Summary of Discussions on Reflector Studies, Neutron Flux and Energy Deposition Studies in the Session, Targets and Moderators: Designs and Tests

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The discussion session on targer-reflector-moderator design included three sessions on moderator optimization and one each on target activation measurements and energy deposition. The Monte Carlo studies of G. Russell were on reflected systems and involved variations in the many parameters in an optimization approach. Generally this involves "tweaking" to make 5-20% gains in the neutron beam yields where the following points merit highlighting:

A. In his studies he found that the removal of the pre-moderator did not decrease the neutron yields. This rather clearly shows that the "reflector" enhancement is due to neutrons coming from the Be rather than being from reflections. This conclusion is based upon the available solid angles for reflection and return for the thin moderators without premoderator and the timing required for neutrons to pass from the moderator to Be and to return. The assumption here being that the incoming neutrons are epithermal >> 30 ev to be compatible with the narrow moderator pulse widths but are not fast neutrons. They are not fast neutrons because they would rapidly leak out of such small system before reaching thermal.

B. Studies of the size of Be reflector show that much smaller sizes are permissable allowing the addition of high Z shielding materials as composite reflectors. These are desirable to shield against fast neutrons from the source and moderator. In addition the reduced mass of the moderator without premoderator would reduce the number of fast particles scattered down the beam tube.

Andrew Taylor presented time dependent crystal diffraction data which show the rough equivalence of Be and Pb "reflectors". Because the time scale for lead moderated neutrons is much longer than Be the in-scattered neutrons from Pb must be above 18 Kev to be compatible with the Be argument above. Removal of the decoupler for a Be system shows a long time decay mode on the tail of the moderator pulses of very low amplitude. These are presumably due to neutrons representing the decay mode in the Be.

Data presented by M. Meier were based upon flux measurements on the moderator surface by means of gold foils. Elegant shape fitting routines provide surface flux shapes showing the areas of highest flux and allowing the choice to be made of where to locate the moderator and the areas of highest flux. Gains of ~ 20% should be available by these means.

The paper presented by D. Filges concerned proton activation measurements in the Pb and Uranium targets as functions of depth. Foils of the same materials were analysed by gamma spectrometry to show the major activities resulting from the proton activation. The information supplies data of immediate interest to machine operators and the designers of handling facilities. Such data will also serve as "bench mark" test material for code developers. Cu foil activations were obtained downstream from the target. These provided high energy neutron activations which show the presence of increasingly higher threshold reaction channels. Because these channels are ~ 8-15 Mev wide, a single foil has great potential for high neutron energy spectral analysis.

W. E. Fischer presented data on energy depositions in the D_2O moderating tank for the SIN Neutron Source. The energy deposition by the fast neutrons during thermalisation has been calculated, but at present only an upper bound estimate for the other contributions is available. The following contributions to the total energy have been calculated for a 1mA current:

1.	High energy neutrons	42.0 kW (UL)
2.	High energy protons	0.8 kW (UL)
3.	Charged pions	0.14 kW (UL)
4.	During thermalisation	18.2 kW (C)
5.	Gammas (from target)	2.6 kW (UL)
6.	Electrons (from target)	0.23 kW (UL)
7.	Gammas (from $D(n,\gamma)T$	2.7 kW (C)

where the qualifiers UL stand for Upper Limit and C for Calculated. This gives an upper limit of approximately 67 kW/mA.

The distribution of energy deposition by the neutrons during thermalisation indicates that 50% of their power contributions is deposited in approximately the first 6cm of the D_2O and 90% in the first 22cm. The peak energy density for this contribution is 1.0 W/cc at 1mA.