**CNN for multi-proton events at the ASTRA range telescope for pCT**

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**Background:** Proton Beam Radiotherapy (PBR) has a lot of potential to treat head and neck tumours and paediatric patients. However, existing devices are unable to perform a high-quality measurement of the Relative Stopping Power (RSP) under realistic clinical conditions. Thus, PBR cannot yet exploit all its potential due uncertainties in the dose deposition caused by indirect measurements of the RSP of the tissues within a patient. In this talk a full simulation of a proton Computed Tomography (pCT) system, seen in Figure 1, is presented as a proof of concept that new technologies developed for High Eenergy Physics (HEP) experiments can improve the currently explored techniques to achieve pCT, which measures the RSP directly. Under clinical conditions, high efficiency on multi-proton events is key to reduce the scanning time and the dose delivered to the patient. Thus, the effect of using Convoluted Neural Networks (CNN) to improve the efficiency of such an analysis, is studied.

**Material and Methods:** The main bulk of the work presented here was published by the peer-reviewed journal: Physics for Medicine and Biology [1], and is based on simulations performed 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 used for the near detector of the Tokay to Kamioka (T2K) neutrino oscillations experiment in Japan. Further work presented here includes the application of CNN to perform the ASTRA data analysis and decouple the proton tracks within the range telescope on multi-proton events.

**Preliminary results:** Simulations show that the system can provide multi proton tracking achieving a sub 1% energy resolution and RSP of six different materials. The use of CNN presents an improvement the multi-proton tracking efficiencies allowing up to an extra 20% of proton tracking efficiency within ASTRA and have the potential to further improve the energy resolution and efficiency of single and multi-proton events by constraining proton secondary interactions by comparing data vs GEANT4 predictions.

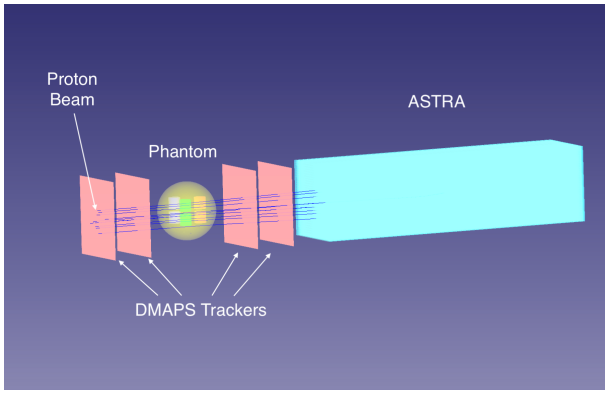


*Figure 1: 3D visualization of the pCT system with 4 DMAPS layers a spherical phantom with 6 cilindrical inserts in place and the ASTRA rang telescope. In the image 10 protons (dark blue image) are being measured.*

[1] M Granado-González *et al* 2022 *Phys. Med. Biol.* **67 (3)** (2022) 035013