Impact of the Redefinition of SI on Testing and Calibration Laboratories
國際單位制的修訂對測試及校正實驗室的影響

8 March 2019
Standards and Calibration Laboratory
標準及校正實驗所

Credit: BIPM

On November 16, 2018, the 26th meeting of the General Conference on Weights and Measures (CGPM) passed a resolution to revise four of the seven SI base units. This is the most significant revision of the SI since its inception in 1960.

第26屆國際計量大會（CGPM）於2018年11月決議重新定義現有國際單位制7個基本單位中的其中4個單位。這是國際單位制自1960年以來最重要的修訂。

The Metre Convention
米制公約

- **Metre Convention** was established on 20 May 1875 with 17 founding member states. As of 2018, there are **60** member states and **42** associate states. It is an **Inter-governmental diplomatic treaty** on matters of world metrology, particularly **world wide uniformity of measurements.**
- 1875年5月20日，17個國家簽署了**米制公約**，成為創始會員。在2018年, 米制公約是一個由 60 個國家及 42 個**附屬會員**簽署的外交條約, 其目的為促進和保証全世界的**測量量值一致**。
- **Hong Kong (China)** became an **associate** in Year 2000
- 2000年, **中國香港**成為根據米制公約成立的**附屬會員**。

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The International System of Units (SI)
國際單位制 (SI)

- In 1960, the General Conference of Weight and Measures **(CGPM),** adopted the name **International System of Units (SI)** for the system of units of measurement.
- 在1960年， **國際計量大會** (CGPM)正式建立**國際單位制** (SI)作為標準度量衡單位系統。
- SI is a set of rules that defines the **unit of measurement** of all quantities used in science and technology. It lays down rules for the **base units**, the **derived units** and **prefixes**.
- SI訂定了下列的規則
  - 國際單位制**基本單位**
  - 國際單位制**導出單位**
  - 國際單位制**詞頭**

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SI base units
國際單位制基本單位

- There are seven SI **base units**. Four will be redefined in 20 May 2019.
  國際單位制共有七個基本單位。其中四個會在**2019**年**5**月**20**日做出修訂。

■	秒	second (s)	(於1967訂定)
■	米	metre (m)	(於1983訂定)
■	坎德拉	candela (cd)	(於1979訂定)
■	公斤	kilogram (kg)	(於1889訂定)
■	安培	ampere (A)	(於1948訂定)
■	開爾文	kelvin (K)	(於1967訂定)
■	摩爾	mole (mol)	(於1971訂定)

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■	摩爾	mole (mol)	(於1971訂定)

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SI derived units
國際單位制導出單位

- SI derived units are units which may be expressed in terms of products of powers of base units.
- 國際單位制導出單位是從七個基本單位以冪乘積表達的單位。

- Examples 例子如下 :
  - Force 力 : newton, N = kg m s^{-2}
  - Frequency 頻率 : hertz, Hz = s^{-1}
  - Energy 能量 : joule, J = kg m^2 s^{-2}

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SI prefixes
國際單位制詞頭

- 堯 yotta (Y) 10^{24}
- 澤 zetta (Z) 10^{21}
- 艾 exa (E) 10^{18}
- 拍 peta (P) 10^{15}
- 太 tera (T) 10^{12}
- 吉 giga (G) 10^{9}
- 兆 mega (M) 10^{6}
- 千 kilo (k) 10^{3}
- 毫 milli (m) 10^{-3}
- 微 micro (μ) 10^{-6}
- 納 nano (n) 10^{-9}
- 皮 pico (p) 10^{-12}
- 飛 femto (f) 10^{-15}
- 阿 atto (a) 10^{-18}
- 仄 zepto (z) 10^{-21}
- 么 yocto (y) 10^{-24}

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Redefinition of SI
重新定義國際單位制

- In November 2018, the 26th **General Conference on Weights and Measures** (CGPM) reviewed the International System of Units (SI) of four of the seven base units namely **kilogram, ampere, kelvin** and **mole** by fixing the values of the **Planck constant** (*h*), the **elementary charge** (*e*), the **Boltzmann constant** (*k*) and the **Avogadro constant** (N_A). The redefined SI will be implemented worldwide on the following World Metrology Day which is on **May 20 2019**.
- 第26屆**國際計量大會**（CGPM）於2018年11月重新定義現有國際單位制 7 個基本單位中的其中4個單位，分別為**公斤**、**安培**、**開爾文**和**摩爾**。新定義把相關基本單位與4個物理常數，分別是**普朗克常數**（*h*）、**基本電荷值**（*e*）、**波茲曼常數**（*k*）和**阿伏伽德羅常數**（N_A）連結。新的定義通過後，將於其後的世界計量日，即2019年5月20日在全球實施。

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Redefinition of SI
重新定義國際單位制

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 × 10^{-34} J s,**
- **the elementary charge *e* is 1.602 176 634 × 10^{-19} C,**
- **the Boltzmann constant *k* is 1.380 649 × 10^{-23} J/K,**
- **the Avogadro constant N_A is 6.022 140 76 × 10^{23} mol^{-1},**
- **the luminous efficacy of monochromatic radiation of frequency 540 × 10^{12} hertz K_{cd} is 683 lm/W.**

From "*The International System of Units (SI) 9th edition 2019*"

Standards and Calibration Laboratory, Hong Kong, China

The next 3 SI base units keep the original definitions with changes in wording

以下三個基本單位
定義維持不變
但措辭有所改動

Time (second)
時間(秒)

Definition prior to 20 May 2019

The second is the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two **hyperfine** levels of the ground state of the caesium 133 atom.

與銫-133原子基態的兩個**超精細能級**間躍遷對應的輻射的 9 192 631 770 個周期的持續時間。

Primary Standard at SCL
標準及校正實驗所的基準

Caesium Beam Frequency Standard
銫原子束標準

Time (second)
時間(秒)

Definition prior to 20 May 2019

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與銫-133原子基態的兩個**超精細能級**間躍遷對應的輻射的 9 192 631 770 個周期的持續時間。

The Revised Wording

The second is defined by taking the fixed numerical value of the caesium frequency $\Delta\nu_{Cs}$, the unperturbed ground-state **hyperfine** transition frequency of the caesium 133 atom, to be 9 192 631 770 when expressed in the unit Hz, which is equal to s^{-1}.

秒由銫133原子於非擾動基態**超精細能級**間躍遷對應的輻射頻率 $\Delta\nu_{Cs}$之固定數值所定義，以單位Hz表示時 (相當於s^{-1})，其值為9 192 631 770。

Length (metre)
長度(米)

Definition prior to 20 May 2019

The metre is the length of the path travelled by light in vacuum during a time interval of 1/299 792 458 of a second.

一米為光於 1/299792458 秒的時間內在真空中所經路程的長度。

Primary Standard at SCL
標準及校正實驗所的基準

Iodine Stabilized Helium-neon Laser
碘穩頻氦氖激光器

Length (metre)
長度(米)

Definition prior to 20 May 2019

The metre is the length of the path travelled by light in vacuum during a time interval of 1/299 792 458 of a second.

一米為光於 1/299792458 秒的時間內在真空中所經路程的長度。

The Revised Wording

The metre is defined by taking the fixed numerical value of the speed of light in vacuum ***c*** to be 299 792 458 when expressed in the unit m s^{-1}, where the second is defined in terms of the caesium frequency $\Delta\nu_{Cs}$.

米由真空中光速 *c* 之選取固定值所定義，以m s^{-1}為單位時，其值為 299 792 458；其中秒是由銫的頻率 $\Delta\nu_{Cs}$ 所定義。

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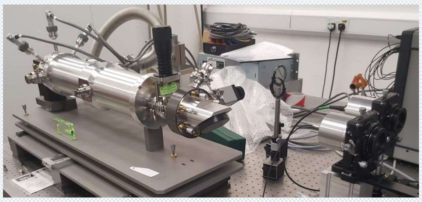
Luminous Intensity (Candela)
發光強度(坎德拉)

Definition prior to 20 May 2019

The candela is the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency 540 × 10^{12} hertz and that has a radiant intensity in that direction of 1/683 watt per steradian.

發光強度，該光源發出540x10^{12} 赫茲頻率的單色輻射，且在該方向上的輻射強度為每球面度 1/683 瓦特。

Primary Standard at SCL
標準及校正實驗所的基準



Cryogenic Radiometer
低溫輻射計

Standards and Calibration Laboratory, Hong Kong, China

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The Revised Wording

The candela is defined by taking the fixed numerical value of the luminous efficacy of monochromatic radiation of frequency 540 × 10^{12} Hz, ***Kcd***, to be 683 when expressed in the unit lmW^{-1}, which is equal to cd srW^{-1}, or cd sr kg^{-1} m^{-2} s^3, where the kilogram, metre and second are defined in terms of h, c and $\Delta\nu_{Cs}$.

坎德拉由頻率 540 × 10^{12} Hz 單色輻射光的發光效能 *Kcd* 之選用固定數值所定義，以單位lm W^{-1} (即cd sr W^{-1} 或 cd sr kg^{-1} m^{-2} s^3) 表示時，其值為 683 。 其中公斤、米和秒分別由 h, c 和 $\Delta\nu_{Cs}$ 所定義。

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The Common Construction of the New Definitions
新定義的共同構建

The **A** is defined
by taking the fixed numerical value of **B**
to be **C**
when expressed in the unit **D**.

A 的定義是
通過把 **B**
當以單位 **D** 表達時
選取固定數值 **C** 而達致.

Standards and Calibration Laboratory, Hong Kong, China

The Common Construction of the New Definitions
新定義的共同構建

The **A** is defined by taking the fixed numerical value of **B** to be **C** when expressed in the unit **D**.
A 的定義是通過把 **B** 當以單位 **D** 表達時選取固定數值 **C** 而達致.

A = second （秒）
B = caesium frequency $\Delta\nu_{Cs}$ （銫頻 率$\Delta\nu_{Cs}$）
C = 9 192 631 770
D = s^{-1}

The effect of this definition is that the second is defined as the time interval corresponding to 9 192 631 770 cycles of the caesium frequency $\Delta\nu_{Cs}$.
該定義的效果是把秒定義為對應於銫頻率$\Delta\nu_{Cs}$ 9 192 631 770個週期的時間間隔。

Standards and Calibration Laboratory, Hong Kong, China

The Common Construction of the New Definitions
新定義的共同構建

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A 的定義是通過把 **B** 當以單位 **D** 表達時選取固定數值 **C** 而達致.

A = metre （米）
B = the speed of light in vacuum c （真空中光速 c）
C = 299 792 458
D = m s^{-1}

The effect of this definition is that the metre is defined as length travelled by light in vacuum in 1/299 792 458 of a second.
該定義的效果是把一米定義為光於 1/299792458 秒的時間內在真空中所經長度。

Standards and Calibration Laboratory, Hong Kong, China

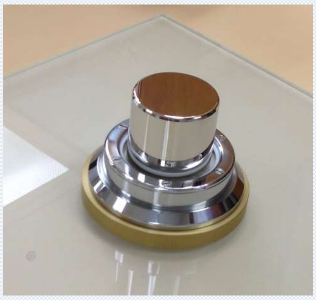
The next 4 SI base units will be redefined on 20 May 2019

以下四個基本單位在
2019年5月20日作出修訂

Mass (kilogram)
質量(公斤)

- Definition prior to 20 May 2019 :

  The kilogram is equal to the mass of the international prototype of the kilogram (IPK).
- Similar to most member states of the Metre Convention which hold copies of the IPK as national prototypes, Hong Kong has acquired copy no. 75 of the IPK.
- 公斤相等於國際計量局保存的國際公斤原器的質量。
- 米制公約的大多數成員國都持有國際公斤原器的複製品作國家原器。香港亦持有國際公斤原器第75號複製品。



Copy no. 75 of the IPK is now stored at the Standards and Calibration Laboratory
國際公斤原器75號複製品,現藏於標準及校正實驗所

Why the kilogram is to be redefined ?
為何要重新定義公斤 ？

- kilogram is the last base unit of the SI to be defined by a **material artefact**.
- 公斤是最後一個以**器件**作定義的SI基本單位。
- The major disadvantage of an artefact is that it **cannot be absolutely stable**. The mass of the IPK may have drifted 50 µg over the past 100 years.
- 以器件作定義的最大問題是**不能長期保持絕對穩定**。國際公斤原器的質量在過去百年間可能已有50微克的改變。
- Since the definition of the **ampere** is related to the kilogram, unknown changes in the mass unit also influence the electrical units. Similarly, the definitions of the **mole** and **candela** also depend on the kilogram.
- 因為**安培**的定義與公斤有關，質量單位的變化也會影響電學單位。 同樣，**摩爾**和**坎德拉**的定義也取決於公斤。

Standards and Calibration Laboratory, Hong Kong, China

Proposed Revised Definition for Kilogram
公斤的建議修訂定義

Definition prior to 20 May 2019

- The kilogram is equal to the mass of the international prototype of the kilogram (IPK).
- 公斤相等於國際計量局保存的國際公斤原器的質量。

The revised definition

- The kilogram is defined by taking the fixed numerical value of the Planck constant ***h*** to be 6.626 070 15 × 10^{-34} when expressed in the unit J s, which is equal to kg m^2 s^{-1}, where the metre and the second are defined in terms of ***c*** and $\Delta \nu_{Cs}$.
- 公斤定義為當將普朗克常數 ***h*** 以單位 J s （即等於 kg m^2 s^{-1}）表達時， 其數值固定為 6.626 070 15x10^{-34}，而米和秒以 ***c*** 和 $\Delta \nu_{Cs}$ 作定義。

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Methods for Realizing the New Definition of the Kilogram (1)
公斤新定義的復現方法 (1)

- Method 1 : By comparing electrical power to mechanical power using an instrument called **Kibble balance**
- 第一種方法是利用稱為 Kibble 天平的儀器通過比較電功率與機械功率來復現。

Kibble balance
at LNE, France
位於法國國家計量測試實驗所
的Kibble 天平

Standards and Calibration Laboratory, Hong Kong, China

Methods for Realizing the New Definition of the Kilogram (2)
公斤新定義的復現方法 (2)

- Method 2 : By comparing the unknown mass to the mass of a single atom of a specified isotope. Single crystals of silicon are most often used. For practical reasons, the crystal is made into spherical form having a mass of approximately 1 kg.
- 第二種方法是將未知質量與指定同位素的單個原子的質量進行比較。 這方法最常使用是矽的單晶。出于實際原因，一般將晶體製成質量約為 1 kg 的球體。

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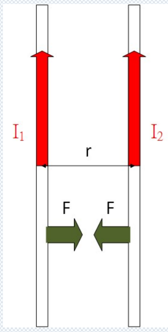
Current (Ampere)
電流(安培)

Definition prior to 20 May 2019

The ampere is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section, and placed 1 meter apart in vacuum, would produce between these conductors a force equal to 2 x 10^{-7} newton per meter of length.

在真空中，在截面積可忽略的兩根相距1米的無限長平行圓直導線內，通以等量恆定電流時，如在導線產生的相互作用力在每米長度上是2x10^{-7} 牛頓，則每根導線中的電流是1安培。



$$\frac{F}{L} = \frac{\mu_0 I_1 I_2}{2\pi r}$$

Ampere's Force Law:
安培力定律

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Current Method for Realizing the ampere
現在復現安培的方法

Primary Standard at SCL
標準及校正實驗所的基準

Josephson Array Voltage Standard
約瑟夫森結陣電壓標準

A = V ÷ Ω

Primary Standard at SCL
標準及校正實驗所的基準

Quantum Hall Resistance Standard
量子化霍爾電阻標準

$$V = nf\frac{h}{2e} = \frac{nf}{K_{J-90}}$$

K_{J-90} =483597.9 GHz/V
R_{K-90} = 25812.807Ω

$$R_H = \frac{h}{ie^2} = \frac{R_{K-90}}{i}$$

Standards and Calibration Laboratory, Hong Kong, China

Propose Revised definition of ampere
安培的建議修訂定義

- The ampere is defined by taking the fixed numerical value of the elementary charge *e* to be 1.602 176 634 $\times 10^{-19}$ when expressed in the unit C, which is equal to A s, where the second is defined in terms of $\Delta\nu_{Cs}$.

- 安培由基本電荷 *e* 之選取固定數值所定義，以 C (即A s)為單位時，其值為1.602 176 634 $\times 10^{-19}$，其中秒由$\Delta\nu_{Cs}$ 所定義。

Methods for Realizing the New Definition of the ampere
安培新定義的復現方法

(a) by using Ohm's law, the unit relation A = V/Ω, and using practical realizations of the SI derived units the volt V and the ohm Ω, based on the Josephson and quantum Hall effects, respectively, as discussed in Secs. 4 and 5 below; or

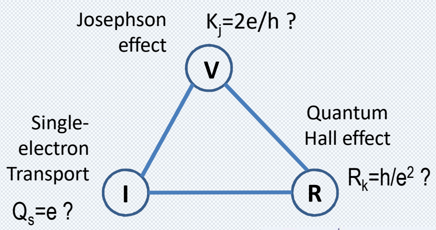
(b) by using a single electron transport (SET) or similar device, the unit relation A = C/s, the value of *e* given in the definition of the ampere and a practical realization of the SI base unit the second s; or

(c) by using the relation $I = C \cdot dU/dt$, the unit relation A = F·V/s, and practical realizations of the SI derived units the volt V and the farad F and of the SI base unit second s.

From "Mise en pratique for the definition of the ampere and other electric units in the SI, Version 1.0"

Quantum Metrological Triangle

$K_j R_k Q_s = 2$?



Methods for Realizing the New Definition of the ampere
安培新定義的復現方法

	Josephson constant (GHz/V)	Von Klitzing constant (Ω)
Conventional value	K_{J-90} = 483 597.9	R_{K-90} = 25 812.807
New value	K_J = 483 597.848 416 984	R_K = 25 812.807 459 304 5

- **Voltage values will be changed by $+1.1 \times 10^{-7}$.**
- 電壓值將改變 $+1.1 \times 10^{-7}$
- **Resistance values will be changed by $+1.8 \times 10^{-8}$**
- **電阻值將改變 $+1.8 \times 10^{-8}$**

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Impacts of the New Definition of the ampere
安培新定義的影響

Criteria	Actions
2.5 $d \leq U$	no action is necessary until the next recalibration (or measurement). 在下次重新校正之前不需要修訂其儀器的標準值或安排從新校正。
$U <$ 2.5 d	numerical correct or recalibrate before the standard's next use for traceability. 高精度直流電壓標準和電阻標準的用戶可能需要在下次使用之前為其標準儀器調整其標準值或安排重新校正

Standards and Calibration Laboratory, Hong Kong, China

Impacts of the New Definition of the ampere
安培新定義的影響

Instruments	U (1×10^{-6})	d (1×10^{-6})	U < 2.5 d
Zener voltage standards	0.06		Yes
Calibrators (DC voltage)	0.7	0.11	No
DMM (DC voltage)	1.5		No
Standard resistors	0.3		No
Calibrators (Resistance)	1.0	0.018	No
DMM (Resistance)	1.0		No
Calibrators (DC current)	2.6	0.09	No
DMM (DC current)	1.0		No

Thermodynamic Temperature (kelvin)
熱力學溫度(開爾文)

Definition prior to 20 May 2019

The kelvin, unit of thermodynamic temperature, is the fraction 1/273.16 of the thermodynamic temperature of the **triple point of water.**

一開爾文定義為水三相點熱力學溫度的1/273.16。

Primary Standard at SCL
標準及校正實驗所的基準

Triple of Water Cell
水的三相點容器

What Water ?

什麼水？

- The current definition of kelvin depends on the properties of the water sample, especially the **isotopic** composition.
- 目前開爾文的定義會受到水的性質所影響，特別是**同位素**的成分分佈。

- In 2005, the isotopic composition of the water was specified as that of **Vienna Standard Mean Ocean Water (VSMOW)**
- 在2005年，水的同位素的成分分佈採納以**維也納標準平均海水**為準。
  - $(^{2}H/^{1}H)_{VSMOW}$ = 0.000 155 76 (5);
  - $(^{18}O/^{16}O)_{VSMOW}$ = 0.002 005 2 (5);
  - $(^{17}O/^{16}O)_{VSMOW}$ = 0.000 379 9 (9);

Standards and Calibration Laboratory, Hong Kong, China

Propose Revised definition of kelvin

開爾文的建議修訂定義

Definition prior to 20 May 2019

The kelvin, unit of thermodynamic temperature, is the fraction 1/273.16 of the thermodynamic temperature of the **triple point of water.**

一開爾文定義為**水三相點**熱力學溫度的1/273.16。

The revised definition

The kelvin is defined by taking the fixed numerical value of the **Boltzmann constant** k to be 1.380 649 × 10^{-23} when expressed in the unit J K^{-1}, which is equal to kg m^2 s^{-2} K^{-1}, where the kilogram, metre and second are defined in terms of h, c and $\Delta\nu_{Cs}$.

開爾文由波爾玆曼常數 k 之選取固定數值所定義，以 J K^{-1}為單位 (即kg m^2 s^{-2} K^{-1}) 時，其值為1.380 649 × 10^{-23}；其中公斤、米和秒分別由 h, c 和 $\Delta\nu_{Cs}$ 所定義。

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S = *k* log W

The physical meaning of thermodynamic temperature is given by the following formula
熱力學溫度的物理意義由下式給出

$$\frac{1}{T} = \left(\frac{\partial S}{\partial U}\right)_{V,N}$$

S = *k* log W

T = thermodynamic temperature 熱力學溫度
S = entropy 熵
U = Internal energy of the system 系統的內部能量
k = Boltzmann constant 波爾茲曼常數
W = Number of quantum states accessible to the system 系統可到達的量子狀態數

Many consider S = *k* log W the most important equation in thermal physics.
許多人認為 S = *k* log W 是熱物理學中最重要的公式。

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The Boltzmann constant k corresponds to a conversion factor between the quantities temperature (with unit kelvin) and energy (with unit joule), …

The temperature of a system scales with the thermal energy, but not necessarily with the internal energy of a system.

From "*The International System of Units (SI) 9th edition 2019*"

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Amount of substance (mole)
物質的量(摩爾)

Definition prior to 20 May 2019

1. The mole is the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon 12; its symbol is "mol".
2. When the mole is used, the elementary entities must be specified and may be atoms, molecules, ions, electrons, other particles, or specified groups of such particles.

1. 某一系統的物質的量，該系統中所包含的基本單元數目與0.012公斤碳12的原子數目相等。
2. 在採用摩爾時，必須指明基本單元，基本單元可以是原子、分子、離子、電子及其他粒子，或是該等粒子的特定組合。

Standards and Calibration Laboratory, Hong Kong, China

Propose Revised definition of mole
摩爾的建議修訂定義

- 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.
- An elementary entity may be an atom, a molecule, an ion, an electron, any other particle or specified group of particles.

- 一摩爾恰好包含6.022 140 76x10^{23}個基本單元。 該數字是**阿伏加德羅常數N_A**以單位mol^{-1}表達時的固定數值，稱為阿伏加德羅數。
- 基本單元可以是原子、分子、離子、電子及其他粒子，或是該等粒子的特定組合。

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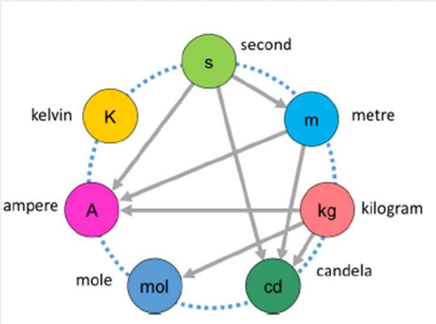
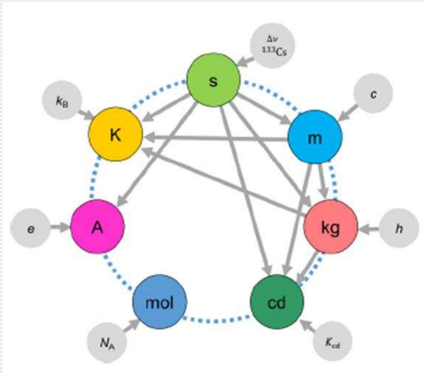
Relations between seven SI base units
七個 SI 基本單位之間的關係



Current definition



Proposed revised definition

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Preserving continuity, as far as possible, has always been an essential feature of any changes to the International System of Units.

From "*The International System of Units (SI) 9th edition 2019*"

Hence, the impacts of the revision of the SI to the general public and the testing and certification industry are kept to the minimum as far as possible.

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Impacts of the Revision of the SI on the General Public
國際單位制的修訂對公眾的影響

The kilogram 公斤	• The value of the mass standards will remain unchanged • No impact on the general public. • 質量計量標準的數值將保持不變。 • 對公眾不會產生影響。
The ampere 安培	• One-time change of + 0.1 ppm for voltage values and of + 0.02 ppm for resistance values. • These small changes should have no impact on the general public. • 修訂將會使電壓值和電阻值產生分別約百萬份之+0.1和約百萬份之+0.02的變化。 • 這些微小的改變對公眾不會產生影響。
The kelvin 開爾文	• Readings of previously calibrated thermometers not affected • No impact on the general public. • 先前已校正的溫度計的讀數不會受到影響。 • 對公眾沒有影響。
The mole 摩爾	• no impact on the general public. • 對公眾沒有影響

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Impacts of Revision on Testing and Calibration Laboratories
修訂對測試及校正實驗所的影響

The kilogram 公斤	• The value of the mass standards will remain unchanged • The measurement uncertainties of the mass standards will be slightly larger than that before. • However, only those high echelon laboratories such as SCL and overseas NMI will need to review and revise, if necessary, the measurement uncertainties of their mass standards. • The uncertainties for mass measurement offered by SCL to our customers will be broadly unaffected. • 質量計量標準的數值將保持不變。 • 測量不確定度將會略為增大。 • 不過，這只會對例如標準及校正實驗所等進行高精密度質量計量的實驗室產生影響。此等實驗室需要審查其質量計量標準的測量不確定度並在有需要時作出修改。 • 標準及校正實驗所向客戶提供的質量計量的測量不確定度將大致不受影響。

Standards and Calibration Laboratory, Hong Kong, China

Impacts of Revision on Testing and Calibration Laboratories
修訂對測試及校正實驗所的影響

The ampere 安培	• One-time change of + 0.1 ppm for voltage values and of + 0.02 ppm for resistance values. • For the vast majority of measurement users, no action need be taken until the next recalibration. • Practitioners working at the highest level of accuracy would need to adjust the values of their standards and to review their measurement uncertainty budgets. • SCL will implement the change on 20 May 2019. Users of DC voltage standards and resistance standards may need to apply correction or arrange recalibration before the standard's next use for traceability. • SCL will contact affected users in 2019 about the change and related arrangement for re-calibration of their standards.

Standards and Calibration Laboratory, Hong Kong, China

Impacts of Revision on Testing and Calibration Laboratories
修訂對測試及校正實驗所的影響

The ampere 安培	• 修訂將會使電壓值和電阻值產生分別約百萬份之+0.1和約百萬份之+0.02的變化。 • 絕大多數的測量用戶在他們下次重新校正之前不需要修訂其儀器的標準值或安排從新校正。 • 而高精度實驗室則需要為其標準儀器調整其標準值和審視其測量不確定度。 • 標準及校正實驗所將將於2019年5月20日實施有關修訂。直流電壓標準和電阻標準的用戶可能需要在下次使用之前為其標準儀器調整其標準值或安排重新校正，以確保其溯源有效。 標準及校正實驗所將於2019年初聯絡受影響的用戶，通知有關變化和重新校正其標準儀器的相關安排。

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Impacts of Revision on Testing and Calibration Laboratories
修訂對測試及校正實驗所的影響

The kelvin 開爾文	• The redefinition of the kelvin has no effect on the results, the uncertainties and traceability of temperature measurements conducted by SCL. • The readings of previously calibrated thermometers will not be affected by the redefinition of the kelvin and no adjustments are needed. • 重新定義開爾文對標準及校正實驗所進行的溫度計量的結果，測量不確定度及測量溯源性沒有影響。 • 先前已校正的溫度計的讀數不會受到開爾文重新定義所影響, 無需作出調整。開爾文重新定義對一般测试及校正實驗所預計沒有影響。
The mole 摩爾	• The mole is more related to chemical metrology. Generally speaking the redefinition of the mole will have no impact to testing and calibration laboratories. • 摩爾與化學計量的關係較大。一般而言，摩爾重新定義對一般测试及校正實驗所預計沒有影響。

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Finally, a Good News … for Hong Kong

最後，為香港送來一個好消息

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World Metrology Day Poster
世界計量日海報

- ‘World Metrology Day’ (WMD) is the annual celebration of the signing of the Metre Convention on 20 May 1875. To commemorate the occasion, BIPM, jointly with the OIML, organizes the creation of a WMD Poster. Each year a CGPM member is selected to design this poster.
- “世界計量日”是每年為慶祝1875年5月20日簽署米制公約舉辦的活動。為紀念此活動，國際計量局與OIML共同組織了世界計量日海報的製作。 每年都會選出一位國際計量大會成員負責設計這張海報。

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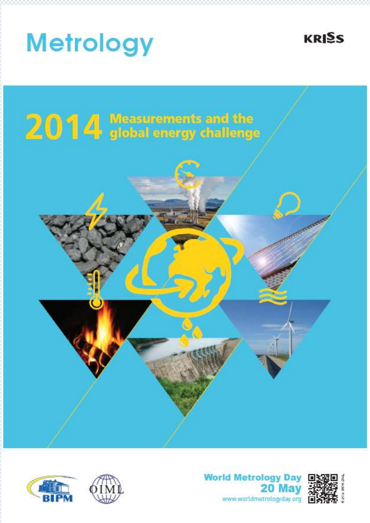

2014
KRISS
Korea 韓國

2015
NMISA
South Africa 南非

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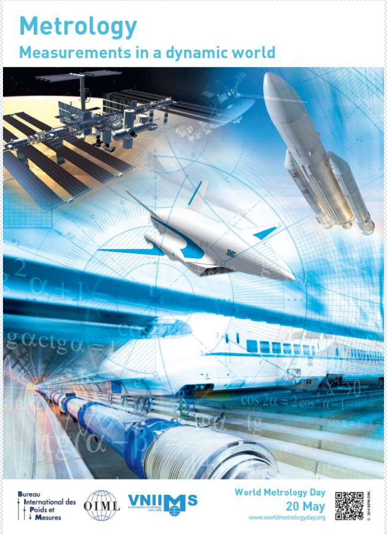

2016
VNIIMS
Russia 俄國

2017
INM
Columbia哥倫比亞

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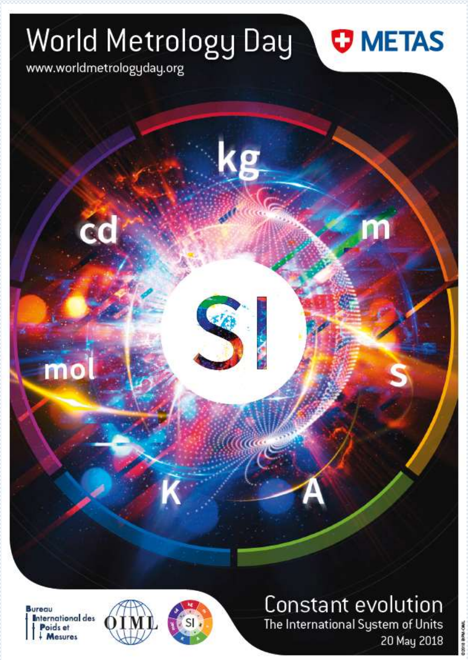

2018
METAS
Switzerland 瑞士

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What about 2019 ?

2019年呢？

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http://www.worldmetrologyday.org/

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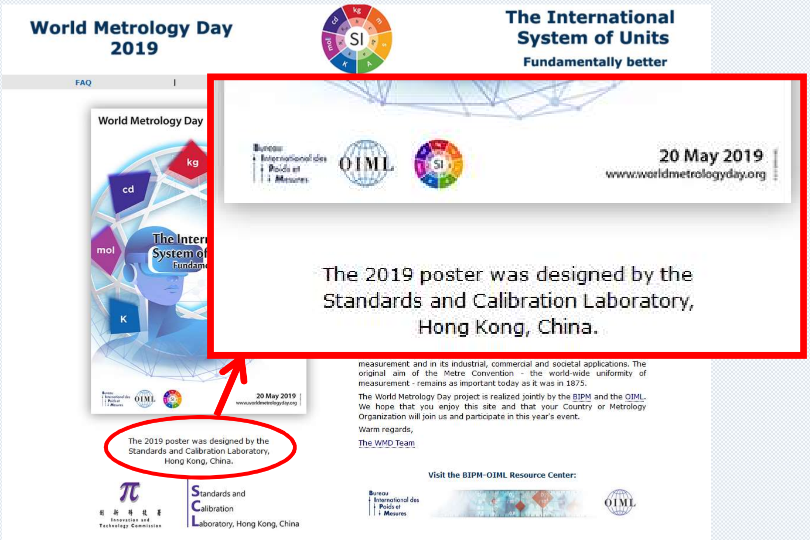
http://www.worldmetrologyday.org/



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The poster designed by SCL will be used all over the world to promote this important day of implementation of the revised SI.

標準及校正實驗所設計的 海報, 將會獲世界各地採用，以宣揚2019年5月20日實施新修訂國際單位制這個重大日子。

Standards and Calibration Laboratory, Hong Kong, China

Thank you

謝謝

Standards and Calibration Laboratory, Hong Kong, China