Looking inside the atom for new technologies

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Nuclear physics, which studies the huge variety of nuclei in all the matter that surrounds us, not only provides answers about the evolution of our universe, it also provides the underpinning knowledge needed to exploit nuclear properties in new technologies.

A new report launched by the Institute of Physics (IOP), *Nuclear physics and technology - inside the atom*, explains how Rutherford's discovery of the atom at the University of Manchester in 1911 led to improvements in healthcare, energy provision, national security and inspired thousands of students to take up science.

Modern healthcare offers many examples of widely used technologies that have nuclear physics at their core. In medical diagnosis, it was nuclear physicists' discovery of short-lived isotopes and the kind of radiation that these isotopes emit that began a new era in medical imaging.

Progress in imaging continues as the prospect of three-dimensional images of, for example, blood flow in the heart and brain begin to be available through a technique called single photon emission computed tomography. The technique involves detecting gamma rays emitted from radioactive tracers at all angles - a nuclear physics detection technique adapted for hospitals.

Nuclear physics research and technology also promise methods for the treatment of diseases such as cancer. There is growing application of particle beams that can be aimed directly at a target tumour. The beams

are sculpted in both shape and energy to ensure their particle energy is deposited on the tumour, leaving the surrounding healthy tissue unaffected.

Just as peering inside the atom led to pioneering new techniques for healthcare, exploring this fundamental science will continue to offer novel methods for harnessing and understanding the powerful forces locked inside the nucleus, helping to generate an environmentally friendly source of energy.

Other applications of nuclear physics highlighted in the report include methods to transform nuclear waste into a harmless substance and, inspired by the high-energy acceleration experiments designed to inspect nuclei, a set of analytical tools for research manufacturing and environmental monitoring.

Dr Robert Kirby-Harris, chief executive at IOP, said: “The uncovering of the structure of atoms - the basic units of matter - as composed of clouds of electrons surrounding a central nucleus is one of the landmark 20th-century discoveries, underpinning modern healthcare, advanced materials and information technology.”

More information: Full copy of the report (PDF, 10 MB)

Provided by Institute of Physics