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Development of a silicon tracker for imaging with protons

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Tomography has found extensive applications in medicine, industry and security due to its ability to produce detailed 3D images of objects and their internal structure. In medicine, computed tomography (CT) using x-rays is routinely used for the treatment planning of radiotherapy which most often uses x-rays for treating patients with various types of cancer. Radiotherapy using beams of charged particles such as protons is known as proton or hadron therapy and is rapidly becoming a more popular way of treating cancers that are deep inside the body or close to critical structures. The advantage of using charged particles for radiotherapy lies in its potential to target more dose into the cancerous tissue than with x-rays, reducing the dose to healthy tissue in the process.

The Proton Radiotherapy, Verification and Dosimetry Applications (PRaVDA) consortium have developed a new silicon micro-strip detector and readout ASIC based upon technology from high-energy physics for performing proton computed tomography (pCT). This technique utilizes measurements of the deflection and residual energy of many individual protons as they pass through a rotating object. The ultimate aim of pCT is to enable patients undergoing proton therapy to have their treatment planning and therapy carried out with the same particle beam, which in turn allows the margins of error associated with proton therapy to be reduced and the advantages of this treatment increased even further.

Details will be shown of the tracker assembly, readout and track reconstruction techniques using results from measurements made with therapy beams of ˜100-200 MeV at the iThemba LABS, South Africa. Results that demonstrate the possibility to reconstruct new varieties of pCT images based upon tracking information alone will be discussed using images of a test object (phantom) containing tissue equivalent inserts.

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