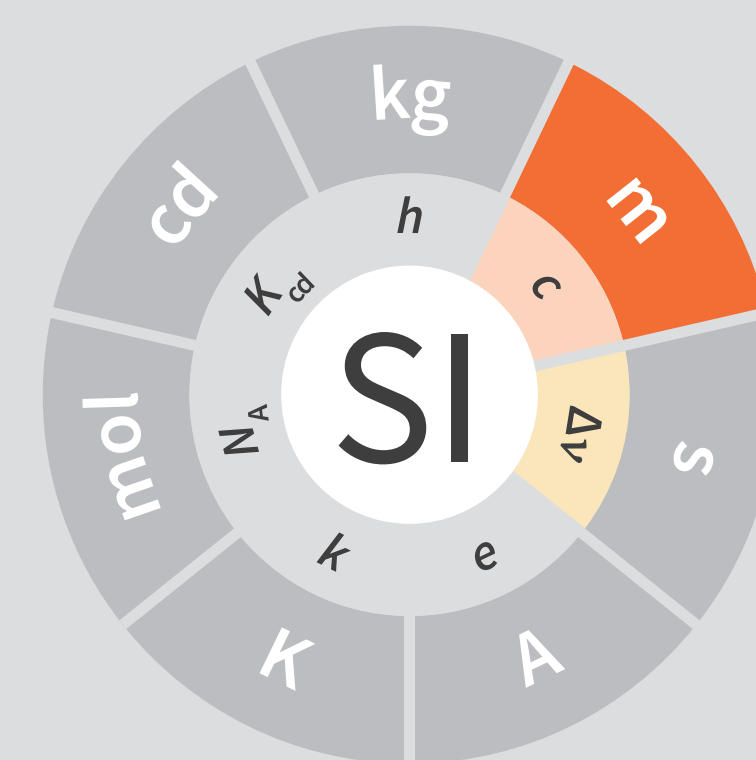


length measurement **m** metre



Length measurement matters

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

- In all aspects of manufacturing – ensuring that parts made at different times and in different places fit together.
- To work out speeds and accelerations.
- Critical in designing and building optical devices and lasers.
- 3-D shape and form are critical for aerodynamics.

Measurement of length

Measurements of length are made by comparing a distance against a standard length.

Most measurements in laboratories, homes and factories use a ruler as the standard length.

More accurate measurements are made using callipers and micrometers (in this case, pronounced mi-CROM-eeters not micro-MEE-ters!).

Many factories use standard gauge blocks to check micrometers and callipers.

The most accurate measurements are made using the wavelength of laser light as a standard length.

Instruments called interferometers count the number of wavelengths between two positions.

Because the wavelength of light is very small (typically 0.0006 mm), interferometers can make length measurements with very low uncertainties.



Definition

The SI base unit for length, the metre, is defined in terms of two fundamental constants

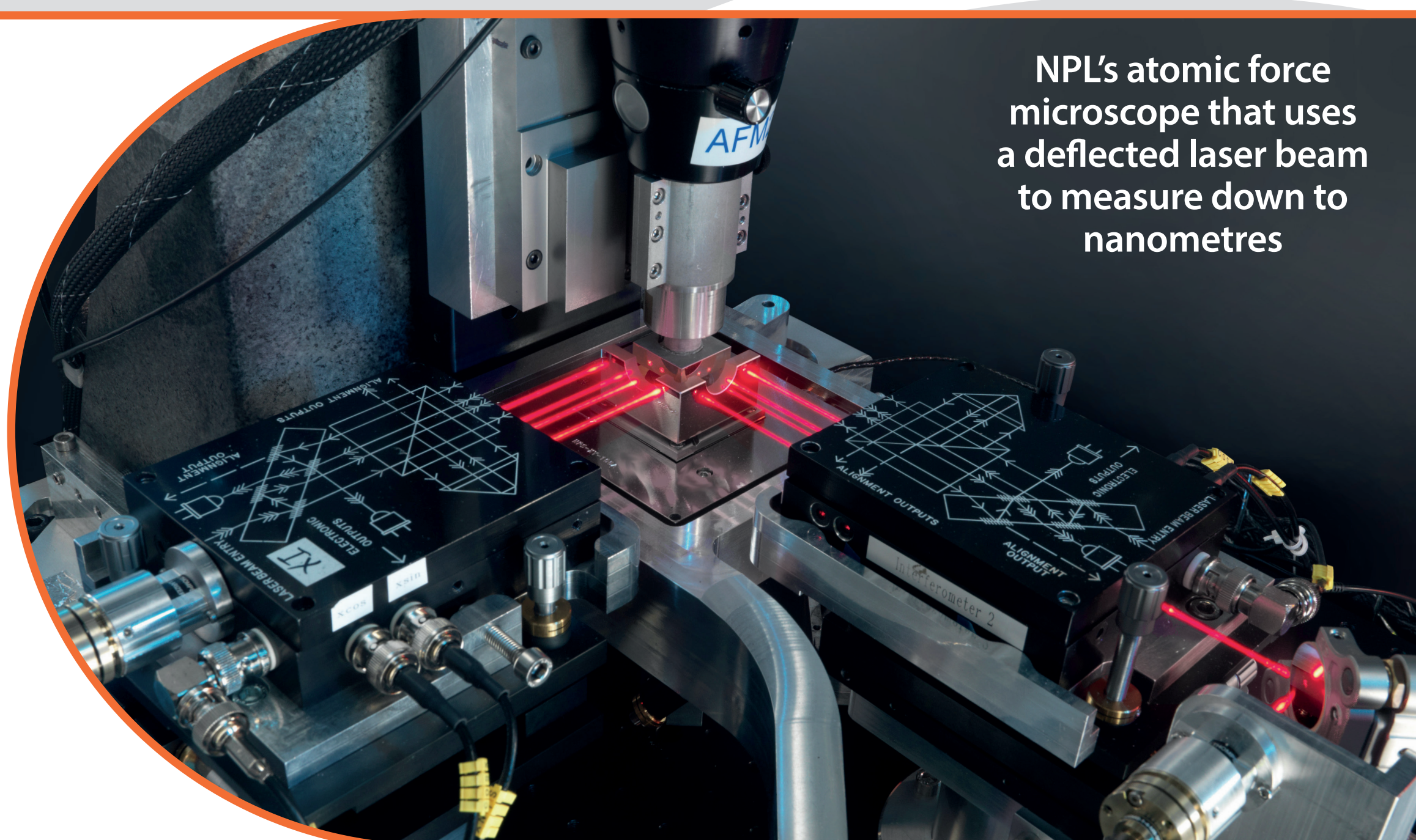
- $\Delta\nu$
- c

Fundamentally, we define a metre in terms of the distance light travels in vacuum in a certain time

$\frac{1}{299\,792\,458}$ seconds.

To use this definition to make 1 metre in practice, we need to know the frequency of the light we are using – and this tells us the wavelength of the light.

We can then use interferometers to calibrate micrometers, callipers, gauge blocks and rulers.



NPL's atomic force microscope that uses a deflected laser beam to measure down to nanometres

Did you know?

The Large Hadron Collider, which detected the Higgs boson particle, is installed in 30 km of underground tunnels. To make it work, the steering magnets must be positioned to an accuracy of 100 μm (two hair widths) every 100 m.