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ASTRA, a novel range telescope concept for proton CT

Proton beam therapy has great potential to improve the treatment of cancers whilst reducing toxicity for oncology patients. However, this technique cannot exploit yet all of its potential due uncertainties in the dose deposition caused by indirect measurements of the stopping power of the materials within a patient. The aim of this work is to present a proof of concept that new technologies developed for High Energy Physics (HEP) experiments can improve the currently explored techniques to achieve proton Computed Tomography (pCT) which measures the Relative Stopping Power (RSP) directly. Existing devices are unable to perform a high quality measurement of the RSP under realistic clinical conditions. The work presented here is based on simulations with the Geant4 toolkit and the technologies used for this project are: A set of four silicon detectors based on the Depleted Monolithic Active Pixel Sensors (DMAPS) developed for the inner tracker upgrades at the High Luminosity Large Hadron Collider (HL-LHC), and a plastic scintillator Range Telescope (RT) based on the technology designed for the Super Fine-Grained Detector (SFGD) at the Tokay to Kamioka (T2K) experiment in Japan. Simulations show that the system is able to provide multi proton tracking at, at least , a 40MHz sampling rate (limited by the current DMAPS specifications) achieving a sub 1% energy resolution and RSP of six different materials.

Primary experiment

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Track Classification: Medical Applications