Energy spectra and absolute yields of neutrons from a thick copper target bombarded by 270 MeV $^3\text{He}$ particles have been measured. Information about absorption of neutrons has also been obtained with the use of a shadow bar. The results of these measurements are important for estimating the neutron background which is produced in the focal plane of the $K=600$ magnetic spectrograph when the $^3\text{He}$ beam hits an internal Faraday cup inside the spectrograph in the $(^3\text{He},t)$ reaction at 0°.

Beams of 1 to 3 na, pulse-selected 1:2 (period 63 nsec) were directed onto a thick Cu viewer located in beam line 5. An NE102 plastic scintillator, 2.5 x 2.5 x 5.1 cm$^3$, served as neutron detector. It was mounted at a distance of 196 cm and at an angle of 19° with respect to the beam. A thin charged-particle veto scintillator in front of the neutron detector was used to eliminate events triggered by high-energy charged particles. The pulse height calibration of the detector used the known conversion between electron energy and proton energy$^1$ and the location of the Compton edges$^2$ for $^{22}\text{Na}$, $^{137}\text{Cs}$ and $^{228}\text{Th}$. A typical two-dimensional spectrum of pulse height versus time-of-flight is displayed in Fig. 1. Prompt gamma rays from the target appear in channel 940. Pulse-selection leak-through from the intermediate beam burst about 32 nsec after the main burst is seen near channel 100. Time-uncorrelated background at low pulse heights is due to $(n,n)$, $(n,n')$ and $(n,n'_\gamma)$ reactions in the walls and the floor.

Combining the pulse-height and time-of-flight calibrations with scintillator efficiency calculations using the program of Cecil, Anderson and Madey$^1$ makes it possible to construct consistent absolute neutron spectra. The time-independent background must be eliminated with appropriate software pulse-height thresholds. The experimental neutron spectrum so obtained is shown in Fig. 2 in units of neutrons/MeV sr incident particle).

The spectrum displays a low-energy plateau of about $2 \times 10^{-4}$ n(MeV)$^{-1}$(sr)$^{-1}(^3\text{He})^{-1}$ extending to about 70 MeV, followed by an essentially exponential falloff over three orders of magnitude. Also shown in Fig. 2 is a calculated spectrum obtained by assuming projectile fragmentation.$^3$ The shape of the experimental spectrum above 80 MeV is exceptionally well reproduced, but the calculations overpredict the
located 3.4 m from the low-resolution exit port. The focal plane detector is shielded by 1.6 m of Fe from the neutrons emitted from the beam stop at 19° with respect to the \(^{3}\text{He}\) beam direction. Using the procedures of Ref. 3 to estimate the absorption in Fe and the scintillator efficiency of Ref. 1 leads to a neutron background rate in the focal plane scintillators of a few events per second for a 200 MeV \(^{3}\text{He}\) beam of 100 na. However, this estimate is probably too low, and rates of a few 100 counts/sec are more realistic. Shadow bar measurements which were intended to test the absorption calculations are not fully understood yet and are likely to require a modification of the procedures of Ref. 3. The assumption that the effective removal cross section is about 50% of the total cross section\(^6\) seems to give a reasonable attenuation length in Fe of about 20 cm.

5) R.G. Alsmiller, R.T. Santoro and J. Barish, Particle Accelerator 7 (1975) 1; see also H.S. Smith, IUCF Internal Report IUCF 74-6 (1974).