Contribution ID: **217** Type: **Poster presentation**

Smart dosimetry by pattern recognition using a single photon counting detector system in time over threshold mode

Tuesday, 5 July 2011 15:29 (1 minute)

The function of a dosimeter is to display the absorbed dose of radiation, where a particular type of radiation is usually targeted. Recently, there have also emerged applications where all kinds of radiation are absorbed and sorted by pattern recognition, such as the Medipix2 application in [1]. This form of smart dosimetry enables measurements where not only the total dosage is displayed, but also the distribution of different types of radiation impinging on the detector surface. Furthermore, the use of a photon counting system in "time-over-threshold"mode, where the energy deposition can be measured in each individual pixel, ensures measurements with high accuracy of the pattern recognition.

In this article a Timepix [2] detector system working in "time-over-threshold"mode has been used for a smart dosimeter for alpha, beta and gamma radiation. The particle tracks impinging on the detector surface are read out and image processing algorithms are used to classify each particle hit. The individual hits are calculated and the dosage for each type of radiation is given as a result. In some cases, several hits can impact in roughly the same place, forming connected hits. In order to handle this problem, a hit separation method has been added to the pattern recognition algorithm. When the hits have been separated, they are classified by shape and sorted into the correct type of radiation. The algorithms and methods used in this dosimeter have been developed to be simple and computationally effective, in order to enable implementation on a portable device.

[1] Holy T., Heijne E. H. M., Jakubek J. Pospisil S., Uher J., Vykydal Z., "Pattern Recognition of Tracks Induced by Individual Quanta of Ionizing radiation in Medipix2 Silicon Detector", Nuclear Instruments and Methods, sect. A, 2008.
[2] Llopart X., Ballabriga R., Campbell M., Tlustos L, Wong W., Nuclear Instruments and Methods, section A, 581 (2007) 485.

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Session Classification: Poster Mini Talks VI

Track Classification: Applications