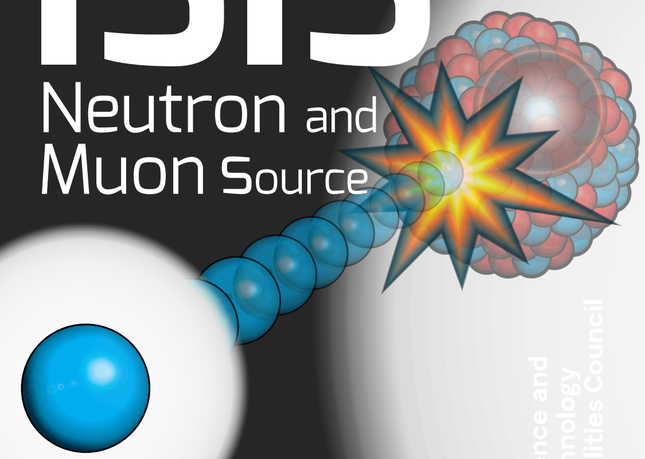
ISIS
Neutron and Muon Source



At ISIS, beams of neutrons and muons are produced that allow scientists to study materials at the atomic level.
ISIS is used to study areas as diverse as clean energy, medicine, nanotechnology, engineering, archaeology and many others.

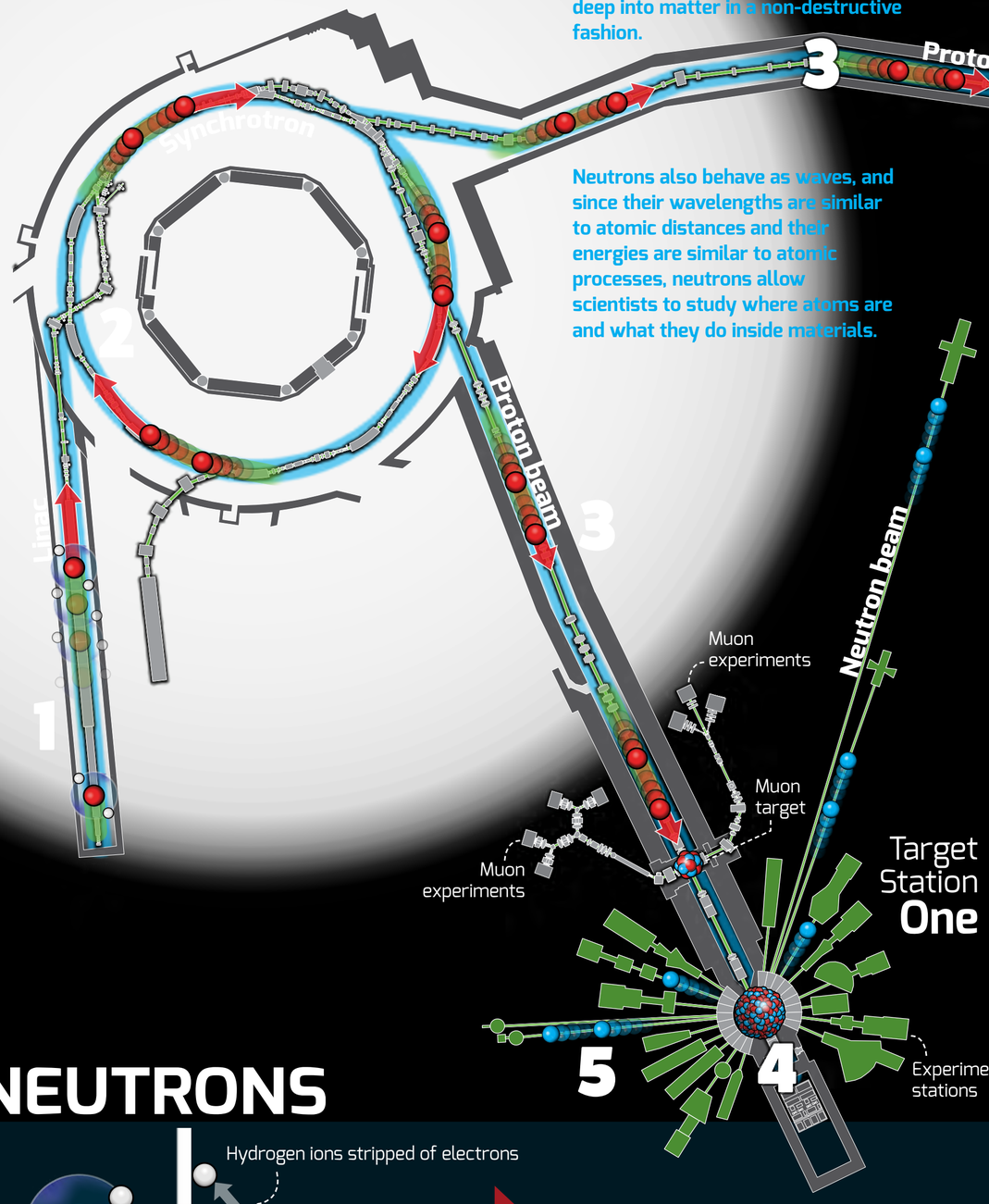
Science and Technology Facilities Council

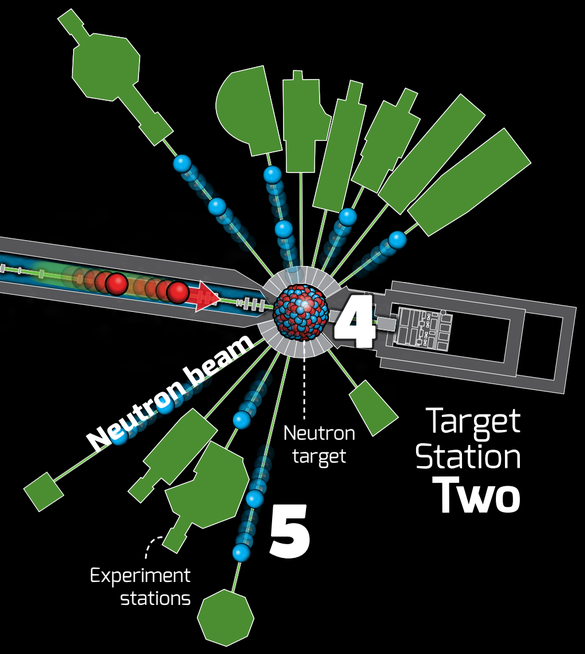
UKRI

Why use neutrons?

Because neutrons are neutral, they do not interact with charges within the atom. This allows them to penetrate deep into matter in a non-destructive fashion.

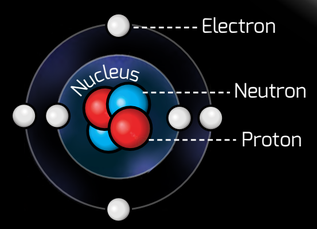
Neutrons also behave as waves, and since their wavelengths are similar to atomic distances and their energies are similar to atomic processes, neutrons allow scientists to study where atoms are and what they do inside materials.



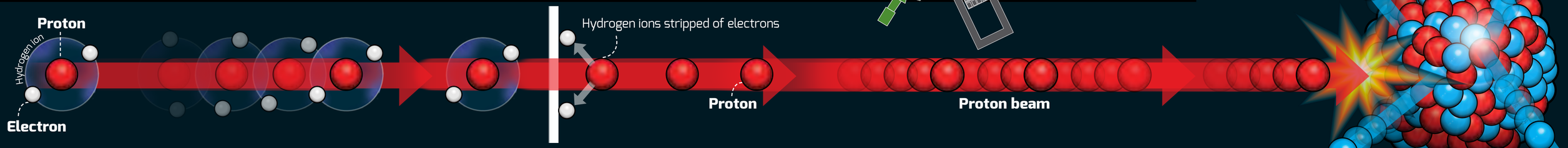


What is a neutron?

Neutrons are subatomic particles, tightly bound together with protons in the nucleus at the centre of an atom. They have about the same mass as a proton and, unlike protons and electrons, carry no charge so are neutral particles.



HOW ISIS MAKES NEUTRONS



1 The process starts in the ion source with the creation of negatively charged hydrogen ions (H-), made up of one proton and two electrons. Electric fields are used to focus, bunch and accelerate the H- ions. The linear accelerator (linac) accelerates the beam to 37% of the speed of light.

2 The ions pass through a thin foil made of carbon – this strips off the electrons, leaving protons. The proton beam enters the synchrotron. Electric fields accelerate the beam and magnetic fields focus and bend the beam. After 12,000 revolutions, the protons are travelling at 84% of the speed of light.

3 The proton beam is kicked out of the synchrotron by very fast magnets and directed down to the target stations. At each target station the proton beam collides with a neutron target, a block of tungsten the size of a house brick.

4 The high energy protons strike the tungsten target, driving neutrons from the nuclei of the tungsten atoms. This process is called spallation.
Each proton collision releases 15-20 neutrons from the target. This means 20,000 million million neutrons are produced every second.

5 The neutrons are directed to suite of scientific instruments, each optimised to explore different properties of materials.