# Radiating Health: an alpha, Beta and Gamma of radionuclide imaging

## A talk by Dr Liz Parvin at The Adstock Science Club – Thursday 15th September, 2016

Medical physicists, biomedical engineers and clinical technologists are all directly involved with patients. Though sometimes unseen by patients, these professionals are all part of the team, including doctors, pharmacists and nurses, who support and care for the patients during their treatment.

But of course there are even more people involved behind the scenes. All the technologies used in the NHS have their origins in basic physics, engineering, computer sciences and maths. Transforming this knowledge from basic science into applied technology requires dedicated teams of physics and engineering academics working on healthcare-related research.

Dr Liz Parvin is one such physicist who has spent most of her academic life in this environment and has recently retired from full time lecturing at the Open University but still keeps herself occupied as a consultant as well as giving talks on her subject. The Adstock Science Club had the pleasure of having her present a talk – "Radiating Health: an alpha, Beta and Gamma of radionuclide imaging" which proved extremely interesting and enlightening.

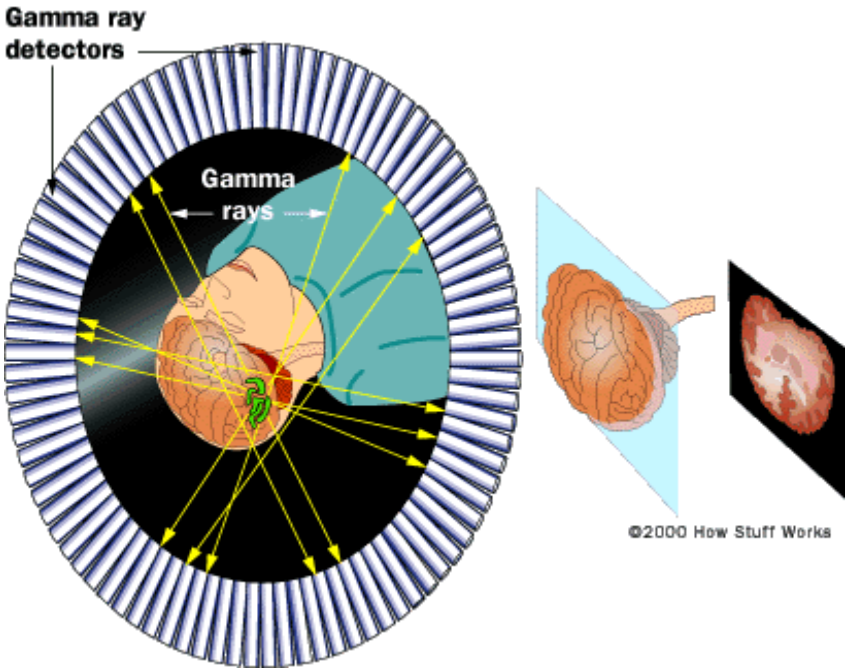
Before getting into the main part of her talk, Dr Parvin gave us a lesson in some basic physics and explained what constituted an Atom. She explained the meaning of the terms atomic weight and atomic number and how one element can exist as different isotopes of the same element. Some of these isotopes are stable however others such as Tritium are unstable and decay giving off radiation.

There are essentially 3 types of radiation emitted by radioactive elements, these are termed Alpha, Beta and Gamma. The Alpha particles being essentially Helium nuclei, 2 protons and 2 neutrons, the Beta particles are fast moving electrons and Gamma rays are extremely high energy photons. These different kinds of radiation can be used for different purposes where medical diagnosis is concerned. The Alpha particles can only penetrate a very short distance into an obstacle and in fact will be stopped in its tracks by, for instance your skin, whereas Beta particles will penetrate a short distance further, Gamma rays on the other hand penetrate just about anything.

Dr Parvin explained that there were in fact two types of Beta decay possible the first being Beta Plus which is the normal emission of an electron by a decaying atomic nucleus. The second type of decay is named Beta minus, this is where a nucleus emits a positron, the stuff of Science Fiction which as some of you may know powers the Starship Enterprise across the Galaxy on its mission "to find new worlds, seek out new civilisations and to boldly go where no man/one has gone before". This second type of Beta decay is used in Positron Emission Tomography or PET scanners.

In her talk, Dr Parvin covered the role of radioactive materials in medicine especially in the imaging and diagnoses of various ailments and covered some of the equipment and technologies used in this process. She discussed how physicists, doctors, radiographers and technologists work together in the nuclear medicine team. They give the patient a short-lived radioactive tracer, usually by injection. She explained how this tracer is carefully chosen to minimise the patient's exposure to radioactivity and to target the body part under investigation. For example, to check brain function, they would choose a tracer containing a chemical used by the brain, such as oxygen or glucose.

The tracer is carried around the body in the bloodstream. Rays from the radioactive tracer pass out of the patient, specialised cameras can then detect the rays and convert them into a visual image. This allows the medical team to track how the tracer is moving around and being used by the body.




*The diagram on the left shows how a PET scanner operates. Positrons are created in the affected area following the injection of a suitable trace element and the resulting gamma rays from their collisions with normal matter are emitted in opposite directions from this location and can be pinpointed using information from the gamma ray detectors. This can be used to build up a detailed image of the area under consideration.*

Nuclear imaging techniques include the gamma camera, which is also used for Single Positron Emission Computed Tomography or SPECT imaging, and PET scanners.

Nuclear medicine images are different from other medical scans, such as X-rays or Magnetic resonance Imaging (MRI): they reveal how well the body is working, rather than just showing its structure.

Nuclear medicine scans can be combined with other scan types that show structural detail to produce images that are even more useful.