How ISIS probes matter

Neutrons don’t carry an electrical charge so they are largely unaffected by the electrons that surround an atom’s nucleus. This allows them to penetrate deep into matter in a completely nondestructive fashion.

1. A beam of neutrons is fired at the object under study. The neutrons penetrate deep inside the sample where they strike the atoms and are deflected away and out into an array of detectors.

2. By recording the angles at which the neutrons fly out, scientists can create a diffraction pattern that reveals the sample’s structure by plotting the position of its atoms.

3. Also, by recording the energies that neutrons come out with, scientists can learn about how the atoms are moving and the forces between them.

ENGIN-X Putting stress to the test

ENGIN-X is a dedicated engineering science facility at ISIS designed to measure strains and stresses deep within a crystalline material – such as steel.

Using Engin-X to probe stresses and strains both inside, and externally influencing, engineering components helps us to understand how they behave in everyday use.

A diffraction pattern pinpoints the position of atoms with the sample. By plotting the movements of atoms as the sample is placed under stress, scientists can map those stresses in three dimensions – revealing the material’s strength and resistance to fracture and fatigue.

At rest

Distance between atoms when the sample is at rest

Under tension

The lattice behaves like a network of springs – when the sample is under tension, the distances between atoms increases

The change in the distance between atoms in the crystal lattice can be seen as shift of the diffraction pattern

Compression

When the sample is under compression, the distance between atoms decreases

The change in the distance between atoms in the crystal lattice can be seen as shift of the diffraction pattern