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Using the rules of nature to create the rules of measurement

The International System of Units (SI) is the accepted set of units for all applications of measurement worldwide. Since it was first given the name SI nearly 60 years ago, improvements have been agreed to it whenever it has been possible to exploit advances in measurement technologies to address new requirements.

In November 2018, the General Conference on Weights and Measures is expected to agree one of the most significant changes to the SI which will base it on a set of definitions each linked to the laws of physics. This historic change towards using the laws of nature in the definitions will eliminate the final link between the SI and definitions based on physical artefacts. Following the revisions, the kilogram will be linked to the exact value of the Planck constant rather than the International Prototype of the Kilogram, as sanctioned by the 1st CGPM in 1889.

For over 200 years, a collective ambition for the “metric system” has been to provide universality of access to the agreed basis for worldwide measurements. The definitions expected to be agreed in November will be a further step towards this goal. They are based on the results of research into new measurement methods that have used quantum phenomena as the basis for standards that are fundamental. Great attention has been paid to ensure that these new definitions will be compatible with the current ones at the time the change is implemented. The changes will be unnoticeable to all but the most demanding users.

Whilst providing the necessary level of continuity for existing users, the changes have the advantage of being able to embrace future improvements in measurement methods to meet the needs of future users because they are based firmly on the laws of physics. The new definitions will use ‘the rules of nature to create the rules of measurement’ linking measurements at the atomic and quantum scales to those at the macroscopic level.

As science and technology progress, the demands for measurements to underpin new products and services will increase. Metrology is a dynamic branch of science and the steps taken by the BIPM and the wider metrology community to advance the SI in 2018 will underpin these requirements and meet these needs for many years to come.