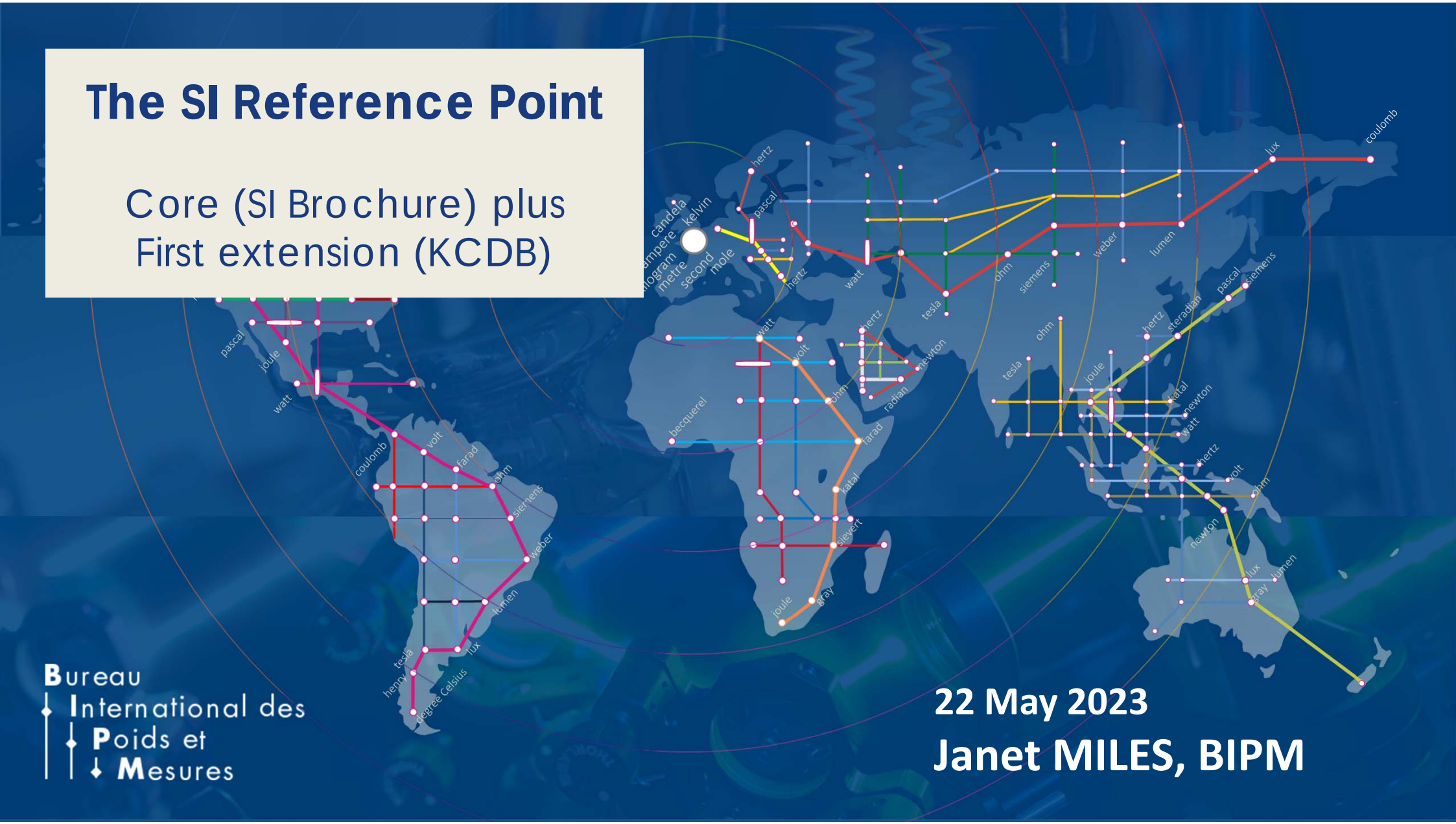
The SI Reference Point

Core (SI Brochure) plus
First extension (KCDB)



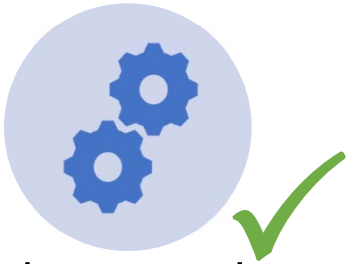
Bureau International des Poids et Mesures

22 May 2023

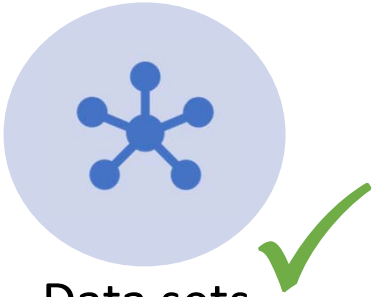
Janet MILES, BIPM

SI Reference Point

What is included? SI base units, derived units, prefixes, defining constants



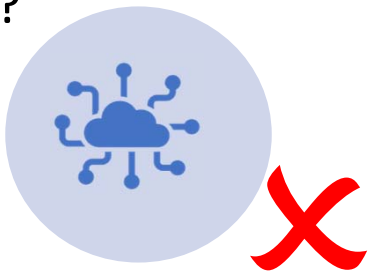
Machine-machine interactions



Data sets

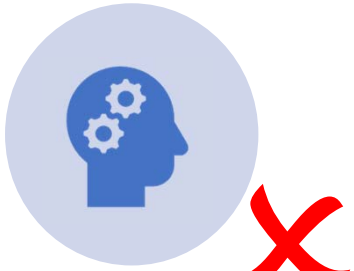
Digital Calibration Certificates

What is not?



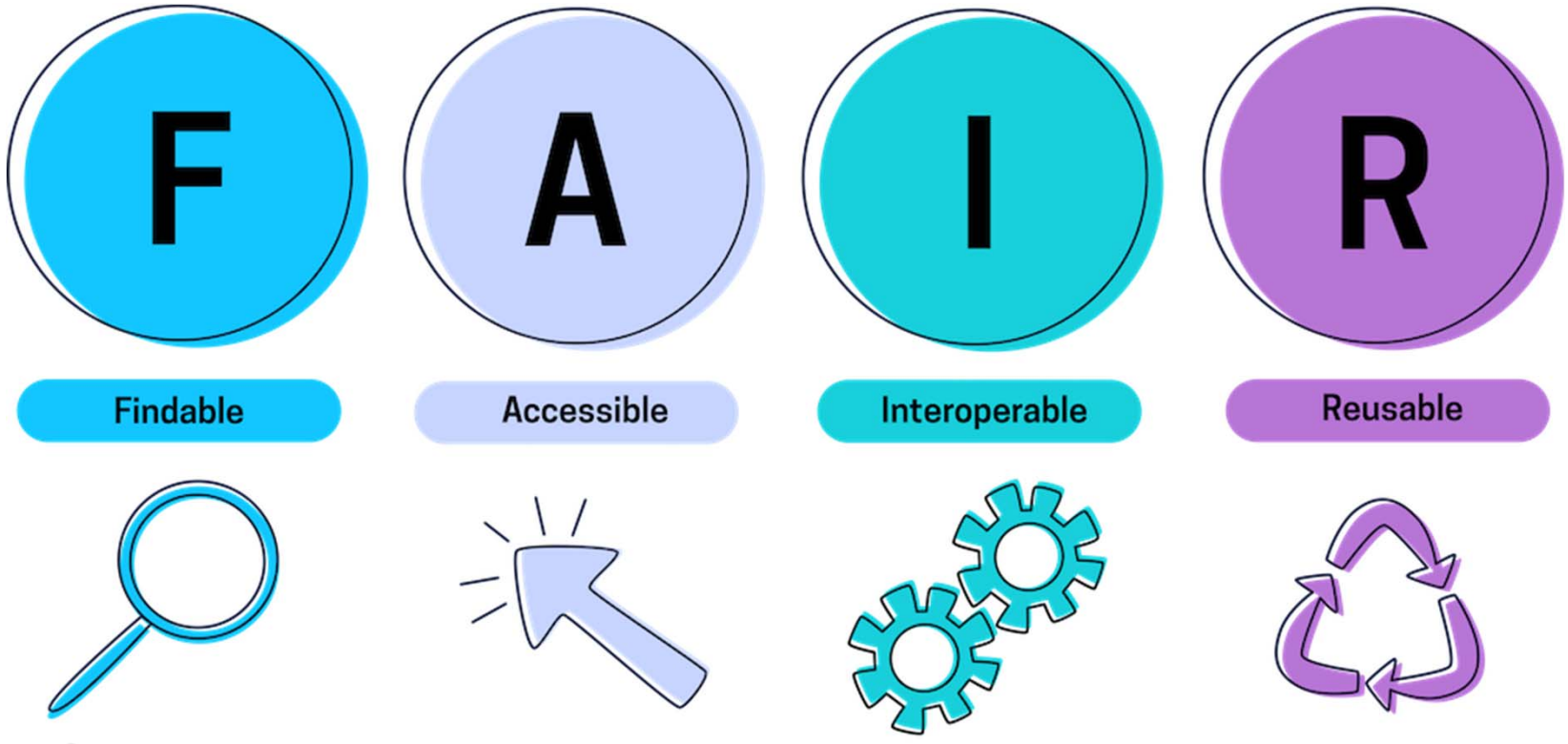
Blockchain

Big Data



Artificial intelligence

How to achieve the goals set

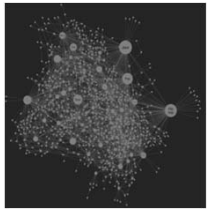


[1] https://www.go-fair.org/fair-principles/

Tools

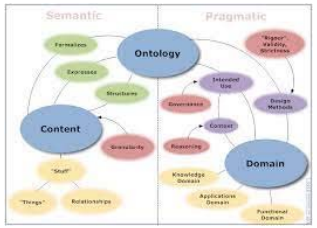
It's all about identifiers

XML



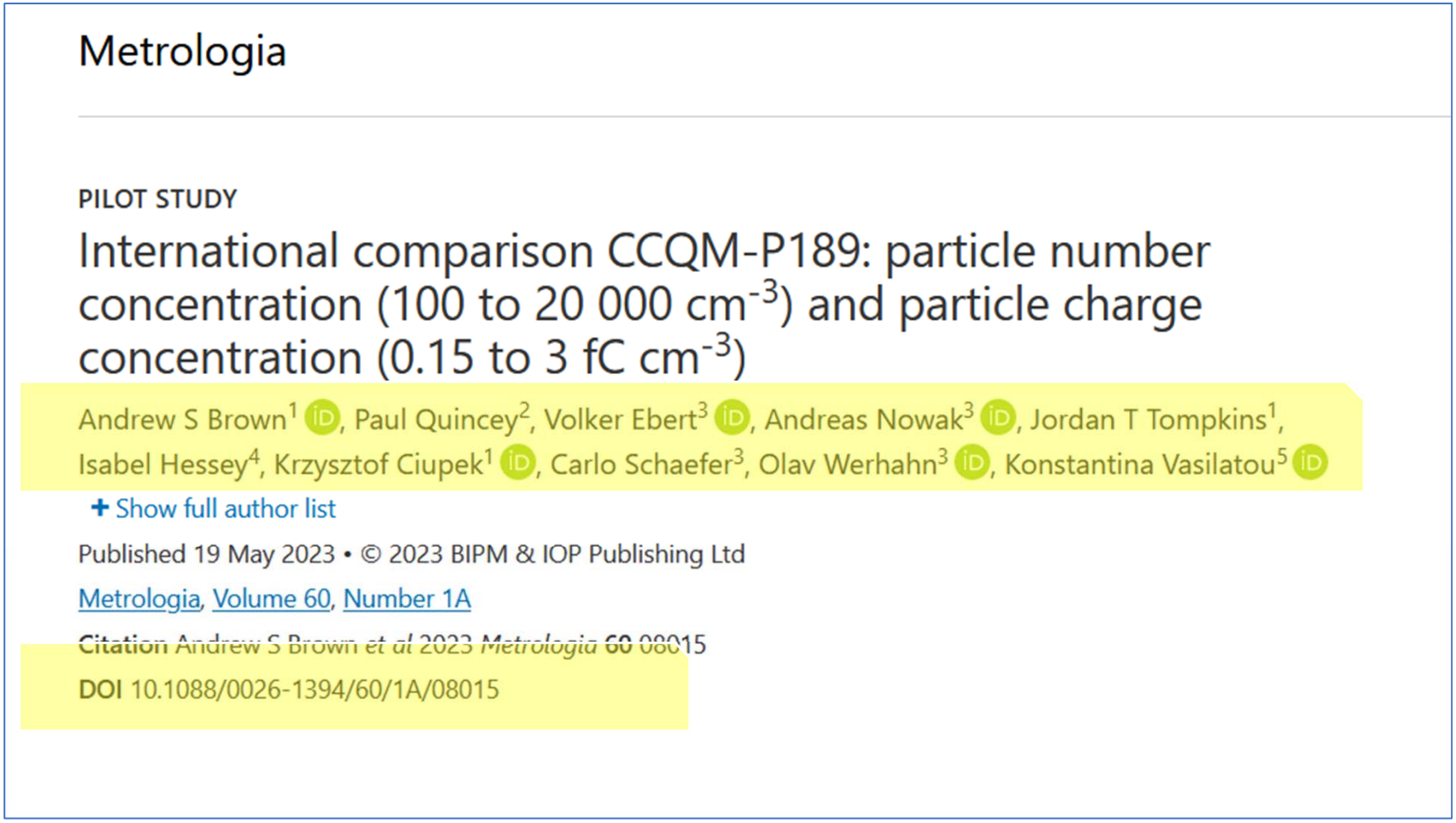
Knowledge Graph

JSON



Ontology

Some familiar digital identifiers: DOIs and ORCiDs



Metrologia

PILOT STUDY

International comparison CCQM-P189: particle number concentration (100 to 20 000 cm^{-3}) and particle charge concentration (0.15 to 3 $fC\ cm^{-3}$)

Andrew S Brown[1], Paul Quincey[2], Volker Ebert[3], Andreas Nowak[3], Jordan T Tompkins[1], Isabel Hessey[4], Krzysztof Ciupek[1], Carlo Schaefer[3], Olav Werhahn[3], Konstantina Vasilatou[5]

+ Show full author list

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Metrologia, Volume 60, Number 1A

Citation Andrew S Brown *et al* 2023 *Metrologia* **60** 08015

DOI 10.1088/0026-1394/60/1A/08015

The Interoperability Plane: Interoperability and Reusability

Units

Quantities

Constants

International vocabulary

SI

BIPM core references

VIM

SI Brochure

GUM

The Interoperability Plane: Interoperability and Reusability

Units

Content

Units

- Symbol
- Definitions (of SI base units (EN/FR)
- Validity dates of definition
- Defining CGPM Resolutions

Prefixes

- Symbol
- Multiplication factor

Status

- Advanced prototype available
- Being tested together with other modules

BIPM core references

VIM

SI Brochure

GUM

The Interoperability Plane: Interoperability and Reusability

Units

```
1107  ###  http://si-digital-framework.org/SI#second1967
1108  SI:second1967 rdf:type owl:NamedIndividual ,
1109                         SI:Definition ;
1110                  SI:hasDefiningAuthority <http://si-digital-framework.org/SI#13th_CGPM> ;
1111                  SI:hasDefiningText "La seconde est la durée de 9 192 631 770 périodes de
1112                                     "The second is the duration of 9192631770periods of th
1113                  SI:hasEndValidity "2019-05-19"^^xsd:date ;
1114                  SI:hasStartValidity "1967-05-20"^^xsd:date .
1115
1116
1117  ###  http://si-digital-framework.org/SI#second2018
1118  SI:second2018 rdf:type owl:NamedIndividual ,
1119                         SI:Definition ;
1120                  SI:hasDefiningAuthority <http://si-digital-framework.org/SI#26th_CGPM> ;
1121                  SI:hasDefiningText "La seconde, symbole s, est l'unité de temps du SI. El
```

Prototype

BIPM core references

VIM

SI Brochure

GUM

Application to the KCDB

Current response

```
12  'quantityValue': 'Temperature',
13  'cmc': {
14      'lowerLimit': 961.78,
15      'upperLimit': 961.78,
16      'unit': '°C'},
17  'cmcUncertainty': {
18      'lowerLimit': 0.09,
19      'upperLimit': 0.09,
20      'unit': '°C'},
21  'cmcBaseUnit': {
22      'lowerLimit': 1234.9299999999998,
23      'upperLimit': 1234.9299999999998,
24      'unit': 'K'}
25  'cmcUncertaintyBaseUnit': {
26      'lowerLimit': 273.23999999999995,
27      'upperLimit': 273.23999999999995,
28      'unit': 'K'}
29  'confidenceLevel': 95.0,
30  'coverageFactor': 2.0,
```

https://www.bipm.org/kcdb/

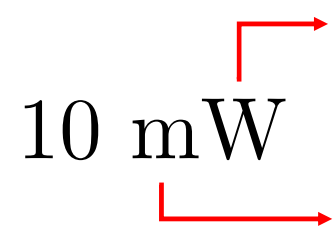
Machine-actionable response

Replace units expressed in **strings** (not machine-actionable) by identifiers from the **SI Reference Point**

```
463  ###  http://si-digital-framework.org/SI#degree_Celsius
464  SI:degree_Celsius rdf:type owl:NamedIndividual ,
465                               SI:SIUnitSpecialName ;
466                    SI:hasSymbol "°C"^^xsd:string .
467
```

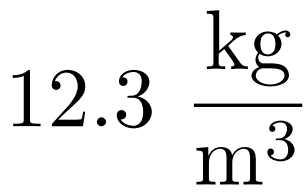
First extension: to cover the CC Service Categories

Identifiers for “compound” measurement units



http://si-digital-framework.org/SI/unit#watt

http://si-digital-framework.org/SI/prefix#milli



http://si-digital-framework.org/SI/unit#kilogram

http://si-digital-framework.org/SI/unit#metre …..

Calibration certificates

CIPM MRA Logo and statement

France, LNE-LCM/Cnam (Conservatoire National des Arts et Métiers/Laboratoire Commun de Métrologie)

Items for defining ITS-90 , Temperature : **660.323 °C**
Aluminium for SPRT
Absolute expanded uncertainty : **2.4 mK**
Comparison with a cell
Pressure-controlled heat pipe furnace Service provided by the LNE-INM
Approved on 18 May 2004
Institute service identifier : CMT

[5] Appendix A of CIPM MRA-P-11
https://www.bipm.org/en/cipm-mra/cipm-mra-documents

Summary

- Techniques from the semantic web allow us to make data **machine readable / actionable (FAIR)**
- BIPM is committed to providing a digital **SI Reference Point**
- An **advanced prototype** of the SI Reference Point has been developed
- A **testbed** for the SI Reference Point (producing HTML and JSON outputs) will be tested by the CIPM Expert Group before being released to the community for beta-testing
- The BIPM will work with the CCs to extend the core SI Reference Point to cover the CMCs (units and kinds of quantity) included in all the Service Categories defined by the CCs in the CIPM MRA


THANK YOU
Happy to answer any questions!
Bureau International des Poids et Mesures
Janet MILES, BIPM