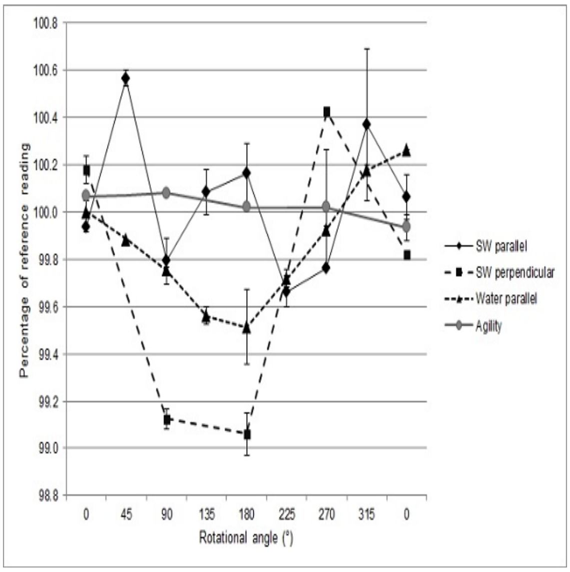
phantom, both parallel and perpendicular to the magnetic field, and in water (waterproof chambers only). The influence of the distribution of air around the chambers in the SW phantom was measured by displacing the chamber in the insert using a paper shim, approximately 1 mm thick, positioned in different orientations between the chamber casing and the insert.

Results: The responses of the three waterproof chambers measured on the MR-linac increased by 0.6% to 1.3% when the air volume in the insert was filled with water. The responses of the chambers on the Agility linac changed by less than 0.3%. The angular dependence ranged from 0.9% to 2.2% in solid water on the MR-linac, but was less than 0.5% in water on the MR-linac and less than 0.3% in SW on the Agility linac. An example of the angular dependence of a chamber is shown in Figure 1.



Changing the distribution of air around the chamber induced changes of the chamber response in a magnetic field of up to 1.1%, but the change in chamber response on the Agility was less than 0.3%.

Conclusion: The interaction between the magnetic field and secondary electrons in the air volume around the chamber reduces the charge collected by between 0.6 and 1.3%. The large angular dependence of ion chambers measured in SW in a magnetic field appears to arise from a change of air distribution as the chamber is moved within the insert, rather than an intrinsic isotropy of the chamber sensitivity to radiation. It is therefore recommended that reference dosimetry measurements on the MR-linac be performed only in water, rather than in SW phantoms.

OC-0076

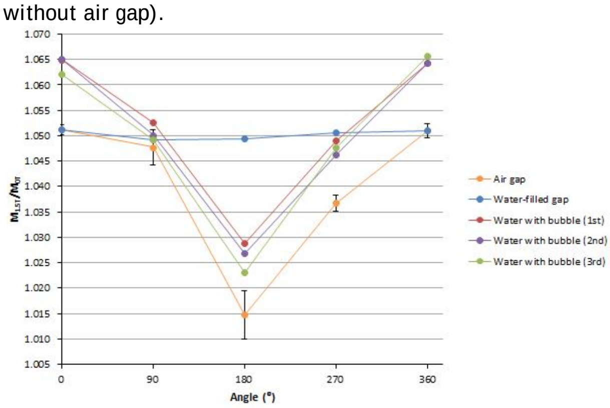
Towards MR-Linac dosimetry: B-field effects on ion chamber measurements in a Co-60 beam

J. Agnew[1], G. Budgell[1], S. Duane[2], F. O'Grady[1], R. Young[1]
[1]*The Christie NHS Foundation Trust, CMPE, Manchester, United Kingdom*
[2]*National Physical Laboratory, Radiation Dosimetry Group, Teddington, United Kingdom*

Purpose or Objective: To quantify the effect of small air gaps at known positions on ionisation chamber (IC) measurements in the presence of a strong magnetic (B-)field, and to characterise the response of ICs over a range of B-field strengths in the absence of air gaps.

Material and Methods: The ratio of responses of four commercially available ICs was measured in a Co-60 beam with and without a 1.5T B-field ($M_{1.5T}/M_{0T}$) using a GMW electromagnet unit and a 5cm pole gap. Measurements were made in custom-built Perspex phantoms with the chamber, beam and B-field all orthogonal. The measurements were repeated with the phantoms at each cardinal angle (rotated about the long axis of the ICs). The phantoms were designed to be symmetric under rotation about this axis except for a shallow 90° section next to the sensitive volume of the ICs. The measurements were repeated with the air gap removed by introducing water to the phantom cavity. For the PTW 30013 chamber further measurements were performed after introducing a small (approximately 30 mm^3) bubble into the recess when the cavity was otherwise filled with water, which was made possible by the novel phantom design. The measurements in water were repeated with additional build-up material and in multiple phantoms at a single phantom orientation.
Measurements were also taken to characterise the ratio of responses for five ICs over a range of B-field strengths (0 – 2T in 0.25T increments).

Results: For all 4 ICs in the rotating setup, the response varied consistently with the position of the recess when the air gap was present, with the lowest value of $M_{1.5T}/M_{0T}$ obtained when the recess was upstream of the IC. The maximum peak-to-peak (PTP) variation was 8.8%, obtained for the PTW 31006 'Pinpoint' IC, and the minimum was 1.1%, obtained for the Exradin A1SL IC. This variation all but disappeared (maximum PTP variation 0.7%, seen for PTW 31010 IC) when the air gap was removed. A large (3.9%) PTP variation was observed for the PTW 30013 when an air bubble was inserted into an otherwise airless setup (0.2% variation without air gap).



	Chamber	($M_{1.5T}/M_{0T}$ - 1) x 100 averaged over cardinal angles (%)	PTP Variation over cardinal angles (%)
Air Gap	PTW 30013	3.9	2.9
	*PTW 30013**	*4.7*	*3.9*
	PTW 31006	-1.3	8.8
	PTW 31010	7.1	4.0
	Exradin A1SL	6.4	1.1
Without Air Gap	PTW 30013	5.0	0.2
	PTW 31006	6.3	0.2
	PTW 31010	5.1	0.7
	Exradin A1SL	8.6	0.2
** Bubble air gap*			

Conclusion: Small air gaps are responsible for large variations in IC response in the presence of a magnetic field. These variations can be eliminated by introducing water into the cavity, but even small bubbles will cause large variations in the response. Further, IC response in the presence of a 1.5T B-field is insensitive to changes in depth and scatter conditions of the phantoms investigated here. Each IC has different M/M_{0T} response across the range of B-field strength 0 – 2T.

OC-0077

Dual energy CT proton stopping power ratio calibration: Validation with animal tissues

Y. Xie[1], L. Yin[1], C. Ainsley[1], J. McDonough[1], T. Solberg[1], A. Lin[1], B.K. Teo[1]
[1]*University of Pennsylvania, Department of Radiation Oncology, Philadelphia, USA*

Purpose or Objective: One main source of uncertainty in proton therapy is the conversion of Hounsfield Unit (HU) to