

A Neutron Dose Detector with REM Response to 1 GeV

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1. Introduction

The limitation of current remmeters, which do not measure neutron dose equivalents above about 15 MeV, is a serious problem at high-energy accelerator facilities, where a much wider range of neutron energies exist. The purpose of this work was to measure the response of a modified Andersson-Braun (A-B) remmeter to neutron energies up to 1 GeV. The modifications to the standard A-B remmeter were based on the experimental results of $\text{Pb}(n, xn)$ reactions⁽¹⁾.

2. Experimental Procedure

A diagram of the modified A-B detector is shown in Fig. 1. The modification to the standard A-B detector is shown as a cylindrical layer (the moderator) of lead (instead of polyethylene), part 2 in Fig. 1.

We have carried out preliminary experiments at both the 88" Cyclotron and the Bevalac accelerators located at Lawrence Berkeley Laboratory. The remmeter response was measured at neutron energies of 40 MeV, 400 MeV, and 1050 MeV. Neutrons of 40 MeV were obtained at the 88" Cyclotron by bombarding a Li target with proton projectiles. At the Bevalac 400-MeV neutrons were obtained by bombarding an Al target with Au projectiles while the 1050 MeV neutrons were

obtained by bombarding a polyethylene target with deuteron projectiles. In all cases, the charged particles were swept away with a downstream dipole magnet, leaving behind a pure neutron beam. The 400-MeV and 1050-MeV neutron beams were previously characterized at the Bevalac⁽²⁾. A comparison between the response to neutrons for the modified and unmodified A-B neutron detectors was carried out.

3. Results

The results for the response of the modified and standard A-B remmeters are expressed as the ratio of the response of the detector with the lead-containing moderator to the detector with polyethylene moderator. The ratios were 6.6 for 400-MeV neutrons and 9.8 for 1050-MeV neutrons. The ratio for the 40-MeV neutrons was found to be 1.8. These ratios are quite close to ratios obtained by Monte Carlo calculations using the LAHET and MCNP codes. The experimental results and theoretical curves are shown in Fig. 2.

Further work will be carried out at energies both above and below those reported in this paper. In the future work, various modifications to the standard A-B remmeter will be carried out, and the responses of these detectors to neutrons will be measured experimentally.

Reference

- (1) Birattari, C. et al., "An Extended Range Neutron REM Counter," NIM, A297 (1990), 250-257.
- (2) Albergo, S. et al., "MUFFINS: A Multi-functional Neutron Spectrometer," 22nd ICRC, Dublin, Ireland, 1991.

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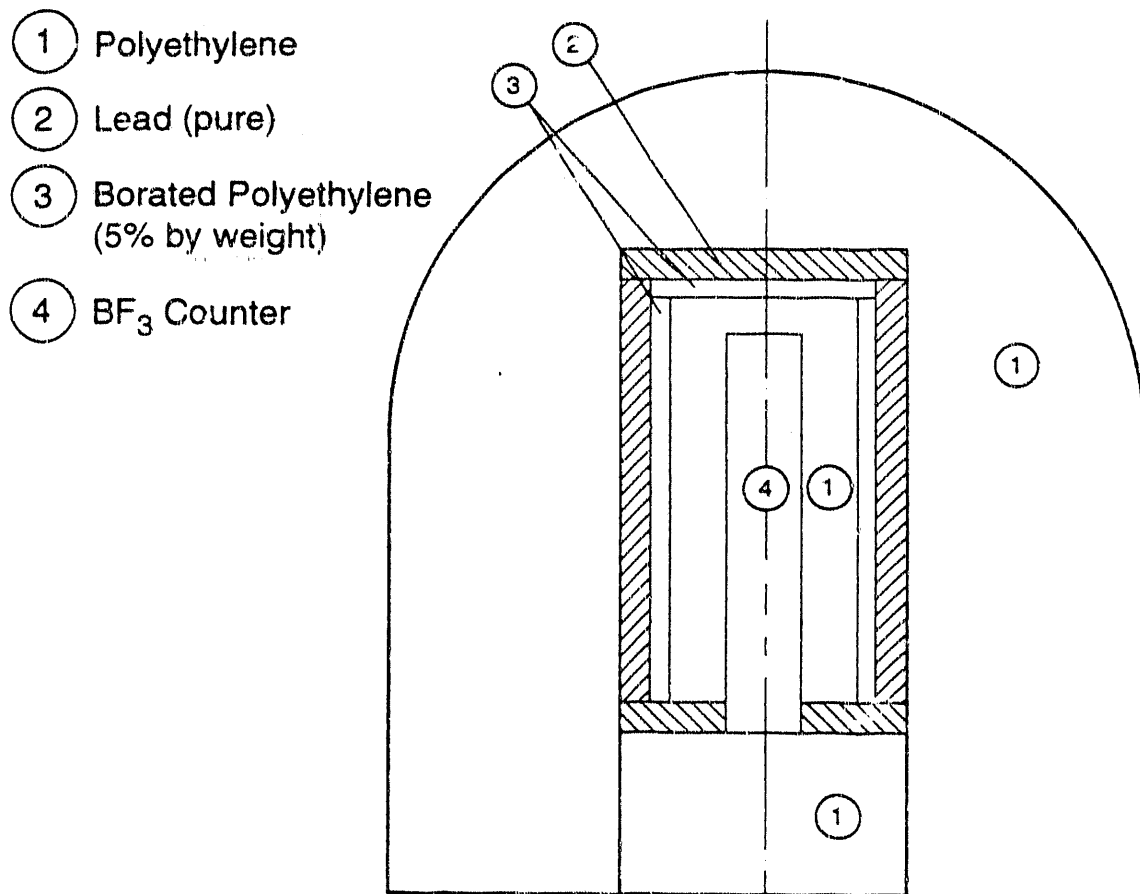


Fig. 1 Modified Andersson—Braun Remmeter

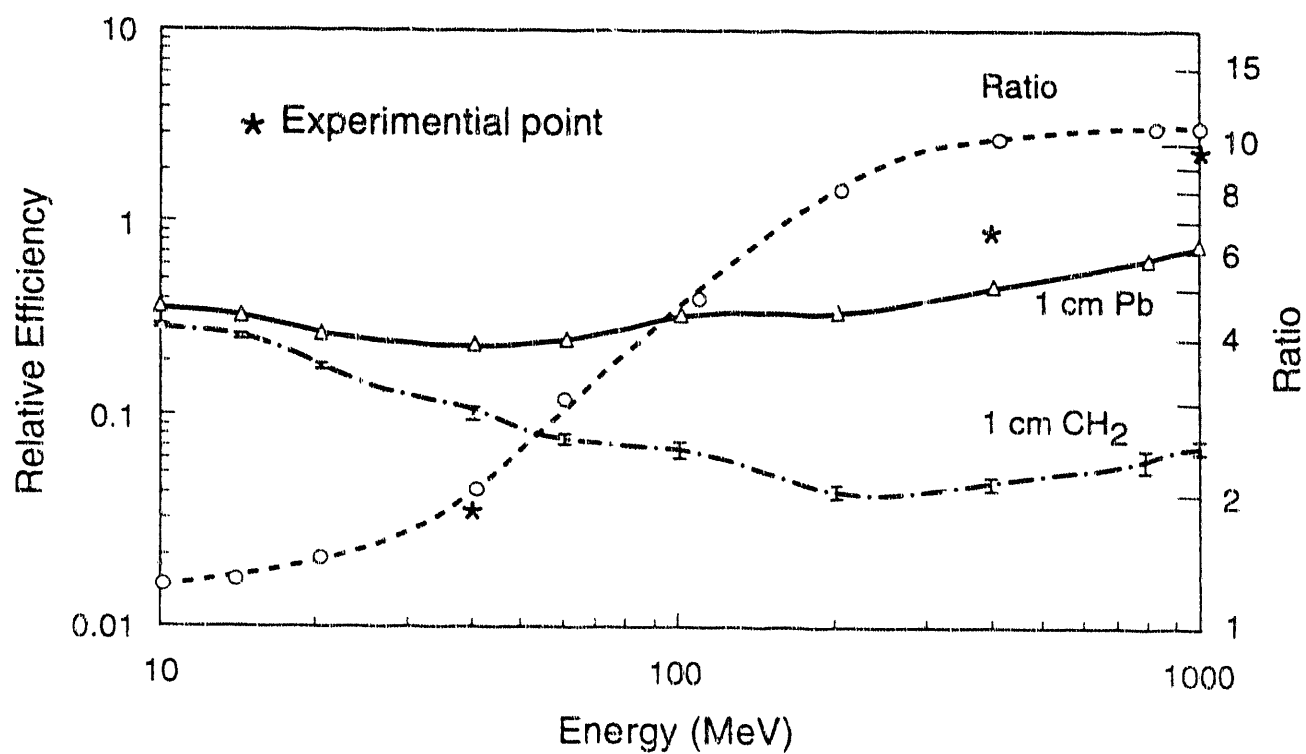


Fig. 2 Responses of Modified Andersson—Braun Remmeter

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