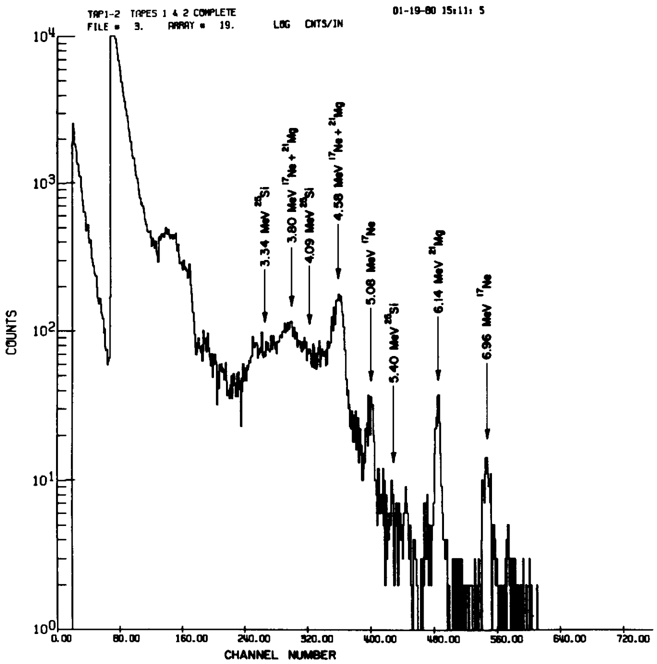

Figure 1. Delayed proton spectrum observed following 175 MeV proton bombardment of ^{24}Mg. The energies listed are the laboratory proton energies associated with the various peaks. The 5.40 MeV peak appears to decay at a rate consistent with that of ^{25}Si.

dominant ^{25}Si peak at 4.089 MeV should be seen. In the next run, use of a 1000 μm thick detector and modification of the target assembly geometry to take advantage of the unique kinematics of the $(p,\pi^- xn)$ reactions near threshold are expected to improve the signal-to-noise ratio. Relatively clean ^{25}Si peaks have been observed with lower background by using longer delays prior to the initiation of counting. This allows the shorter lived ^{21}Mg, ^{17}Ne, and ^{9}C activities (∿ 110-130 ms) to decay to a greater extent than the ^{25}Si activity (220 ms). This, however, reduces the overall counting efficiency considerably. We believe that the planned steps will make a significant improvement of the data quality in our next run. In addition, we plan to install ^{16}O targets, in which case the only background protons will arise from ^{9}C and the ^{17}Ne activity and should be correspondingly easier to detect. In this case, only two states of ^{17}Ne are particle stable.

RECOIL DETECTION OF THRESHOLD PION REACTIONS

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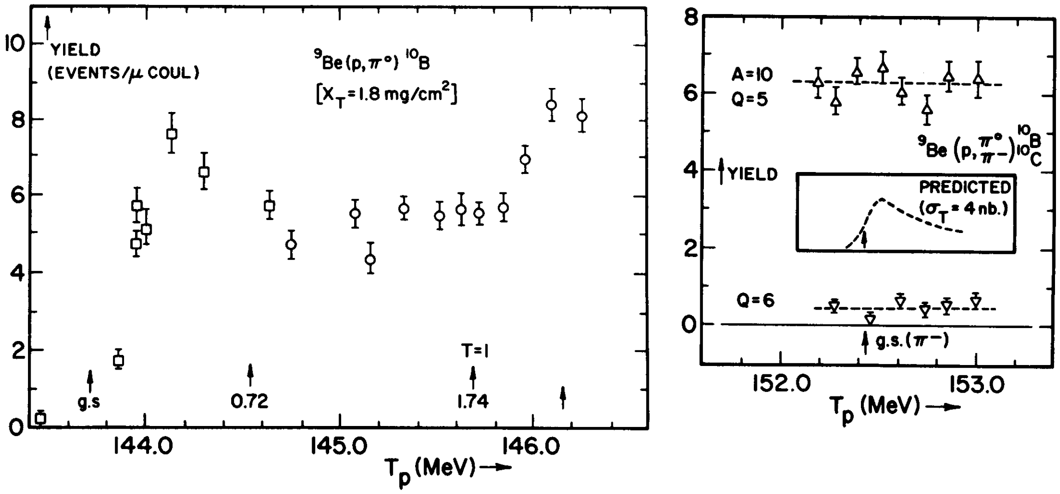
The technique of observing the (p,π°) reaction threshold by detection of the product nucleus 0° recoil was described in the IUCF 1978 report. During 1979 this technique was applied to the reactions $^{9}Be(p,\pi^\circ)^{10}B(g.s.)$ and $^{9}Be(p,\pi^0)^{10}B^*(E_x = 1.74$ MeV). The excited state is of particular interest as the third member of an isospin triplet for which the $^{9}Be(p,\pi^+)^{10}Be$ cross section has been recently determined within 2 MeV of threshold[1], and for which the $^{9}Be(p,\pi^-)^{10}C(g.s.)$ cross section is known at higher energy. The $^{9}Be(p,\pi^0)^{10}Be(g.s.)$ cross section has recently been independently determined by a different technique[2] so that the recoil experiment can provide information on the excited state cross section independent of absolute normalization of the recoil detection efficiency.

The excitation function for the recoil yield is shown in Fig. 1. The method used to change cyclotron energies by a fraction of an MeV requires only a few minutes so that many data points could be taken in a run of 2 or 3 shifts. The right side of the figure shows a search for the threshold $^{9}Be(p,\pi^-)^{10}C(g.s)$ reaction by the same apparatus. The detector in this run was set first for mass-10, charge state 5^+, for which it was sensitive to a large background from the total (p,π°)

Figure 1. (left) Excitation function for the recoil yield for the $^9Be(p,\pi^0)^{10}Be$ reaction. Arrows show the threshold for various excited states of ^{10}Be. (right) Excitation function search for the threshold for the $^9Be(p,\pi^-)^{10}C$ reaction. The inset figure shows the predicted energy dependence of the cross section at threshold.



yield for the several, particle-stable states of ^{10}B, as well as the (p,π^-) process of interest, and alternatively set for 6^+ recoils to reject the ^{10}B background. Preliminary analysis of this data gives an upper bound to the (p,π^-) yield which is somewhat smaller than expected by extrapolation downward in energy, from the single known cross section value from Uppsala, using the penetrability and phase space functions which describe the $^{10}B(p,\pi^+)^{11}B$(g.s.) energy dependence.[3]

This apparatus has been dismantled to make room for the QQSP spectrograph. The final results of the measurement and a full description of the technique will be prepared for publication.

1) R.E. Marrs, R.E. Pollock, and W.W. Jacobs, Phys. Rev. C 20, 2308 (1979).

2) M. Pickar, IUCF Experiment 18, reported elsewhere in this volume. See also M. Pickar, et al., Bull. Am. Phys. Soc. 24, 819 (1979)

3) P.H. Pile et al., Phys. Rev. Lett. 42, 1461 (1979).

ACTIVATION MEASUREMENTS OF THE $^{208}Pb(^3He,\pi^-xn)^{211-xn}At$ REACTION

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The $^{208}Pb(^3He,\pi^-xn)^{211-xn}At$ reaction is being studied radiochemically by measuring the residual α-activity of the astatine isotopes. A measurement of the $(^3He,\pi^-)$ yield at energies well below the free nucleon-nucleon pion threshold can be used to test for collective effects in pion production using complex projectiles. Bertsch[1] has calculated pion-production in heavy ion collisions and has shown that neglecting collective effects, the $(^3He,\pi)$ reaction cross section at 70 MeV/nucleon gives zero and by including the internal momentum of the nucleons in ^3He, it yields ∿ 1 nb. Wall et al.[2] reported a $^{12}C(^3He,\pi^0)$ cross section of ≤ 0.007 nb/sr-MeV at 200 MeV bombarding energy, yielding a total cross section of the order of ≤ 1 nb. More recently Benenson et al.[3] have measured the π^+/π^- yields produced by ^{20}Ne heavy ions from 85-400 MeV/nucleon on a number of targets. Those results compare favorably with the Bertsch type calculation and indicate that the production of pions with complex projectiles is consistent with his simple model.