

What is a synchrotron and how does it work?

A synchrotron works like a giant microscope, harnessing the power of electrons to produce a bright light that scientists can use to study anything from fossils to jet engines to viruses and vaccines.

The machine accelerates electrons to near light speeds so that they give off light 10 billion times brighter than the sun. These bright beams are then directed off into laboratories known as beamlines. Here, scientists use the light to study a vast range of subject matter, from new medicines and treatments for disease to innovative engineering and cutting-edge technology.

Diamond is one of the most advanced scientific facilities in the world, and its pioneering capabilities are helping to keep the UK at the forefront of scientific research.

- A The injection system** – the electron gun and the linac. The electrons which orbit around the storage ring and generate the light are initially produced by an electron gun. A linear accelerator (linac) is used to accelerate the electrons to nearly the speed of light.
- B Booster synchrotron** – the electrons are ejected from the linac into the booster synchrotron, where they follow a curved track. Magnets are used to curve the electrons round the bends in the ring, further accelerating their speed.
- C Storage ring** – the ring is not a true circle but is made of 50 straight sections angled together with bending magnets. When the electrons enter the storage ring, they are moving so

fast that they could travel around the entire world 7.5 times in one second. As the path of the electron beam is bent by the magnets, the electrons lose their energy in the form of light, which is then channelled into the experimental stations called beamlines.

- D Beamline** – each beamline is made up of an optics hutch, and experimental laboratory and a control cabin. The optics hutch houses devices to filter and focus the beam. The experimental hutch is where the experiment samples are targeted by the beam of light. In the control cabin, the scientific team can monitor the experiment, using powerful computers to gather data.

