AbstractID: 3427 Title: Investigation of anomalous recombination behaviour in cylindrical ionization chambers

Purpose
Measurements using air-filled ionization chambers must be corrected for the effect of ion recombination. In recent years a number of authors have presented data for cylindrical and parallel chambers that do not agree with the standard Boag theory. An experimental investigation was carried out to look at the possible mechanisms that have been proposed for these deviations.

Methods and Materials
Four different Farmer-type chambers - PTW30001, NE2571, NE2581, Exradin A12 – were used to look at how the recombination behaviour depended on: i) chamber type; ii) continuous or pulsed radiation; iii) dose per pulse; iv) modality (photons or electrons). Three radiation sources were used: i) Sr-90 check source; ii) Co-60 beam; iii) Elekta *Precise* linac.

Results
It was found that all four chamber types showed similar non-linear behaviour at polarizing voltages > 250 V using a low-doserate Sr-90 check source. This was a little surprising considering the significant differences in chamber design for these types. Also, all chamber types showed a difference in the shape of the 1/I vs 1/V plot for opposite polarities – the chamber signal was larger when collecting negative charge - indicating that the effect may be due to free-electron collection and/or charge multiplication. In the linac measurements no difference in behaviour was seen between photon and electron beams (as expected) but the non-linear curvature and difference between polarities was only seen at low dose per pulse values (< 0.02 cGy). Stem and cable irradiation were also investigated and found to be insignificant.

Conclusion
Deviations from classical Boag recombination theory have been observed for “well-designed” Farmer chambers in a range of photon and electron beams. Measurements to date cannot single out one mechanism as the primary effect but indicate that insulator/stem irradiation and free-electron collection are not significant.