Nuclear physics promises earlier detection of brain tumors with just one scan

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Time taken to detect brain tumours could soon be significantly reduced thanks to an ongoing pioneering project led by the University of Liverpool with the Nuclear Physics Group and Technology departments at the Science and Technology Facilities Council (STFC) at Daresbury Laboratory. Project ProSPECTus is developing the technology for next generation SPECT (single photon emission computed tomography) imaging that is set to revolutionise the medical imaging process, improving future diagnosis of cancer and the probability of successful cancer therapy whilst enabling a higher throughput of patients in hospitals.

Project ProSPECTus is based on a form of imaging known as SPECT which detects gamma rays emitted by a tiny amount of a radioactive pharmaceutical which is injected into the body. SPECT is a widely used method of imaging in many areas of medicine providing 3D functional information about the body, which is typically presented as cross-sectional slices through the patient. It is most commonly used to test the functioning of the heart or for the detection of tumours. Conventionally, SPECT imaging uses what is known as an 'Anger Camera' which relies on a collimator, a filtering device with many small holes, which lets just some gamma rays through and relies on geometry to identify exactly where they are coming from in order to build a picture of a biological process happening inside the patient.

However, ProSPECTus has taken a fundamentally different approach and has developed its technology based on what is known as the

'Compton Camera'. This identifies the origin of the gamma rays without the use of a collimator, meaning that much less of the radiation used in the process is wasted, so the radiation is used more efficiently. It has not been possible to do this successfully before. However, using brand new, cutting edge detector systems, ProSPECTus is now building a prototype SPECT imaging system, using the Compton Camera principle, that is one hundred times more sensitive than existing clinical SPECT systems. This increased sensitivity offers two benefits- either the dose of radiation administered to the patient could be reduced or alternatively more patients could be scanned by one machine in a day if the current dose is used.

These new cutting edge detector systems, designed by the University of Liverpool's Nuclear Physics research group alongside the Nuclear Physics Group at STFC Daresbury Laboratory, are a direct spin out of AGATA (Advanced Gamma Tracking Array), a nuclear physics research and development project with the aim of building the next generation gamma-ray spectrometer. ProSPECTus is funded from STFC's Particle and Nuclear Physics Applied Systems (PNPAS) programme, a scheme aimed at exploiting techniques developed in blue-skies basic research projects like AGATA so as to generate knowledge exchange into the areas of health, security and energy applications.

Dr Andy Boston, the project spokesperson, at the University of Liverpool said: "Not only is ProSPECTus' technology a hundred times more sensitive than that of the traditional Compton camera, it is unique in that it will also be possible to operate it simultaneously with MRI (Magnetic resonance Imaging), which has never been an option due to the MRI's strong magnetic field. In fact, it will be possible to fit this SPECT system retrospectively to the 350 or so existing MRI scanners across the UK. For patients this means fewer appointments, earlier and more effective diagnosis of tumours, which means higher probability of effective treatment. The higher sensitivity camera also offers the scope

for shorter imaging time and lower doses of radiation, which is highly beneficial for patients who require frequent scanning. For clinicians, this means that more patients can be seen in a day. This is a truly collaborative effort between the Nuclear Physics Groups both at the University of Liverpool and STFC Daresbury Laboratory, working with STFC's Technology teams who will design and build the detector cryostat and with the essential support from Liverpool's Magnetic Resonance & Image Analysis Research Centre (MARIARC) who provide the MRI expertise."

Ian Lazarus of STFC's Nuclear Physics team at Daresbury Laboratory said: "ProSPECTus has taken the abilities of the Compton imager to a new level. This is a particularly exciting example of how technology emerging from one nuclear physics project, in this case, AGATA, can have a direct and positive impact on the future wellbeing of our society".

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