

Summary of a Discussion on the Gain in Thermal Neutron Flux  
by using Grooved Hydrogenous Moderators

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Grooved moderators as investigated experimentally in various laboratories have a potential to yield a higher thermal neutron leakage from their surface than moderators with a flat surface. Gains reported are between a factor of about 1.3 and little more than two. During the discussion which was organized to try to get a better insight into how and under what conditions these gains come about, several sets of data were presented, most of which had already been given earlier. New results were shown at this meeting by the Japanese group (K. Inoue, et al, these proceedings) and by the Los Alamos group, presented by G. Russell.

In the Japanese experiments which referred to a cold moderator, the fin material forming the grooves was simply added to the surface of the flat moderator used for comparison. A gain by a factor 2 or more was found in the integrated yield but not in the peak flux which was reported to stay virtually unchanged. The thickness of the fins and their mutual separation was 1.6 cm which may be somewhat high relative to the mean transport length of about 0.5 cm or even less in a cold  $\text{CH}_4$ -moderator. The experimenters showed that most of the flux came from the bottom of the grooves between the fins.

Measurements by the Los Alamos group showed that the actual shape of the fins (rectangular, triangular or trapeze-shaped cross section) is not of major importance. This is in accordance with the findings during the experiments done for the SNQ-project. It was of interest to see that there was no significant difference in gain whether the fins were arranged parallel or perpendicular to the target surface in a tangential geometry (wing-type geometry). This offset some of the earlier speculations that the improved coupling to the target brought about by the more extended moderator was the prime reason for the gain.

During the discussion it was felt that the magnitude of the gain does depend quite significantly on whether or not a reflected arrangement is used. This view was supported by the data presented by the SNQ-group at the ICANS-IV meeting (G. S. Bauer, proceedings of ICANS-IV). It does seem, however, that

it is also of importance whether or not a moderating reflector is used (e.g. Be as compared to Pb). In the data obtained during the SNQ-mockup experiments for the special arrangement chosen for the DIANE moderator-reflector system with a large target and a Pb reflector, a significant gain was found for the integrated flux as well as for the peak flux (fig. 1, after data presented at ICANS-V, Bauer et al). A summary of the integrated flux (the quantity of prime interest in an intensity modulated source) obtained at the CERN-Booster for various arrangements (Bauer et al, ICANS-V) is shown in Fig. 2. Here 1.0 is the reference value of the DIANE moderator-reflector design for all energies.

It was concluded, that the answer to the question, whether or not grooved moderators are of advantage in any given design, depends very much on the way in which the source will be used and what its time average power is. The slight pulse-broadening that may be introduced may offset the intensity gain in certain cases on a well reflected and decoupled moderator. If, however, the pulse is long anyway, e.g. because of a long source pulse or because excessive heating precludes the use of a decoupler, the gain from using a grooved moderator is certainly worth the effort.

Grooved moderators of hydrogenous materials essentially work like reentrant beam holes in a moderator of large transport length. In this sense it should be anticipated that there is also a gain in peak flux, which so far does not seem to have been confirmed unanimously.

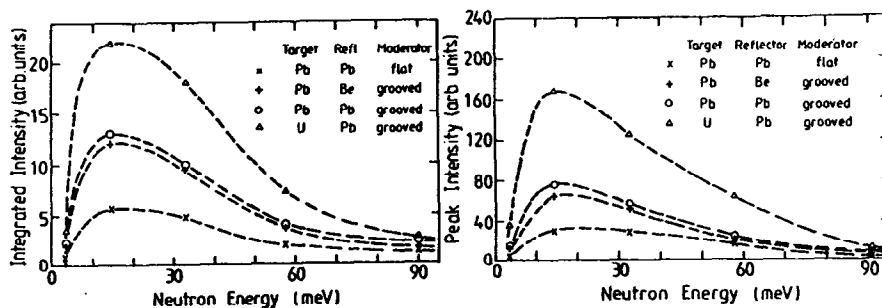


Fig. 1 Relative intensities measured for grooved and flat (polyethylene) moderators with Pb and Be-reflector using targets of Pb and depleted U. Data have not been corrected for crystal reflectivity as a function of energy (higher order reflections used).

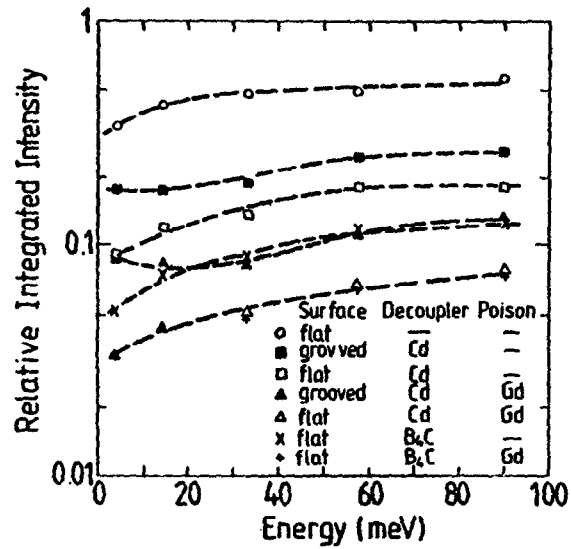


Fig. 2 Energy dependency of the integrated intensity of the reflections of a graphite analyser for various moderator configurations with and without decoupling and poisoning relative to the intensity obtained from a moderator as proposed for DIANE.