Latest advances in medical imaging for revolutionary proton therapy cancer treatment

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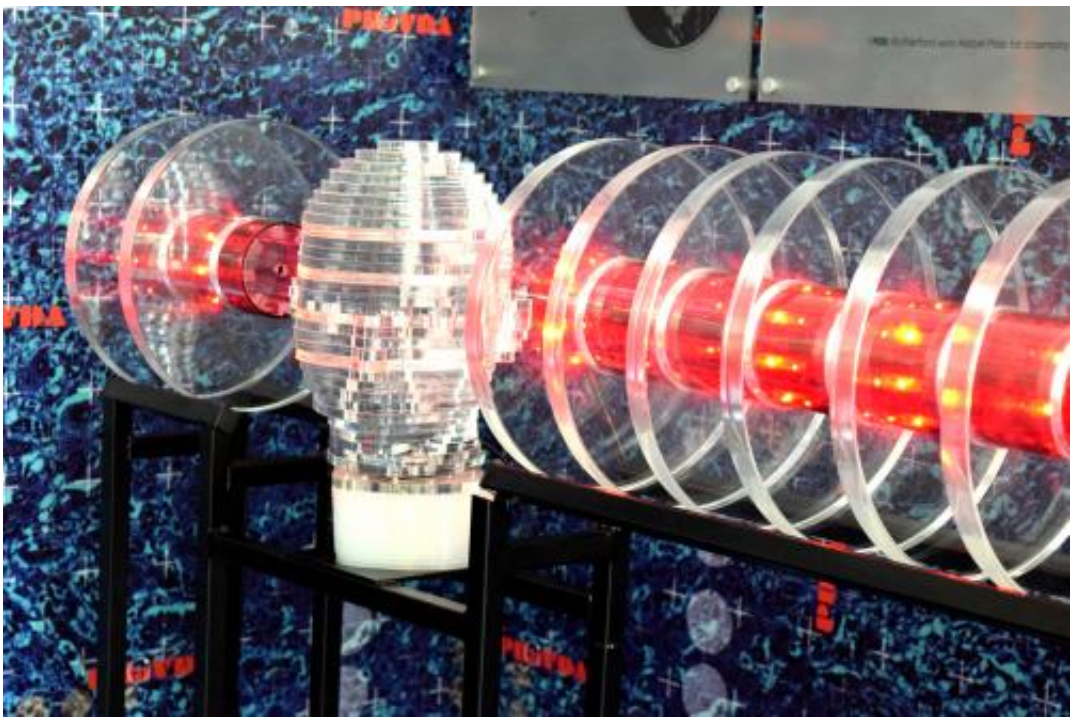

Visual of PRaVDA exhibit at Royal Society Summer Science Exhibition

Advances in medical imaging technology which could make proton beam therapy a viable treatment for many more cancer sufferers will be described on an international stage.

The University of Lincoln's Professor Nigel Allinson MBE will deliver

the keynote talk at the tenth International Conference on Position Sensitive Detectors. The conference, which takes place from 7th to 12th September 2014, features the latest developments in this field from leading researchers around the world.

Professor Allinson leads the pioneering PRaVDA (Proton Radiotherapy Verification and Dosimetry Applications) project. He and his multinational team are developing one of the most complex medical instruments ever imagined to improve the delivery of proton beam therapy in the treatment of cancer.

Proton beam therapy is a type of particle therapy that uses a beam of protons to irradiate diseased tissue. Proton beam therapy has the ability to deliver high doses of radiation directly to a tumour site with very little radiation being absorbed into healthy tissue.

PRaVDA, funded by a £1.6 million grant from the Wellcome Trust, will provide a unique instrument capable of producing real-time 3D images – a proton CT - of a patient, drawing data from the same protons used in the treatment itself.

The patent-pending technology, which uses detectors at the heart of the Large Hadron Collider at CERN alongside world-first radiation-hard CMOS imagers, will reduce dose uncertainties from several centimetres to just a few millimetres.

This promises to make proton therapy an option for thousands more cancer patients by reducing the risks of healthy tissue being damaged during treatment, particularly in vulnerable parts of the body such as the brain, eye and spinal cord.

Professor Allinson, who will also be talking about his research to prospective students at the University of Lincoln open day on Saturday,

20th September, said: "PRaVDA will ensure more difficult tumours will become treatable and more patients overall will be able to receive this revolutionary treatment."

Other members of the PRaVDA team will also present their work at the conference, describing in more detail the high-speed tracking technology that can record the paths of individual protons as they enter and leave a patient. The team will also outline how they make and test the new detectors in PRaVDA to ensure they are resistant to the high levels of radiation present in proton therapy.

The researchers have just taken delivery of some of the technology which will lie at the heart of the system: two state-of-the-art custom integrated circuits (chips) which will underpin PRaVDA's imaging capabilities.

One device is a radiation-hard CMOS imager, measuring 10cm x 6.5cm, and producing more than 1,500 images per second. The camera chip in a mainstream smartphone is a CMOS imager but PRaVDA's chip is over 300 times larger and operates 50 times faster - the fastest large-area CMOS imager ever made. The completed PRaVDA instrument will contain 48 of these imagers, giving a total imaging area of nearly two-and-a-half square metres.

The second device is the read-out chip for the very high-speed strip detectors that track the passage of individual protons as they enter and exit a patient. This chip, called Rhea, converts the electric charge created by a passing proton into a digital signal with additional logic to provide accurate timing (to one hundredth of one millionth of a second) while preventing erroneous signals being recorded.

The strip detectors were designed at the University of Liverpool by the same team that developed detectors for the Large Hadron Collider at

CERN, which led to the discovery of the Higgs Boson in 2013. Nearly 200 Rheas are used in the complete PRaVDA system.

PRaVDA's industrial partner, ISDI LTD, designed both devices. Their testing was undertaken by the project's second industrial partner, aSpect Systems GmbH, in Dresden, Germany.

Provided by University of Lincoln