handle higher rates. We concluded that a NaI detector system would be much more complicated than the present system and most likely not justified at this time.

We hope to take a few more shifts in the spring to further improve the proton beam focus. A modest time in studying the beam could greatly increase our data collecting rate by allowing us to run with higher beam intensities. We then plan to take more data on oxygen to improve the statistical accuracy of our measurement of the angular distribution parameters.


MEASUREMENTS OF \( (p,\pi^-\times n) \) AND \((^3\text{He},\pi^-\times n)\) TOTAL CROSS SECTIONS BY ACTIVATION TECHNIQUES

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In these measurements we hope to take advantage of the distinctive properties of delayed proton emitter spectra as a highly selective indicator that the reactions under study have taken place.

The initial reaction of interest is
\[
24\text{Mg}(p,\pi^-)^{25}\text{Si} \rightarrow ^{25}\text{Al}^* + 24\text{Mg} + p
\]
with measurements of the \( \delta \)-delayed proton spectrum and the lifetimes of the various peaks being used to select events corresponding to the decay of \(^{25}\text{Si}\). If adequate signal-to-noise ratios and high counting efficiencies can be achieved, cross sections (which correspond to the production of \(^{25}\text{Si}\) in any of its seven particle-stable states below the 3.42 MeV proton separation energy) will be measured as a function of energy. These data are intended to complement rather than replace spectrometer data. Using this target, it might also be possible to observe the production of \(^{24}\text{Si}\), produced by the \(24\text{Mg}(p,\pi^-n)^{24}\text{Si}\) reaction.

Other targets and reactions in which the production of \(^{25}\text{Si}\) would provide the signatures are
\[
^{25}\text{Mg}(p,\pi^-n)^{25}\text{Si}; \quad ^{26}\text{Mg}(p,\pi^-2n)^{25}\text{Si}; \quad \text{and} \quad ^{23}\text{Na}(^3\text{He},\pi^-n)^{25}\text{Si}.
\]

Among the additional possibilities for use of the apparatus we are developing are studies of this family of reactions leading to the production of \(^{21}\text{Mg}[\text{i.e.}, \quad ^{19}\text{F}(^3\text{He},\pi^-n)^{21}\text{Mg}]\) and of \(^{17}\text{Ne}[\text{i.e.}, \quad ^{16}\text{O}(p,\pi^-)^{17}\text{Ne}; \quad ^{18}\text{O}(p,\pi^-2n)^{17}\text{Ne}; \quad ^{14}\text{N}(^3\text{He},\pi^-)^{17}\text{Ne}; \quad \text{and} \quad ^{15}\text{N}(^3\text{He},\pi^-n)^{17}\text{Ne}]\).

It was hoped initially that counting on one target could proceed while the next was undergoing bombardment. This proved to be not possible because of background probably arising from neutron induced reactions in and near the detectors. A mechanical chopper was then designed and installed between the pre-injector and the injector cyclotron to provide convenient, clean beam pulsing on a time scale \( \geq 10 \text{ m sec} \). The target wheel, its drive motor, and the associated detectors are presently being installed for runs in the 64" scattering chamber; and the chopper motor, target motor, and counting system control pulses are provided by a 6800 microprocessor.

Two runs have provided data useful for diagnostics and evaluation of the practicality of the technique. Figure 1 shows typical data summed over the time channels. The background present comes from the comparatively large amounts of \(^{21}\text{Mg}\) and \(^{17}\text{Ne}\) produced, together with that arising from continuum low energy protons and from the energy loss of the more energetic \(^9\text{C}\) delayed protons passing through the 500 \( \mu \text{m} \) \( \text{Si} \) detector (which lose from 3 to 8 MeV in the detector). This background obscures the region in which the...
The technique of observing the \((p,\pi^0)\) 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 \(^9\text{Be}(p,\pi^0)^{10}\text{B}(\text{g.s.})\) and \(^9\text{Be}(p,\pi^0)^{10}\text{B}^*(E_x=1.74\text{ MeV})\). The excited state is of particular interest as the third member of an isospin triplet for which the \(^9\text{Be}(p,\pi^+)\)\(^{10}\text{Be}\) cross section has been recently determined within 2 MeV of threshold\(^1\), and for which the \(^9\text{Be}(p,\pi^-)^{10}\text{C}(\text{g.s.})\) cross section is known at higher energy. The \(^9\text{Be}(p,\pi^0)^{10}\text{Be}(\text{g.s.})\) 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 \(^9\text{Be}(p,\pi^-)^{10}\text{C}(\text{g.s.})\) 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 \((p,\pi^+)\)