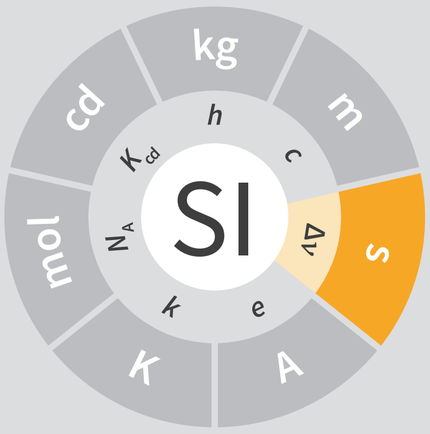
time measurement

s

second



Time measurement matters

Measurements of time are important in lots of areas of science and engineering.

Time is the physical quantity which we can measure with the highest resolution.

Measurements of the time of flight for light pulses is used by LIDAR systems in games machines and cars to detect how far away objects are in front of them.

The time of flight of pulses of ultrasound are used to detect the distance to objects in parking sensors.

Accurate measurements of time are important for the internet to function properly – and to avoid fraud when trading over the internet.

Satellite navigation systems exploit super-accurate clocks on board a fleet of satellites orbiting the Earth.

Measurement of time

Measurements of time are made by comparing an elapsed time against the number of ticks from a standard oscillator.

Historically, we used the length of a day and a year as our standards – and we used mechanical oscillators (pendulums and oscillating springs) to measure shorter times.

We then used the oscillations of quartz crystals shaped like a tuning fork. These are still widely used inside many clocks and watches.

Eventually, we learned how to make oscillators that linked to oscillations of atoms – these oscillations are very reproducible.

Definition

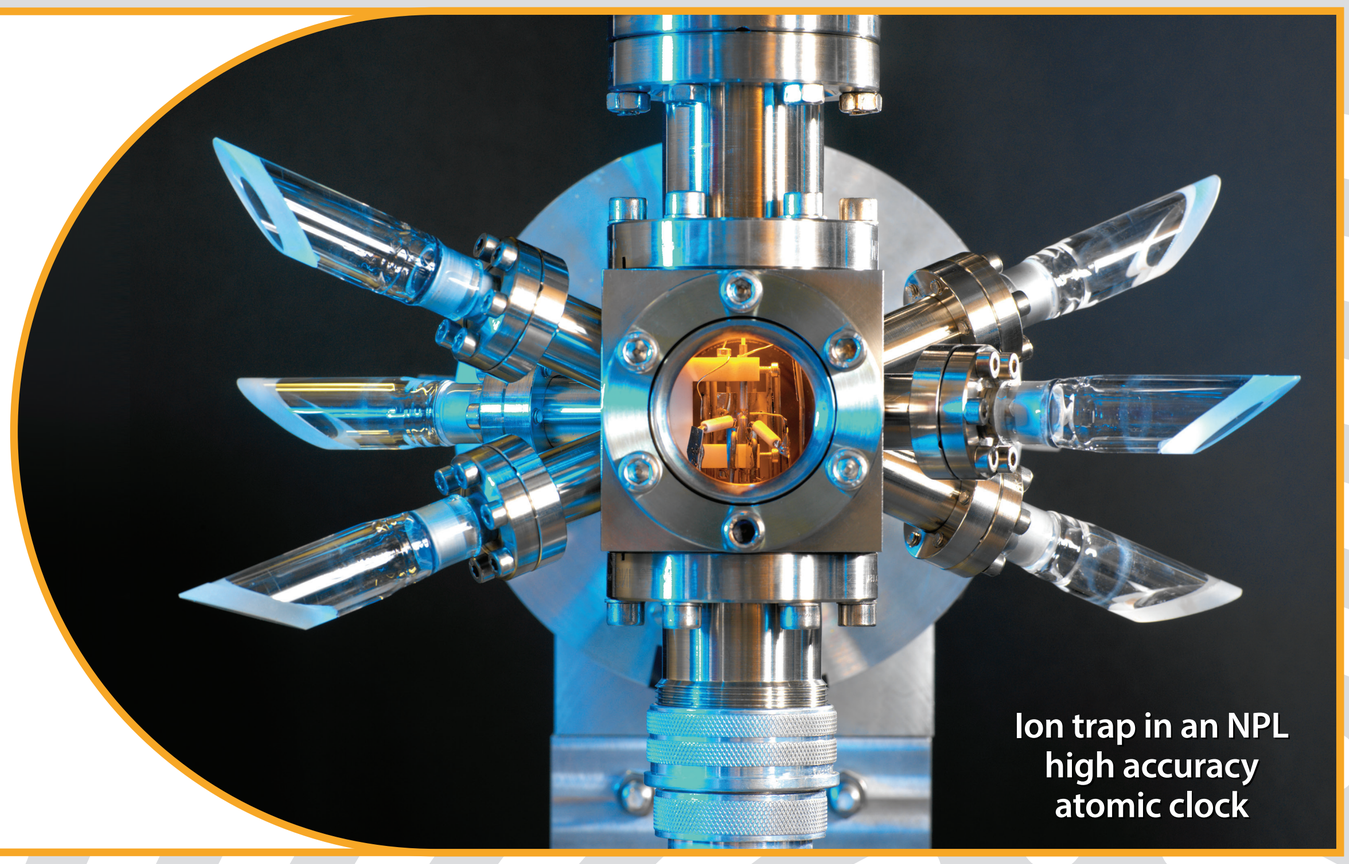
The SI base unit for time, the second, is defined in terms of one fundamental constant

- $\Delta\nu$

Fundamentally, we define a second as the period of time in which microwave radiation which is absorbed by caesium atoms oscillates exactly 9 192 631 770 times.

To create an atom clock like this, we use a gas of caesium atoms where the atoms are moving very slowly, and then tune a microwave oscillator until its radiation is absorbed by the atoms. Then we count 9 192 631 770 of these oscillations to make one second.

We then use this clock to keep all the other clocks in the UK 'on time'.



Ion trap in an NPL high accuracy atomic clock

Did you know?

NPL built the first accurate caesium atomic clock in 1955.

NPL is building clocks which will be accurate to about 1 picosecond per day.

Fibre optic cables carry time signals from NPL's atomic clocks to financial institutions in the City of London.

NPL

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