# MEASUREMENT OF THE TOTAL (p,π) CROSS SECTIONS THROUGH RESIDUAL ACTIVITY

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The residual activity measurement of pion production near threshold has centered on the $^{209}Bi(p,\pi^o)^{210}Po$ reaction with additional efforts at observing the $(p,\pi^+)$ and $(p,\pi^-)$ reactions. Radiochemical procedures for the separation of Bi, Po and At activities have been developed. The residual activity counted in all three pion producing reactions is $^{210}Po$, formed directly or from the EC or $\beta^-$ decay of $^{210}At$ and $^{210}Bi$, respectively.

Monoisotopic Bismuth is ideal for a standard measurement of the total (p,π) cross section for a number of reasons. These are: a) Bismuth lacks spectroscopic impurities of higher Z elements (of those higher in Z only Th and U are "stable") and b) the reaction products $^{210}At(\pi^-)$, $^{210}Po(\pi^o)$ and $^{210}Bi(\pi^+)$ are easily separated radiochemically and identified spectroscopically by alpha or gamma-ray counting. Initially we studied Po production from targets of various thicknesses (5, 25, 600 mg/cm$^2$) at proton energies of 125, 147 and 160 MeV and found substantial secondary isotope production, in particular from the (α,xn) reaction from thick targets.

The results of neutral pion production from protons on Bismuth near threshold are shown in Figure 1. The excitation function was obtained from measurements with proton energies in the range of 62-165 MeV. These results compare well with those obtained earlier by Shaw and Daly[1] in the 65-125 MeV range including one data point above pion threshold at 150 MeV. The uncertainty in our measurement is estimated to be about 20%.

Thick target (≃ 100 mg/cm$^2$) measurements of the $^{210}Po$ yields by Daly and Shaw[1] required a substantial reduction (≃ 50%) due to secondary reactions in order to obtain the net $(p,\gamma+\pi^o)$ contribution. In our measurements we used thin 10-15 mg/cm$^2$ targets, thus substantially reducing the secondary contributions to less than 0.3 μb near pion threshold.

To investigate the $^{209}Bi(p,\pi^-)^{210}At$ reaction we have isolated At from Bi bombarded with 135-182 MeV Protons. In figure 2 is shown a plot of the relative cross sections for At isotope production from 10-15 mg/cm$^2$ targets at 160 MeV proton energy. The yield of $^{211}At$ was observed to be 40 nb in the 130-183 MeV range. Clearly the yields indicate substantial (α,xn) secondary contributions with target thicknesses of 10-15 mg/cm$^2$. Thus, a measurement of the $(p,\pi^-)$ cross section should be performed with very thin ≤ 1 mg/cm$^2$ targets in order to limit (α,3n) contributions to ≃ 1 nb. Further measurements near pion threshold and above are planned.

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1) P.J. Daly and P.F.D. Shaw, Nucl. Phys. 56 (1964) 322.

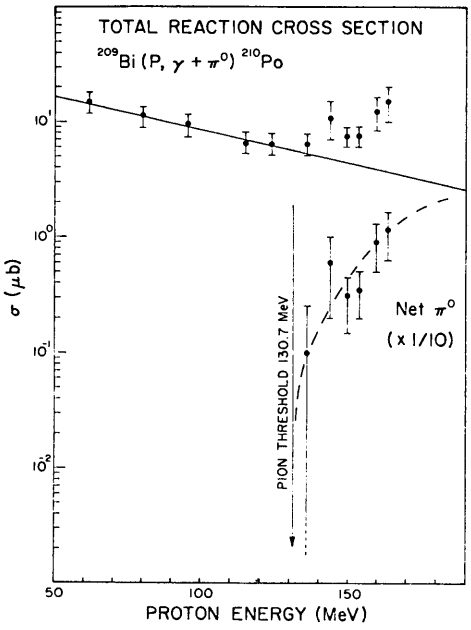


Figure 1

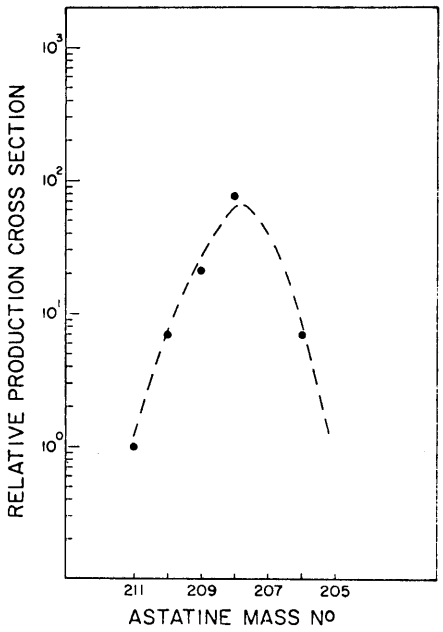


Figure 2