019 in Kraft treten werden.

Die überarbeiteten Definitionen werden auf sieben physikalischen Konstanten basieren (u. a. der Lichtgeschwindigkeit, der Planck´schen Konstante und der Avogadro-Konstante) und werden daher prinzipiell stabil sein. Allen technologischen Neuerungen, die zu besseren Realisierungen der Einheiten führen würden, stehen die Definitionen offen gegenüber; Anpassungen in den Definitionen werden nicht nötig sein. Eine solche Überarbeitung des SI war in Resolutionen der CGPM aus den Jahren 2011 und 2014[2,3] vorgesehen. Weitere in diesen Resolutionen enthaltene Anforderungen werden bei den vier betreffenden Definitionen für einen glatten Übergang sorgen. Die meisten Anwender werden die Änderung im SI-System nicht bemerken. Eine neue Ausgabe der SI-Broschüre[1] wird die Anwender mit den notwendigen Informationen versorgen. Diese Broschüre wird zusammen mit Hinweisen zur praktischen Darstellung der Einheiten veröffentlicht, sobald die überarbeiteten Definitionen formell verabschiedet worden sind [4-8].

Im Folgenden sind Informationen zu möglichen Auswirkungen auf die verschiedenen Bereiche der Messtechnik aufgeführt:

- *Das Kilogramm* wird auf der Basis der Planck´schen Konstante definiert, wodurch die Langzeitstabilität der SI-Masseskala gewährleistet ist. Das Kilogramm kann dann mit jedem geeigneten Verfahren, z. B. durch die Wattwaage oder das Avogadro-Verfahren (auch genannt: XRCD-Verfahren, X-Ray Crystal Density Method), dargestellt werden. Die Rückführung auf das SI erfolgt für die Anwender wie bisher (über das BIPM, über die nationalen Metrologieinstitute und über akkreditierte Laboratorien). Die Konsistenz dieser Rückführungswege wird durch Vergleichsmessungen gewährleistet. Der Wert der Planck´schen Konstante wird so gewählt, dass das SI-Kilogramm zum Zeitpunkt der Neudefinition keine Änderung erfährt. Die Unsicherheiten, die die NMIs ihren Kunden bei der Kalibrierung bieten, werden ebenfalls weitgehend unberührt bleiben.

# NMIs have produced and publicly shared promotional videos on the redefinition of the SI

https://www.bipm.org/wg/SIDocuments.jsp

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### Documents

- PDF_documents
- Videos_by_NMIs

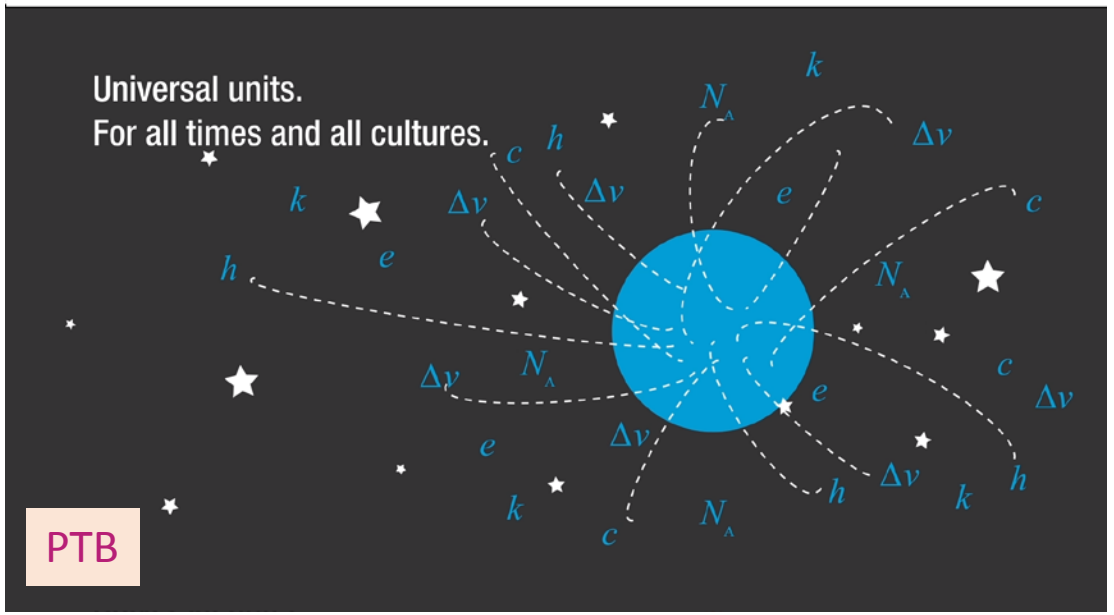
### Task Group for Promotion of the SI

- Mission
- CIPM-TGSI Members
- SI Brand Book and graphics files

# Some screenshots of the videos produced by the NMIs

https://www.bipm.org/wg/SIDocuments.jsp


NIM

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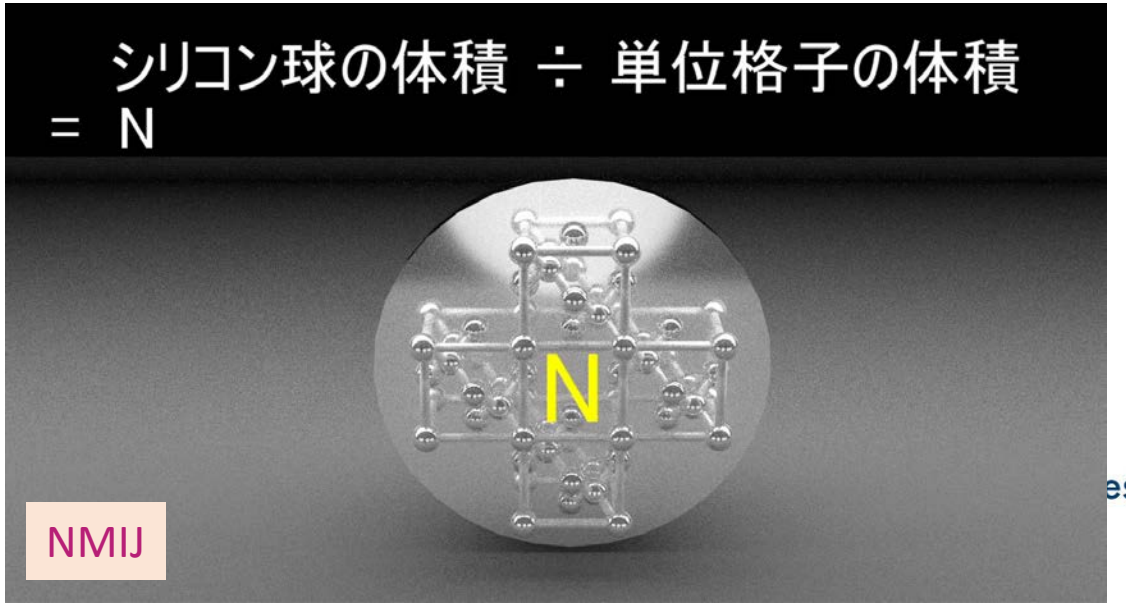


NMIJ

# NMIs have produced as well several promotional pdf documents for public use

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| ↘ | PDF-01 | SI infographics: units and defining constants | PTB | CC-BY | 2017/11/24 | PDF 1900 kbytes |
| ↘ | PDF-02 | Essays on the essential experiments perfomed for the new SI | PTB | CC-BY-SA | 2017/11/24 | PDF 3913 kbytes |
| ↘ | PDF-03 | Essays on the essential experiments perfomed for the new SI (in Spanish) | PTB | CC-BY-SA | 2018/01/09 | PDF 4976 kbytes |
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| ↘ | PDF-11 | La ridefinizione del Sistema Internazionale di unità | Luca Callegaro | CC-BY-ND | 2018/04/12 | PDF 1331 kbytes |
| ↘ | PDF-12 | Draft concise summary of the 9th SI Brochure (German translation) | CCs-PTB | CC-BY-NC-ND | 2018/04/19 | PDF 52 kbytes |
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**Task Group for Promotion of the SI**
- Mission
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# NMIs and RMOs have developed in the last months a great amount of promotional material for internal use and have organized many promotional workshops




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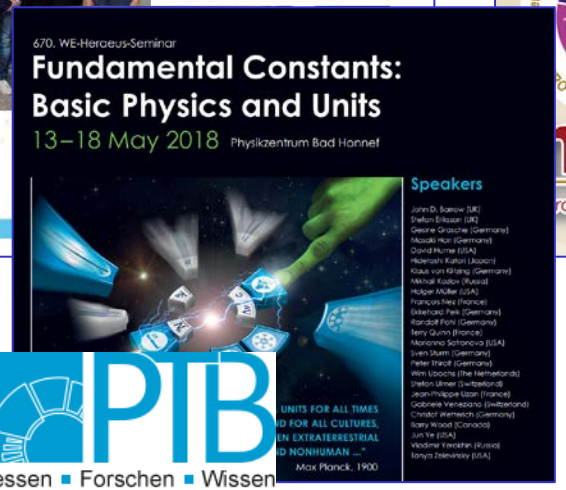



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Le progrès, une passion à partager

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Fiona Auty (NPL, Chair of the PR group) assisted the BIPM in the communication of the revision of the SI for several months until the end of the General Conference

Bureau International des Poids et Mesures

**Hundreds of major pieces published**
In print, online, radio and TV

**Over 70  journalists briefed by BIPM and 50+ attended the conference**

**26,775 viewed open session online**


**“Metric Makeover” viewed 85,000 times in 12 different languages**
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Who decides what time it is in Israel? How do they do it? And why is it so imp to the Coordinated Universal Time Laboratory at Hebrew University provides

Dr. Hadas Gertsovsky controls Israel's national clock.


This is heavy: The kilogram is getting an update

By JOHN LEICESTER November 13, 2018


UN BON KILO

En novembre, un nouveau Système international d'unités devrait être validé, couronné une course folle à la précision. Ou quand la physique liquide définitivement ces objets en métal centenaires qui lui servaient d'étalons


METRO Lab: Highlights to expect at New Scientist Live...

BreakingNews.ie

Scientists expected to redefine the kilogram





GRENZBEREICHE | MIKROTECHNIK

Was ist ein Kilogramm?

1 kg

Ein Stück Metall in einem Pariser Tresor ist der obwalte Vergleichsmaßstab. Aber das »Urkilo« verliert an Masse ...


SI gets a makeover

An upcoming change to SI units – due to be officially approved this month – will mark the end of a long journey from defining quantities in terms of objects to using precise, unchanging and universal constants of nature. Benjamin Skuse tells the story

Benjamin Skuse is a freelance science writer based near Bristol, UK. e-mail

Weighty issues: A prototype kilogram housed in a case PICTURE: ALAMY


Le Monde.fr

Le kilogramme repasse à la pesée






Conference On Weights To Agree On Changes To International System Of Units


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The End Of The Kilogram?


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Mon, 11/05/2018 - 10:07am 2 Comments by Seth Augenstein - Senior Science Writer - @SethAugenstein


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International research efforts have developed to the point where the kilogram can be defined from physical standards

10 April 2018


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Science

## Scientists are about to change what a kilogram is. That's massive.

By Sarah Kaplan
July 5, 2017

SCIENCE

## The Bitter Class Struggle Behind Our Definition of a Kilogram

Before standardization, units of measurement were often manipulated by tyrants to cheat peasants and steal land.

SAM KEAN | OCT 30, 2018

CIENCIA Y SALUD

## Actualizarán cuatro constantes fundamentales, incluido el kilo

Los cambios entrarán en vigor en mayo de 2019. Se trata de la mayor revisión del SI desde su instauración en 1960


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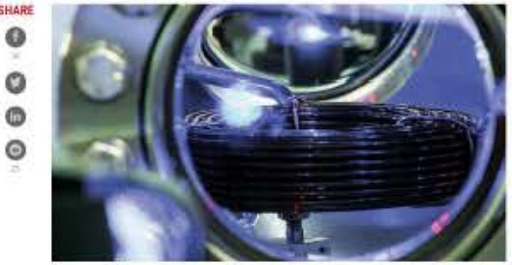

With better atomic clocks, scientists prepare to redefine the second

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In Honour of Professor Philippe G. Ciarlet's 80th Birthday
Date 12 November 2018 (Monday) | Venue City University of Hong Kong
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## Plot to redefine the kilogram nears climax

SCIENTIFIC AMERICAN

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## Redefining the Kilogram

Officials will vote to overhaul the SI system of measurements, basing units such as the kilogram not on physical objects but on fundamental constants

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## FOR THE LAST TIME: THE DIFFERENCE BETWEEN WEIGHT AND MASS

Así las cosas

## Medición del kilogramo, amperio, kelvin y mol cambiarán a partir de 2019

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OPINION

## The problem with precision

GIZMODO

## Scientists Are Redefining The Kilogram

Jennifer Ouellette

Stop the presses! Physicists at the National Institute of Standards and Technology have made a new measurement of Planck's constant to a highly accurate degree. It's the latest step toward improving the official definition of the kilogram, the unit of mass that

## Redefining the kilogram: A turning point for humanity

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Story reached ……


# 2,149,896,341 people

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# World metrology day 2019


## SI redefinition: World Metrology Day social media plan

### Twitter

Twitter is a busier network generally, meaning this content will reach the research community, and the general public.

### Facebook

Facebook is another important channel to reach a broad 'general public' audience. Content that is more fun will be more effective on Facebook, as is evidenced in the example posts.

### LinkedIn

LinkedIn is a network used mainly for professional purposes, with uses like advertising job vacancies and following companies and institutions for industry news.


http://www.worldmetrologyday.org

The Task group has proposed specific content and photographs targeting these social media platforms.

Bureau International des Poids et Mesures