La velocità della luce e il nuovo Sistema Internazionale di misura

IX Convegno Nazionale di DIdattica della FIsica e della MAtematica

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Il 20 Maggio 2019 è stata una giornata storica perché è entrato in vigore il nuovo Sistema Internazionale di misura.

- la frequenza della transizione fra il livello iperfine e il livello fondamentale del cesio 133, è $\Delta\nu_{Cs}$=9 192 631 770 Hz,
- la velocità della luce nel vuoto è c=299 792 458 m/s,
- la costante di Planck è h=6.626 070 15 $\times 10^{-34}$ J s,
- la carica elettrica elementare è e=1.602 176 634 $\times 10^{-19}$ C,
- la costante di Boltzmann è k=1.380 649 $\times 10^{-23}$ J/K,
- la costante di Avogadro è N_A=6.022 140 76 $\times 10^{23}$ mol^{-1},
- l'intensità luminosa della radiazione monocromatica di frequenza 540 $\times 10^{12}$ hertz è K_{cd}=683 lm/W.


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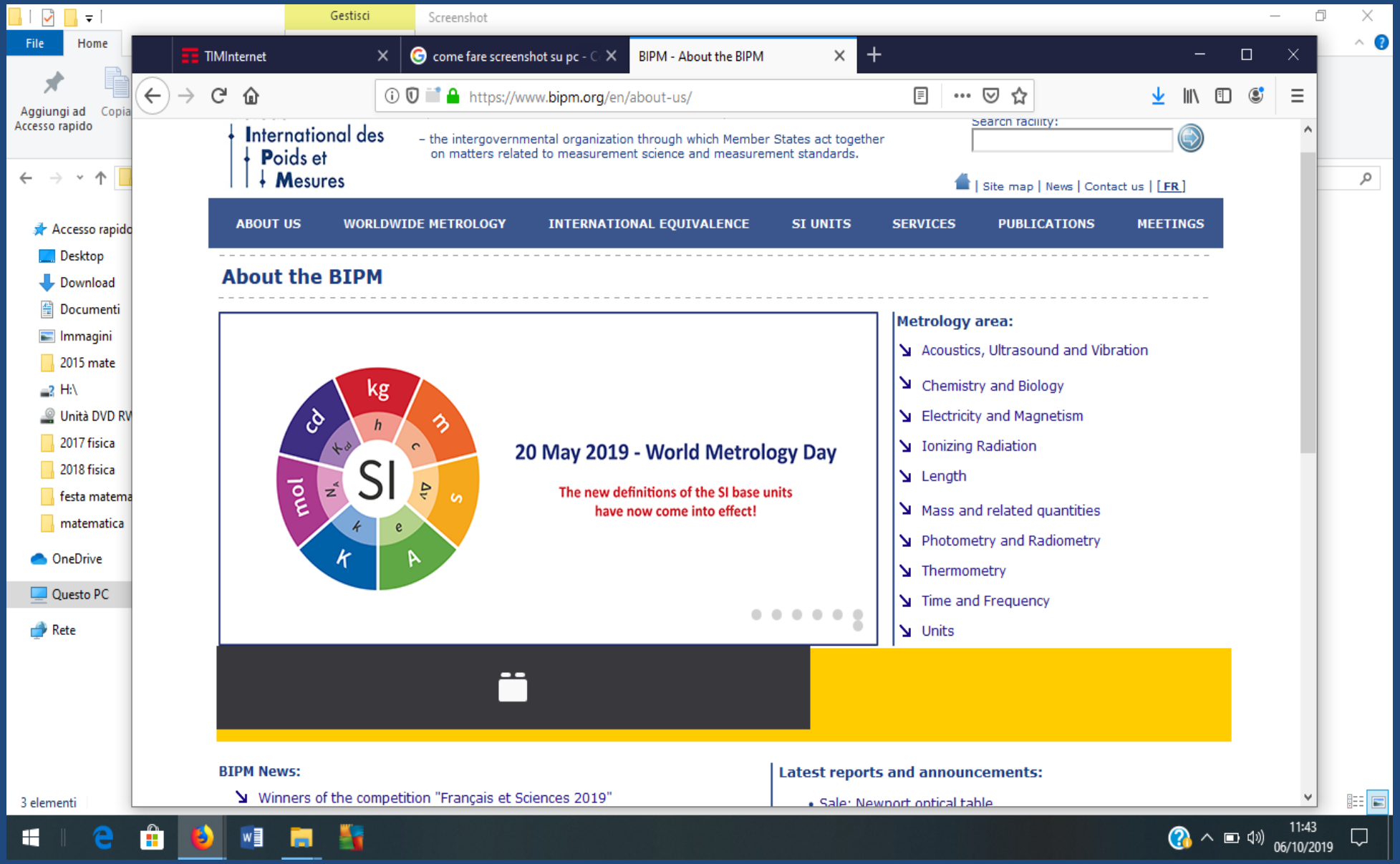
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– the intergovernmental organization through which Member States act together on matters related to measurement science and measurement standards.
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SI
20 May 2019 - World Metrology Day
The new definitions of the SI base units have now come into effect!
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11:43
06/10/2019

History

→ The recommended practical system of units of measurement is the International System of Units (*Système International d'Unités*), with the international abbreviation **SI**.

The SI is defined by the **SI Brochure**, which is published by the BIPM.

In a landmark decision, the BIPM's Member States voted on 16 November 2018 to revise the SI, changing the world's definition of the kilogram, the ampere, the kelvin and the mole.

This decision, made at the 26th meeting of the General Conference on Weights and Measures (CGPM), means that from 20 May 2019 all SI units are defined in terms of constants that describe the natural world. This will assure the future stability of the SI and open the opportunity for the use of new technologies, including quantum technologies, to implement the definitions.

The seven defining constants of the SI are:

- the caesium hyperfine frequency $\Delta\nu_{Cs}$;
- the speed of light in vacuum c;
- the Planck constant h;
- the elementary charge e;
- the Boltzmann constant k;
- the Avogadro constant N_A; and
- the luminous efficacy of a defined visible radiation K_{cd}.

The SI was previously defined in terms of seven base units and derived units defined as products of powers of the base units. The seven base units were chosen for historical reasons, and were, by convention, regarded as dimensionally independent: the metre, the kilogram, the second, the ampere, the kelvin, the mole, and the candela. This role for the base units continues in the present SI even though the SI itself is now defined in terms of the defining constants above.

Metrology area: AUV EM L M PR QM RI T TF U

La velocità della luce *c* entra infatti nella definizione del metro, che non viene più definito mediante un campione materiale, ma, dinamicamente, mediante lo spazio percorso in 1 secondo dalla radiazione elettromagnetica diviso per il valore numerico assegnato per definizione a *c*:

1 m = (*c* / 299 792 458) s.

Base quantity		Base unit	
Name	**Typical symbol**	**Name**	**Symbol**
time	t	second	s
length	l, x, r, etc.	metre	m
mass	m	kilogram	kg
electric current	I, i	ampere	A
thermodynamic temperature	T	kelvin	K
amount of substance	n	mole	mol
luminous intensity	I_v	candela	cd

Definitions

Starting from the definition of the SI in terms of fixed numerical values of the defining constants, definitions of each of the seven base units are deduced by using, as appropriate, one or more of these defining constants to give the following set of definitions:

- The second
- The metre
- The kilogram
- The ampere
- The kelvin
- The mole
- The candela

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6 elementi

Definitions

The second

The second, symbol s, is the SI unit of time. It 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}.

This definition implies the exact relation $\Delta\nu_{Cs}$ = 9 192 631 770 Hz. Inverting this relation gives an expression for the unit second in terms of the defining constant $\Delta\nu_{Cs}$:

$$1\,\mathrm{Hz} = \frac{\Delta\nu_{Cs}}{9\,192\,631\,770}$$

or

$$1\,\mathrm{s} = \frac{9\,192\,631\,770}{\Delta\nu_{Cs}}.$$

The effect of this definition is that the second is equal to the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the unperturbed ground state of the ^{133}Cs atom.

The metre

The kilogram

11:45
06/10/2019

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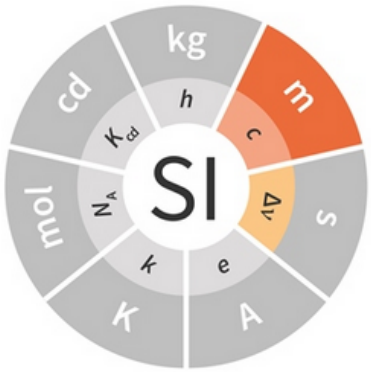
Definitions

The second

The metre

The metre, symbol m, is the SI unit of length. It 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 $\Delta\nu_{Cs}$.



This definition implies the exact relation c = 299 792 458 m s^{-1}. Inverting this relation gives an exact expression for the metre in terms of the defining constants c and $\Delta\nu_{Cs}$:

$$1\,\mathrm{m} = \left(\frac{c}{299\,792\,458}\right)\mathrm{s} = \frac{9\,192\,631\,770}{299\,792\,458}\,\frac{c}{\Delta\nu_{Cs}} \approx 30{,}663\,319\,\frac{c}{\Delta\nu_{Cs}}\,.$$

The effect of this definition is that one metre is the length of the path travelled by light in vacuum during a time interval with duration of 1/299 792 458 of a second.

The kilogram

The ampere

21:34
06/10/2019

Nello stage di fisica organizzato da AIF sezione di Settimo Torinese a Torgnon e rivolto ad allievi meritevoli e interessati alla fisica esiste un tavolo di lavoro

FISICA IN CUCINA

ove, tra l'altro, si svolgono esperienze con il forno a microonde.

L’attività si svolge a gruppi di 7-8 studenti sotto la supervisione di docenti e studenti universitari.
La metodologia seguita è far scoprire agli studenti proprietà fisiche attraverso esperimenti guidati da schede stimolo predisposte dai docenti

In uno degli esperimenti si misura la lunghezza d'onda di un'onda stazionaria creata in un forno a microonde di una radiazione elettromagnetica di frequenza nota: spazio e tempo sono infatti le due grandezze fisiche che intervengono in ogni misura di velocità.

Perché i forni a microonde sono dotati di un piatto rotante?

……

Distribuite sul fondo della teglia messa al posto del piatto rotante un leggero strato uniforme di formaggio (parmigiano o sottilette) e mettete in funzione il forno per poco tempo.

Che cosa osservate?……

Quale tipo di campo elettromagnetico c'è all'interno del forno? ……

A quali punti corrispondono i punti caldi e freddi?……

Misurate le distanze tra due punti in cui i formaggio è fuso e fatene la media aritmetica.

Cosa rappresenta il valore ottenuto?

……

L’obiettivo è far riconoscere agli studenti che l’onda è stazionaria e che i punti in cui il formaggio fonde sono due ventri consecutivi dell’onda e distano perciò $\frac{\lambda}{2}$

Leggendo poi sul retro del forno a microonde la frequenza (pari nel nostro caso a 2450 MHz) si può ricavare il valore della velocità della luce:

0,12* 2,450*10^6= 294000000 m/s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Introduction
Definition of the SI
SI base units
SI prefixes
The 2018 revision of the SI
How to realize the SI units
SI Brochure
History
In the 2018 revision of the SI, the definitions of four of the SI base units – the kilogram, the ampere, the kelvin and the mole – were changed. Their new definitions are based on fixed numerical values of the Planck constant (h), the elementary charge (e), the Boltzmann constant (k), and the Avogadro constant (N_A), respectively.
Further, the definitions of all seven base units of the SI are now uniformly expressed using the explicit-constant formulation. Specific mises en pratique have been drawn up to explain the realization of the definitions of each of the base units in a practical way.
The new definitions came into force on 20 May 2019.
Resolution 1 of the CGPM (2018): On the revision of the International System of Units (SI)
YouTube
Connect to the BIPM's YouTube channel to watch a recording of the live open session of the 26th General Conference on Weights and Measures which took place on 16 November 2018:
https://www.youtube.com/thebipm
FAQs about the revision of the SI, that came into force on 20 May 2019
Information for users about the revision of the SI
SI roadmap (updated 2018)
Resolution 1 of the CGPM (2014): On the future revision of the International System of Units, the SI
Resolution 1 of the CGPM (2011): On the possible future revision of the International System of Units, the SI
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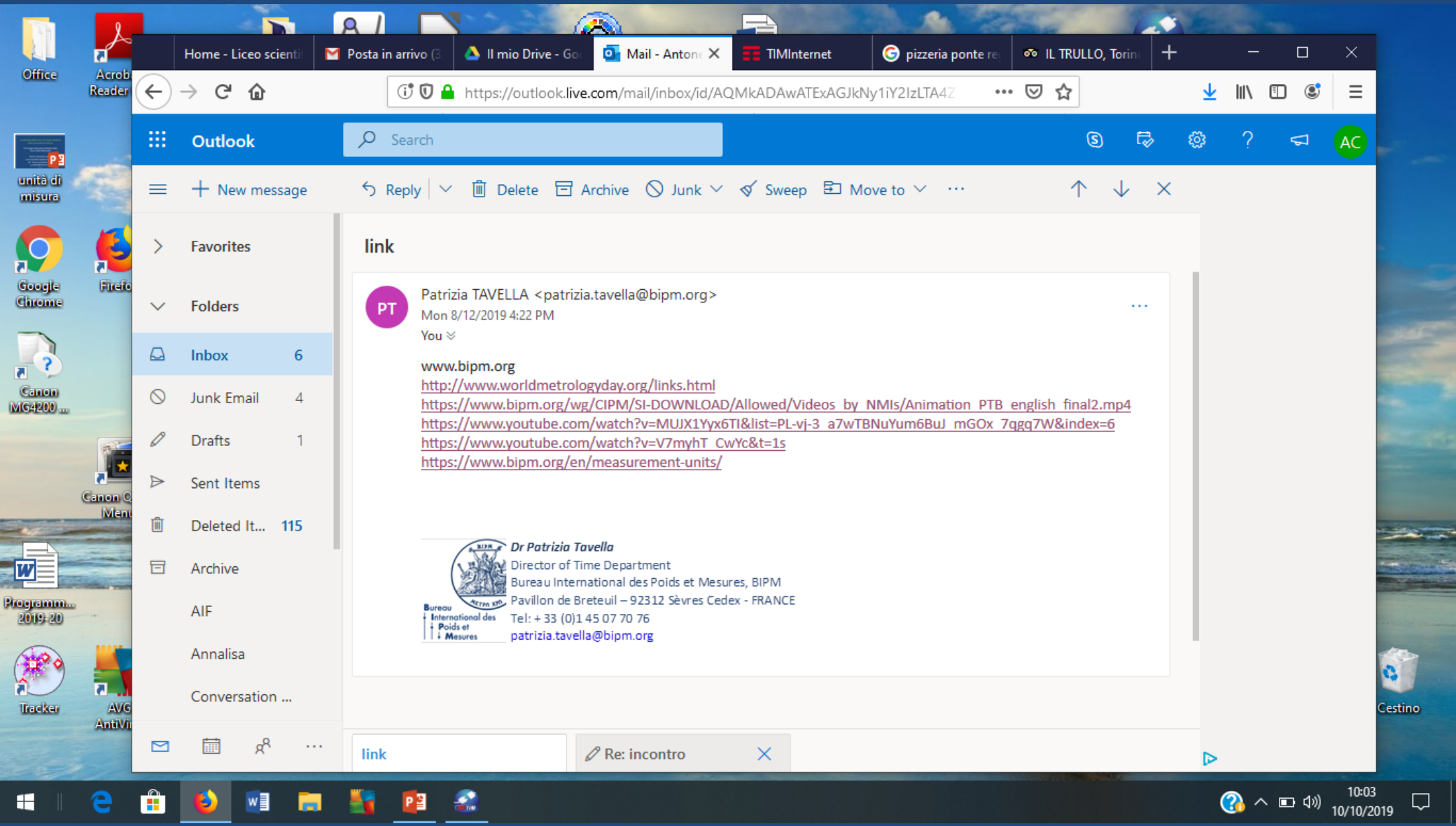
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