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Characterization of the new Single Layer Diamond detector

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Purpose/Objective: Quality assurance of highly modulated radiotherapy techniques, such as IMRT/VMAT, mArc etc., require so called small field dosimetry. The dosimetry of small fields, whith lack of charged particles[1] equilibrium, presents several dosimetric challenges[2]. The topic has been addressed by many authors during the past decade, but so far no detector type has been singled out as the preferred choice for such dosimetry. Diamond has been presented as an interesting detector material due to it's almost tissue equivalent atomic number. However, natural diamond has shown to be unreliable due to unpredictable impurities in the material. In this work, the performance, a synthetic single layer diamond (SLD) detector (PTW, Bransweig, Germany, sensitive vol 0.004 mm^3, nom response 1nC/Gy), is tested and compared to a number of other detectors for small field dosimetry on the market.

Materials and Methods: Relative measurements have been performed in a Blue Phantom water tank (IBA) at source to surface distance of 900 mm at a Siemens Artiste machine with 6 and 15 MV photons. Both percentage depth dose scans and output factors at 100 mm depth were made for a range of field sizes, from 100x100 mm^2. down to 6x6 mm^2. In addition to the single layer diamond detector, the measurements were repeated with other well known detector types. In addition, energy dependency has been investigated by depth dose measurements in 140x140 mm^2 electron fields on an Electa Synergy linac at energy ranges from 4 MeV to 20 MeV. Comparisions has been made for various photon beam profiles, but this abstract is limited to PDD and output factor measurements.

Results: The percentage depth dose scans and the output factors show good consistency between the diamond detector and the PPC40 (Roos plan parallel chamber, IBA) and CC13 (compact chamber, IBA) detectors normally used normally as standard detectors for such measurements at our clinic. No energy dependence of the SLD has been detected for the radiation types and energies investigated. The results have been shown reproducible for different radiation qualities and over time.

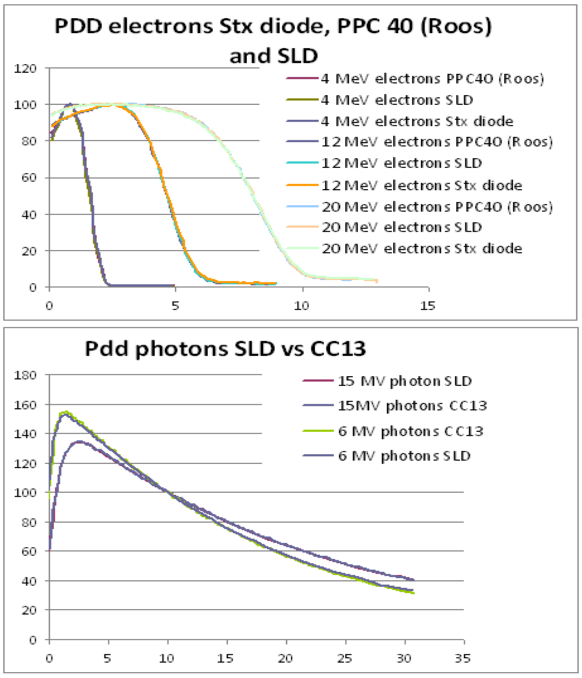

Figure 2a: PDD electrons on Electa Synergy energies 4 MeV to 20 MeV measured with PPC 40, Stx diode and SLD, 1b: PDD photons on Siemens Artiste for energies 6 MV and 15 MV measured with CC13 and SLD

Relative output factors for Stx Diode (IBA)/SLD detector

Field side (mm)	6 MV photons	15 MV photons
6	1.00	1.01
10	0.99	1.00
20	0.98	1.00
30	0.98	0.99
40	0.98	0.99
50	0.98	0.99
100	1.00	1.00

Table 1: Example of relative output factors

Conclusions: Our results indicate that the SLD detector is well suited for small field dosimetry. It has been shown to be energy independent in the energy ranges used in a clinic, and to give reliable and reproducible results in both depth dose scans and output factor measurements in water.

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