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Ion recombination in liquid ionization chambers

Development of an experimental method to quantify general recombination

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Akademisk avhandling

som med vederbörligt tillstånd av Rektor vid Umeå universitet för avläggande av filosofie doktorsexamen framläggs till offentligt försvar i sal 260, byggnad 3A, Norrlands universitetssjukhus, fredagen den 31 maj, kl. 13:00. Avhandlingen kommer att försvaras på engelska.

Fakultetsopponent: Professor Anders Ahnesjö, Inst. för radiologi, onkologi och strålningsvetenskap, Uppsala universitet

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Abstract

An experimental method (the two-dose-rate method) for the correction of general recombination losses in liquid ionization chambers has been developed and employed in experiments with different liquids and radiation qualities. The method is based on a disassociation of initial and general recombination, since an ionized liquid is simultaneously affected by both of these processes.

The two-dose-rate method has been compared to an existing method for general recombination correction for liquid ionization chambers, and has been found to be the most robust method presently available.

The soundness of modelling general recombination in liquids on existing theory for gases has been evaluated, and experiments indicate that the process of general recombination is similar in a gas and a liquid. It is thus reasonable to employ theory for gases in the two-dose-rate method to achieve experimental corrections for general recombination in liquids. There are uncertainties in the disassociation of initial and general recombination in the two-dose-rate method for low applied voltages, where initial recombination has been found to cause deviating results for different liquids and radiation qualities.

Sensitivity to ambient electric fields has been identified in the microLion liquid ionization chamber (PTW, Germany). Experimental data may thus be perturbed if measurements are conducted in the presence of ambient electric fields, and the sensitivity has been found to increase with an increase in the applied voltage. This can prove to be experimentally limiting since general recombination may be too severe for accurate corrections if the applied voltage is low.

Keywords
General recombination, initial recombination, liquid ionization chamber, radiation dosimetry

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