TOTAL MASS AND CHARGE DISTRIBUTIONS IN THE p + ^{27}Al REACTION AT 180 MeV

S. Zhou, K. Kwiatkowski, T.E. Ward and V.E. Viola, Jr.
Indiana University Cyclotron Facility, Bloomington, Indiana 47405

H. Breuer and A. Gokmen
University of Maryland, College Park, Maryland 20742

G.J. Mathews
Lawrence Livermore Laboratory, Livermore, California 94550

Total mass and charge distributions have been measured for reaction products formed in the interaction of 180-MeV protons with ^{27}Al. The fragment mass distributions, $d^3\sigma/d\Omega dEdA$, were measured with a channel-plate, fast-timing semiconductor detector system which permitted discrete identification of all nuclides with A>6 and energies above 0.1 MeV/nucleon. Charge distributions, $d\sigma^3/d\Omega dEdz$, were obtained with a gas-ionization, semiconductor detector telescope which uniquely identified products with Z>3 for energies above 0.25 MeV/nucleon. Measurements of H and He spectra were provided by a conventional, three-element, semiconductor detector telescope.

An example of the mass yield curve for reaction products detected at 20° to the beam is shown in Fig. 1. Enhanced yields are observed for products with A=12, 16 and 20. This feature is characteristic of the observed spectra at all angles. This behavior presumably reflects the influence of ground-state Q-values during the evaporation stage of de-excitation. In Fig. 2 the angular distributions of selected

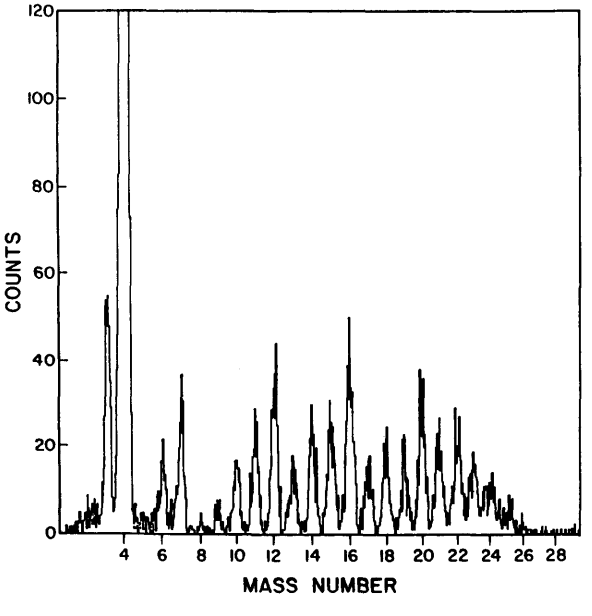

Figure 1. Mass spectrum at 20° resulting from the bombardment of ^{27}Al by 180 MeV protons.

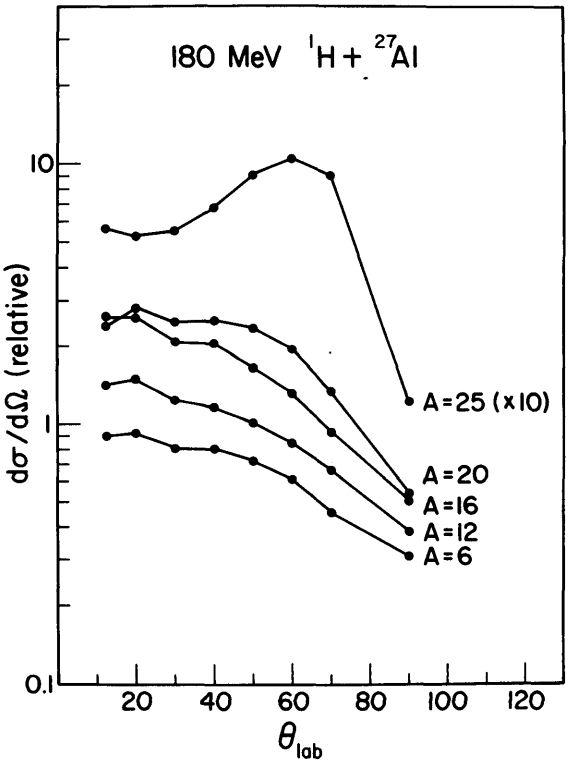

Figure 2. Angular distributions for A=6, 12, 16, 20 and 25 isobars produced by the reaction of 180 MeV protons with ^{27}Al.

fragments are plotted. The lighter fragments exhibit forward-peaked angular distributions; but, as the fragment mass increases, there is a systematic enhancement of the yields at backward angles near the target elastic recoil axis. Both the angular distributions and the associated energy spectra are consistent with a picture in which the light fragments originate largely from high deposition-energy events, whereas the heavier fragments are associated with simple cascade processes followed by statiscal decay involving smaller amounts of excitation energy.

These data will be used to examine existing cascade-evaporation codes[1] and total reaction cross section predictions.[2] In addition they are of interest to problems related to galactic cosmic ray transport through the interstellar medium and to microcircuit upsets in semiconductor devices aboard space satellites.

1) K. Chen, Z. Frankel, G. Friedlander, J.R. Grover, J.M. Miller, and Y. Shimamoto, Phys. Rev. 166, 949 (1968); G.J. Mathews, Phys. Rev., to be published.

2) J.C. Peng, R.M. DeVries, N.J. DiGiacomo, Phys. Lett. 98B, 244 (1981).

ANALYZING POWER OF THE PROTON CONTINUUM FOR 150 AND 200 MeV POLARIZED PROTONS ON ^{12}C AND $^{58,62}Ni$

C.C. Chang, N.S. Chant, G. Ciangaru, A. Nadasen, P.G. Roos, and J. Wesick
University of Maryland, College Park, Maryland 20742

J.R. Hall, M. Saber, P.P. Singh, and E.J. Stephenson
Indiana University Cyclotron Facility, Bloomington, Indiana 47405

R.N. Boyd and T.R. Donoghue
Ohio State University, Columbus, Ohio 43210

R. Segel and P. Zupranski
Northwestern University, Evanston, Illinois 60201

J. Maher
University of Pittsburgh, Pittsburgh, Pennsylvania 15260

The inclusive neutron and charged-particle continuum spectra induced by the bombardment of many target nuclei by medium energy protons have been well studied.[1,2] One common feature of the energy spectra is that the yields to the continuum are large and very forward peaked. Efforts in the past few years have concentrated on attempting to understand the major nuclear reaction mechanisms by which the incident proton dissipates its energy to the target nucleus, resulting in the continuum part of the energy spectra.

Two major competitive mechanisms have been proposed; (1) the quasifree nucleon-nucleon (QFNN) scattering mechanism and (2) the collective multipole, excitation mechanism. The evidences in support of these two mechanisms, although numerous, are in some cases, only suggestive.

One experiment which can shed some light on the importance of the QFNN scattering mechanism is to measure the $(\vec{p},p')$ analyzing power, $A(E,\theta)$, of the continuum as a function of the detection angle. It is expected that if the QFNN scattering mechanism is indeed an important mechanism, the measured $A(E,\theta)$ for the (p,p') continuum should be predictable from the free p-p and p-n analyzing powers, appropriately folded with the momentum distribution of the struck nucleons in the target nucleus and corrected for the mean field effects.

Initial measurements of the analyzing powers of outgoing protons, deuterons and tritons for 150 and 200 MeV polarized proton beams on ^{12}C and $^{58,62}Ni$ targets