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PRESENTATION TITLE

The dose response of the PTW 60019 microDiamond in magnetic fields: Characterisation for the Australian MRI-linac

AUTHOR(S)

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ABSTRACT

Purpose:
A major challenge of MRI-guided radiotherapy is the translation of dosimetry results as the detectors can respond differently in the presence of a magnetic field. The PTW 60019 microDiamond detector has proven to be useful for clinical small field dosimetry due to its high spatial resolution; some other advantages include minimal energy, temperature and directional dependence [1-3]. The behaviour of the microDiamond in a magnetic field has been previously explored through simulations for both in-line and perpendicular magnetic field orientations [4] and measurements for fields up to 0.18T and 1.5T in the perpendicular configuration [4-6]. The Australian MRI-linac [7] is a 1T in-line system therefore it is expected that the magnetic field will cause minimal changes in the microDiamond's dose response. The aim of this work was to quantify the dose response of the microDiamond for both in-line and perpendicular magnetic fields on an experimental magnet system as well as test this detector on an in-line MRI-linac system.

Materials & Methods:
Part 1: The PTW 60019 microDiamond was placed in a permanent magnet system, previously described [8], which can produce a field up to 1.2T. For measurements at 0T the focusing cones were removed from the system and were placed around the phantom in the same orientation as the 1T measurements in order to replicate scatter conditions. The magnet system was oriented both perpendicular and in-line w.r.t a clinical beam with the detector positioned on the central axis at 1.5cm depth in solid water, a response at 1T and 0T were taken for a range of small square jaw defined field sizes (0.9, 1.5, 2.1 cm) at a source to isocentre distance of 150cm. Profiles were also taken in the

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perpendicular magnetic field orientation.
Part 2: Measurements in a 30x30x30cm^3 solid water phantom were acquired on the Australian MRI-linac, with a constant SSD = 1.918m and MLC defined field size of approx.. 9.5x9.5cm^2 at the surface, however the strength of the magnetic field was varied by shifting the proximity of the linac and phantom to the MRI.

Results:
Part 1: The dose response of the microDiamond for the in-line 1T magnetic field was the same without the magnetic field present under the same scattering conditions for the small field sizes measured. Profiles were taken for the perpendicular magnetic field orientation along the crossline direction (perpendicular to the magnetic field). A 0.9x0.9cm^2 field size profile is shown in figure 1, the lateral shift in the profile due to the magnetic field is evident.
Part 2: Comparing PDDs taken in the Australian MRI-linac at a region of high magnetic field (approx. 0.95T) and within the fringe field of the MRI (approx. 0.05T), beyond 2cm depth, where contaminant electrons that contribute to a high surface dose have been completely absorbed, the microdiamond measurements are in agreement. This would suggest that our inline magnetic field does not affect the measurement of relative depth dose with the microdiamond detector.

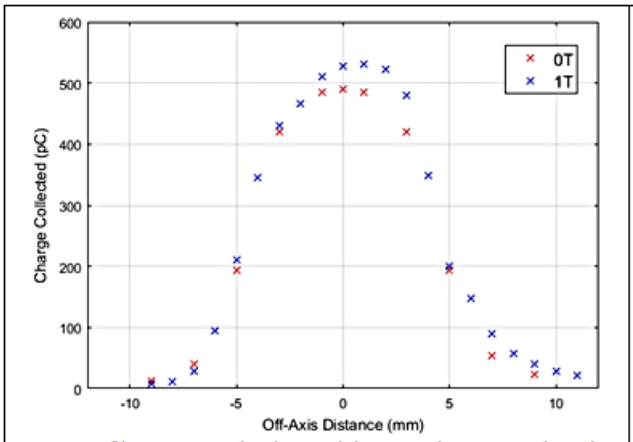

Fig 1: Profile at 1.5cm depth in solid water phantom with and without perpendicular 1T magnetic field for a 0.9x0.9cm^2 field

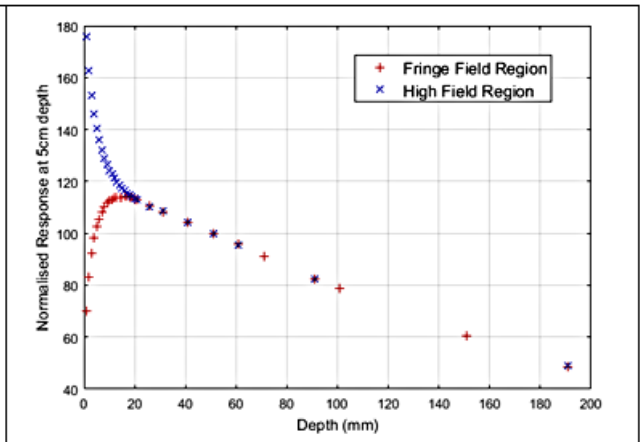

Fig 2: PDDs at different magnetic field strengths, taken in a 30x30x30cm3 solid water phantom on the Australian MRI-linac

Conclusions:
The PTW 60019 microDiamond dose response was examined for both in-line and perpendicular magnetic field orientations. The measurements demonstrate that the microDiamond is a suitable detector to be used for the Australian MRI-linac system.

References:

[1] Di Venazio C Med. Phys. 40 (2), 21712 2013.
[2] Laub WU J. Appl. Clin. Med. Phys. 15 (6), 92-102, 2014.
[3] Ravichandran R J. Appl. Clin. Med. Phys. 17 (2), 291-303, 2016.
[4] Reynolds M Med. Phys. 41 (9), 092103, 2014.
[5] O'Brien D Med. Phys. 45 (2), 884-897, 2018.
[6] Woodings SJ Phys. Med. Biol. doi: 10.1088/1361-6560/aaa1c6, 2017
[7] Liney GP Med. Phys. 43 (9), 5188-5194, 2016.
[8] Oborn B Rad. Oncol. 125 (3), 433-438, 2017.