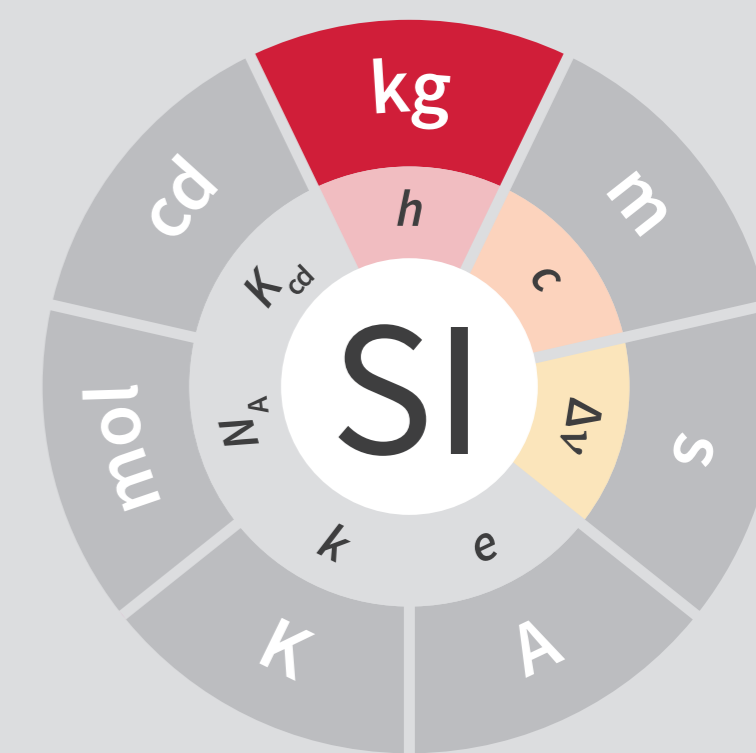


mass measurement kg kilogram



Mass measurement matters

Measurements of mass are important in lots of areas of science and engineering:

- When making up 'recipes' not just for food, but for the manufacture of pharmaceutical drugs, plastics, composites and metals.
- At the heart of measurements of force and torque – such as measuring the thrust of a rocket engine or the torque of a motor.
- Critical in chemistry when preparing new compounds.
- To measure liquid densities which are used to work out the composition of liquid mixtures, e.g. sugar and water.

Measurement of mass

The gravitational force on an object is proportional to its mass. Measurements of the mass of an object are often made by comparing the gravitational force on the object with the gravitational force on a standard object of known mass.

At home and in school, the extension (or compression) of a spring can be used. Alternatively, a 'beam balance' or strain gauge are used.

The most accurate way to measure mass uses an electromagnet in a Kibble balance.

Spring balance



Beam balance



Strain gauge



Definition

The SI base unit for mass, the kilogram, is defined in terms of three fundamental constants

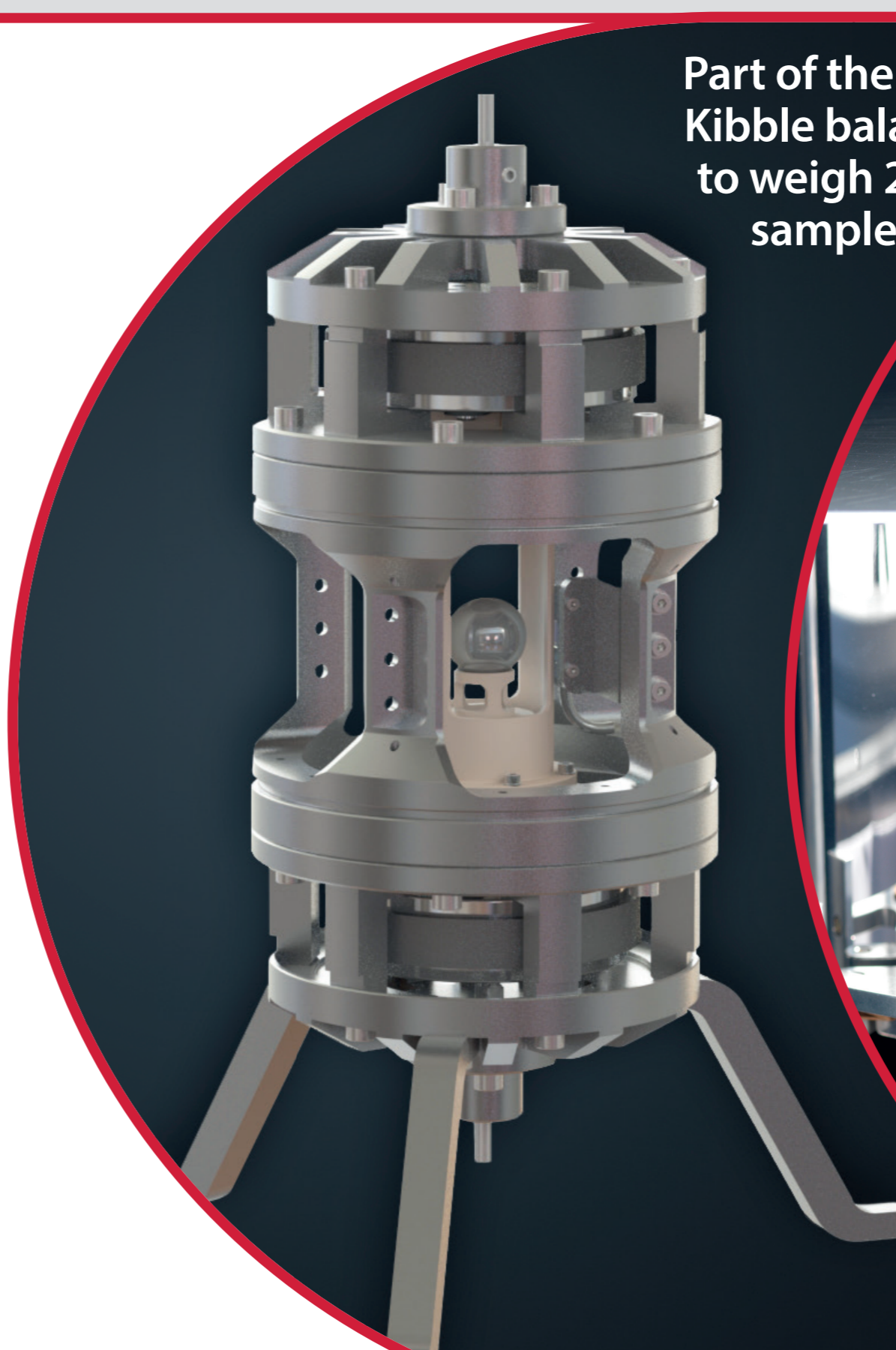
- $\Delta\nu$
- c
- h

We can make standard mass measurements in two ways, both of which rely on these three constants.

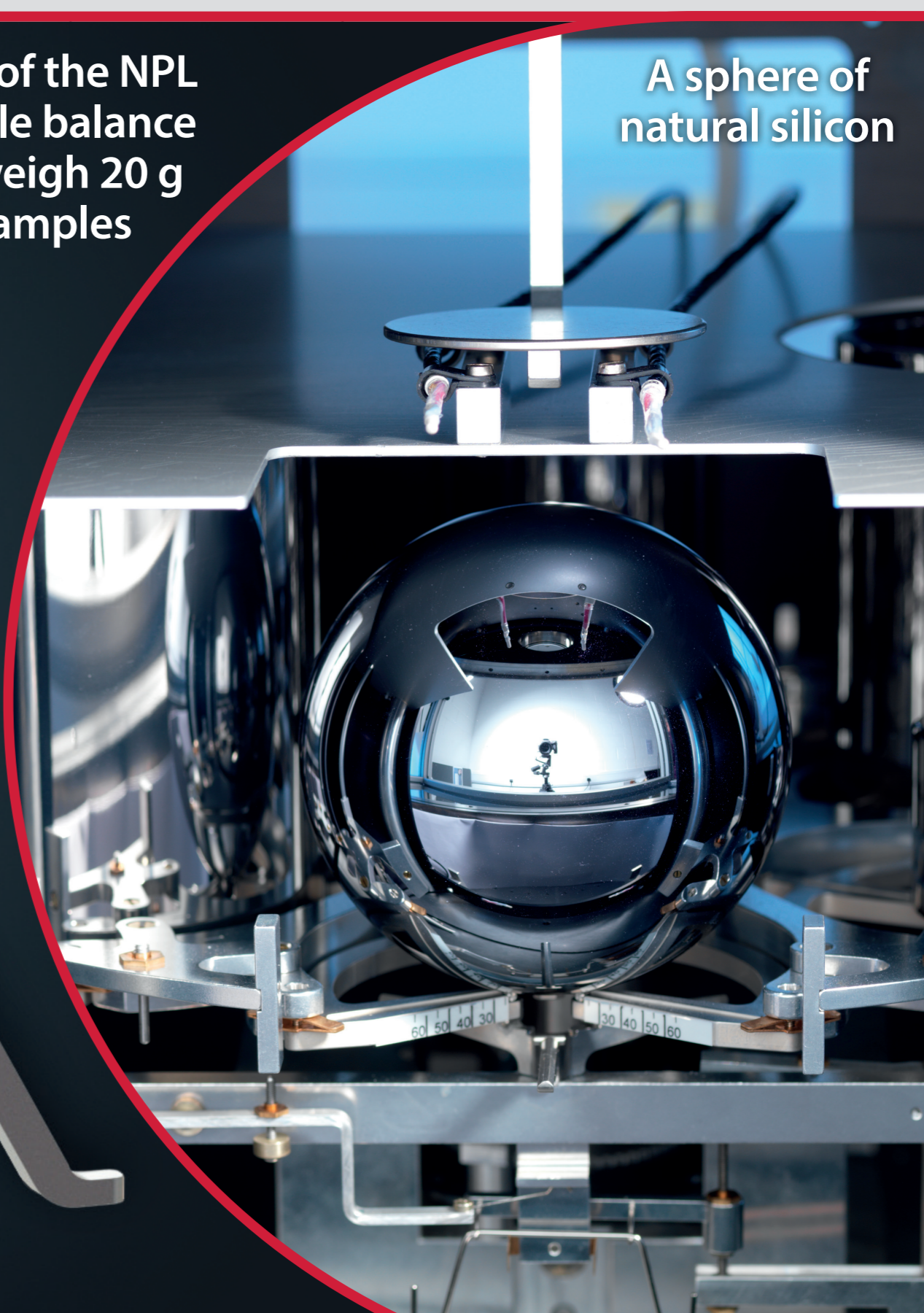
- (1) make a special spherical mass of silicon-28 atoms which we know has a mass of 1 kilogram because we have counted the atoms in it. This pure silicon object costs around a million pounds!
- (2) use a Kibble balance, which balances the gravitational force on an object placed inside it with force from an electromagnet. The force can then be very accurately determined by measuring current and voltage.

Both techniques require special laboratories and are used to make master mass standards which are used to check that scales and balances used throughout the world are working correctly.

Part of the NPL Kibble balance to weigh 20 g samples



A sphere of natural silicon



Did you know?

A litre of cold water has a mass of almost exactly a kilogram and a cubic metre of water has a mass of almost exactly a tonne.

In shops, solids are sold by mass, liquids by volume and ice-cream by both.

Second edition

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