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GRAPHITE CALORIMETER, THE PRIMARY STANDARD OF ABSORBED DOSE AT BNM–LNHB

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The graphite calorimeter is the standard for absorbed dose to water at BNM-LNHB. The transfer from absorbed dose to graphite to absorbed dose to water is then performed by means of chemical dosimeters and ionisation chamber measurements [1]. Therefore the quality of graphite calorimeter measurements is essential.

The present graphite calorimeter is described. The characteristics of this calorimeter are pointed out. Special attention is given to the thermal feedback of the core, which is the main difference with the Domen-type calorimeter.

The repeatability and reproducibility of the mean absorbed dose in the calorimeter core are presented in detail. As an example, individual measurements in the 20 MV photon beam from our Saturne 43 linac are given in Fig.1. The y-axis quantity is the mean absorbed dose in the core divided by the reference ionisation chamber charge. Both are normalised to the monitor ionisation chamber charge.

The standard deviation (of the distribution itself) is 0.12 % for the first set of measurements performed in 1999. In 2002, for each different series, the standard deviation is 0.03%. The improvement on the 2002 standard deviation is mainly due to the change of the ionisation chamber used for the beam monitoring of the linac. Some benefit also comes from changes on the thermal control and measuring systems (nanovoltmeters, Wheatstone bridges, power supplies, determination of the measuring bridge sensitivity (V/Ω)).

The maximum difference between the means of the three series is 0.08 %.

This difference is due to the variation of not only the calorimetric measurements but also of the reference ionisation chamber response, of the position of the assembly and of the monitoring of the beam. The stability of the linac (electron energy, photon beam shape) has to be very good too in order to obtain this global performance.

The correction factors necessary to determine the absorbed dose to graphite at the reference point in an homogeneous phantom from the measurement of the mean absorbed dose to the calorimeter core are examined including gradient correction factor (Fig. 2). The uncertainties are analysed.

The main uncertainty comes from the vacuum gaps correction factor determination [2]. They are measured and calculated by Monte-Carlo code for cobalt 60, 6 MV, 12 MV and 20 MV photon beams.

The influence of the irradiation on the sensitivity of the thermistor has been checked. A specific program was developed in order to perform the electrical calibration and the irradiation together. Recent measurements carried out in the 20 MV photon beam prove that there is no significant difference between the simultaneous measurement (irradiation + electrical power dissipation) and the sum of these two quantities measured separately. This confirms previous measurements in cobalt 60 beams. It is not possible to do this control with the water calorimeter because no electrical calibration is feasible. By using the same type of thermistor this result might be extrapolated to water calorimeters.

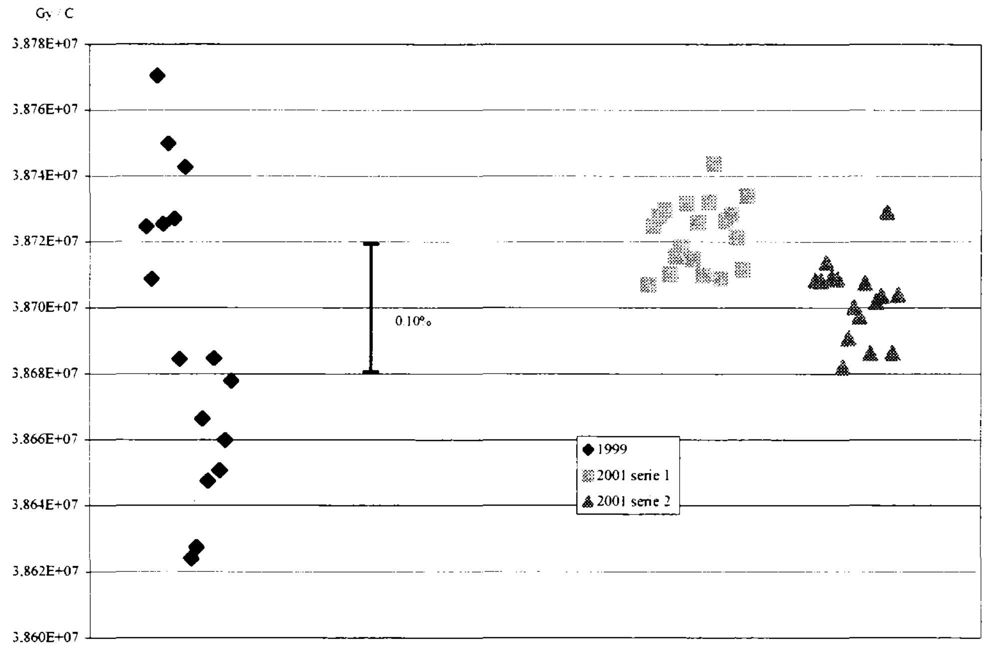

Fig. 1. Mean absorbed dose in the graphite calorimeter core divided by the reference ionisation charge.

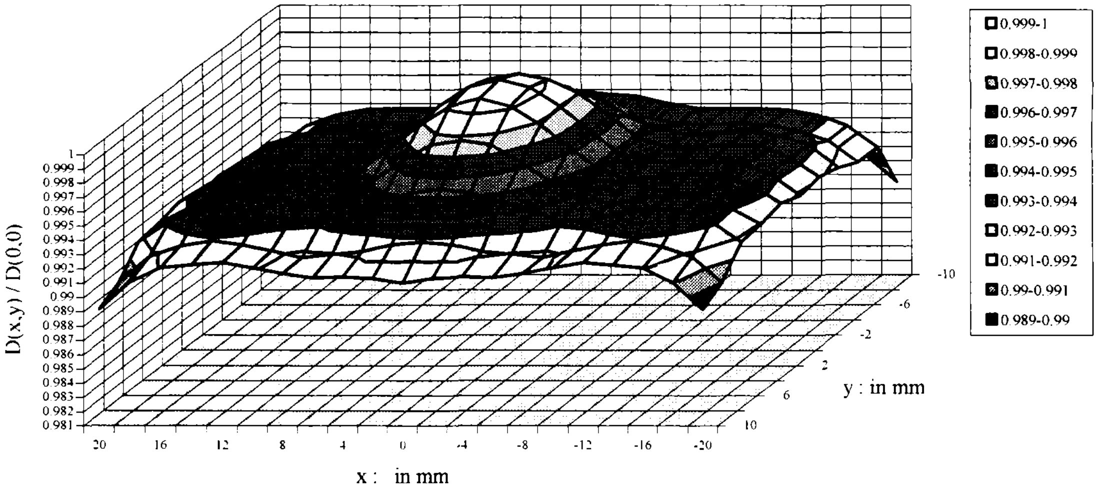

Fig.2. Relative absorbed dose in the graphite phantom at the reference plane perpendicular to the 20 MV beam axis.

REFERENCES

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