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ON THE RESPONSE TO FAST NEUTRONS OF A BF_3 COUNTER IN A PARAFFIN SPHERICAL-HOLLOW MODERATOR

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The flux and dose measurements of fast neutrons are often carried out by means of BF_3 counters in a paraffin moderator. This system of detection has in general high efficiency and good discrimination against γ-rays as well as a response, to a certain extent, independent of the energy, as shown by the "long" counter[1]) and the "double moderator" dosimeter[2]) which are two typical examples of this system of detection.

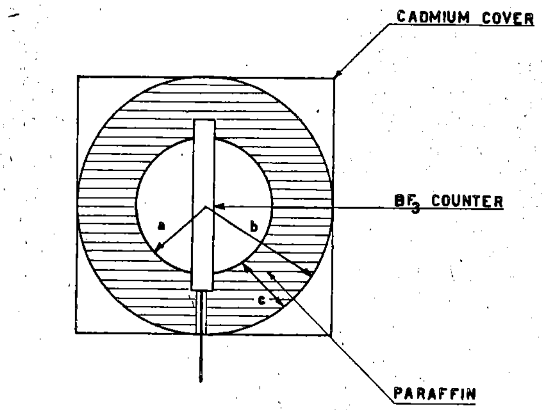

Fig. 1. Section of the counter-hollow sphere system.

Such systems have not however an angular uniform response[2,3]) and this fact might in some instances limit their use. In an isotropic distribution of neutrons, for example, the use of directional detectors requires the correction of the results of the measurements after proper calibration.

A system having an angular uniform response was realized by us by using as moderator a hollow sphere of paraffin. A BF_3 counter was placed into the sphere, as shown, in section, in fig. 1. The outside diameter of the sphere is 28.4 cm, the inside diameter is 15 cm, and the paraffin thickness that acts as moderator is 6.7 cm. The active length, 12 cm, of the counter is entirely contained within the hollow zone.

The angular response of the detector was studied by turning alternatively around it a source of Po + Be (activity 4.2×10^5 n/sec) and one of Ra + Be (activity 1.45×10^4 n/sec), as shown in fig. 2.

Fig. 2 also shows as an example, the angular response in counts per minute obtained for the different values of θ, the source of Po + Be being

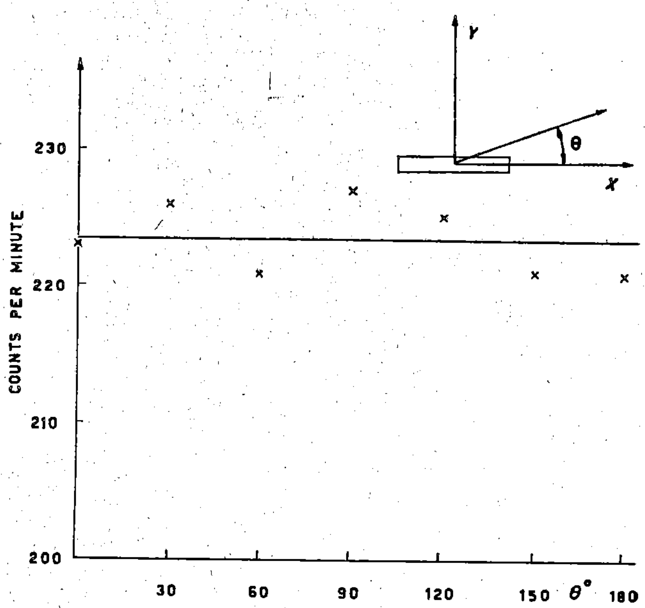

Fig. 2. Angular response of the detector.

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1) A. O. Anson and J. L. McKibben, Phys. Rev. 72 (1947) 673.
2) J. De Pangher, Nucl. Instr. and Methods 5 (1959) 61.
3) S. Børresen, B. Grimeland and S. Messelt, Nucl. Instr. and Methods 16 (1962) 135.

at 150 cm from the geometrical centre of the detection system. As shown in fig. 2, the deviations from the average are below 2%.

Deviations of this order of magnitude were obtained with both sources, for all source-detector distances which were used in the present measurements.

Unlike the usual moderator detectors mentioned above[1,2]), the system counter-hollow sphere, which has efficiency of 2.4 counts/n.cm^{-2}, behaves as a point detector and the determination of its actual centre does not then allow any ambiguity. The data obey the inverse square law, as shown in fig. 3, provided that the distance source-detector r is taken from the geometrical centre of the system, that coincides with the centre of the counter. The instrument may therefore be used, after calibration, for activity measurements of neutron sources. Because of its angular uniform response it is particularly suitable, after calibration, for flux and dose measurements of fast neutrons around a high energy accelerator.

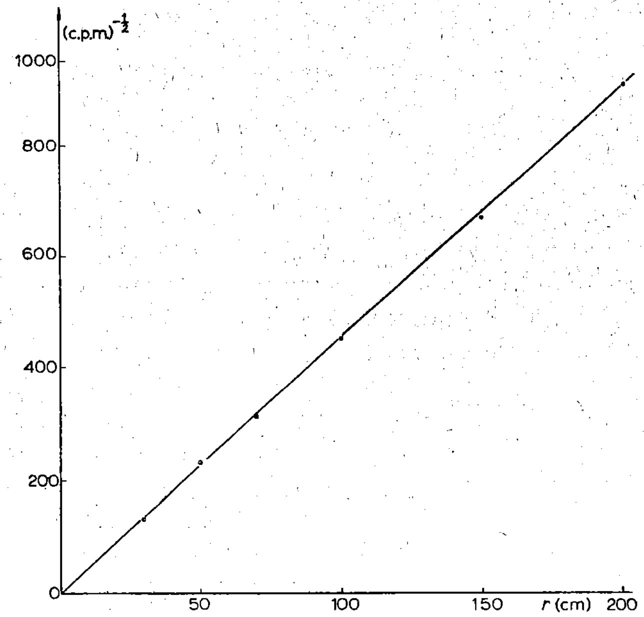

Fig. 3. Variation of (counts per minute)$^{-\frac{1}{2}}$ plotted against source-centre of the counter distance.