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Calibration of a polycrystalline 3D diamond detector fabricated for small field dosimetry

In medical radiation dosimetry, the use of small photon fields is almost a prerequisite for high precision localized dose delivery to delineated target volume. The accurate measurement of standard dosimetric quantities in such situations depends on the size of the detector with respect to the field dimensions. Thanks to a new technology, polycrystalline diamond devices with 3-dimensional structures are produced by using laser pulses to create graphitic paths in the diamond bulk. By fabricating very narrow and close by columnar electrodes perpendicular to the detector surface, it is possible to create arrays of 3D-cells with very small sensitive volume. In order to present a solution to the problem of the detector size for small field dosimetry the 3D technology aims to a new highly segmented larger polycrystalline diamond dosimeter to obtain field profiles in a single shot measurement, reducing the uncertainty of the delivered dose. To this purpose a 3D all carbon detector with an array of 9 3D cells have been produced. Due to the heterogeneous structure of the polycrystalline diamond substrate, it was necessary to study the response of each 3D cell under a standard field photon beam. It was demonstrated that each single cell of the array has a different sensitivity to the radiation beam,but the response is linear, stable and repeatable hence different calibration factors can be applied to obtain an overall detector response and reduce the uncertainty of the delivered dose.

Primary author: KANXHERI, Keida (INFN - National Institute for Nuclear Physics)

Co-authors: Dr DIPILATO, Anna Concetta (Dipartimento di Scienze Chirurgiche e Biomediche, Università degli Studi di Perugia); MOROZZI, Arianna (INFN, Perugia (IT)); CORSI, Chiara (LENS Firenze); TALAMONTI, Cinzia (INFN Firenze and University of Florence Italy); Dr ZUCCHETTI, Claudio (Dipartimento di Fisica Medica, Ospedale Santa Maria della Misericordia, Perugia, Italia); PASSERI, Daniele (Universita e INFN Perugia (IT)); SERVOLI, Leonello (Universita e INFN, Perugia (IT)); ALUNNI SOLESTIZI, Luisa (Universita e INFN, Perugia (IT)); Dr BELLINI, Marco (INO-CNR Firenze); IONICA, Maria (INFN Perugia); Dr IACCO, Martina (Dipartimento di fisica medica, ospedale santa maria della misericordia perugia); BIASINI, Maurizio (Universita e INFN, Perugia (IT)); Dr CAPRAI, Mirco (INFN Perugia); SCIORTINO, Silvio (Universita e INFN, Firenze (IT)); Dr LAGOMARSINO, Stefano (Università e INFN Firenze)

Presenter: KANXHERI, Keida (INFN - National Institute for Nuclear Physics)

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