

CHARGED PARTICLES FROM THE BOMBARDMENT OF COMPLEX NUCLEI WITH MEDIUM ENERGY PROTONS

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Spectra of protons, deuterons, tritons, ^3He , and ^4He were taken from ^{27}Al , ^{58}Ni , ^{62}Ni , and ^{208}Pb targets. Most of the data was taken at a bombarding energy of 165 MeV, although some data was taken at 100 MeV. The angular range between 25° and 150° was covered. In all cases, the spectra could be characterized as having a low energy evaporation peak and a fast spectrum going up to near the maximum energy. The high energy particles are attributed to a direct interaction and, since the mechanism for producing fast and slow particles is quite different, it is best to discuss the two parts of the spectra separately.

At the 165 MeV bombarding energy, at the high energy end of the spectra which, for definiteness, is taken as particles with energy >95 MeV, for all targets there were about 5% as many deuterons as protons. Tritons are down by about another factor of 20 although for ^{208}Pb the d:t ratio was only about 10. For ^{27}Al , ^{62}Ni , ^{208}Pb the t: ^3He ratio was about 4:1 while for ^{58}Ni this ratio was about unity. For ^{58}Ni , there were about as many fast alpha as ^3He particles while for the other targets the alphas were about four times as intense. The data supports the contention that the fast complex particles that do escape originate near the surface of the nucleus.

For lower energy emergent particles the cross sections decrease less with increasing complexity. For ^{58}Ni , in the 48-95 MeV region, the p:d:t: ^3He : ^4He ratios are approximately 1:0.1:0.01:0.01:0.01. The fact that the mass-3 spectra are degraded relative to that of the deuterons which, in turn are degraded rela-

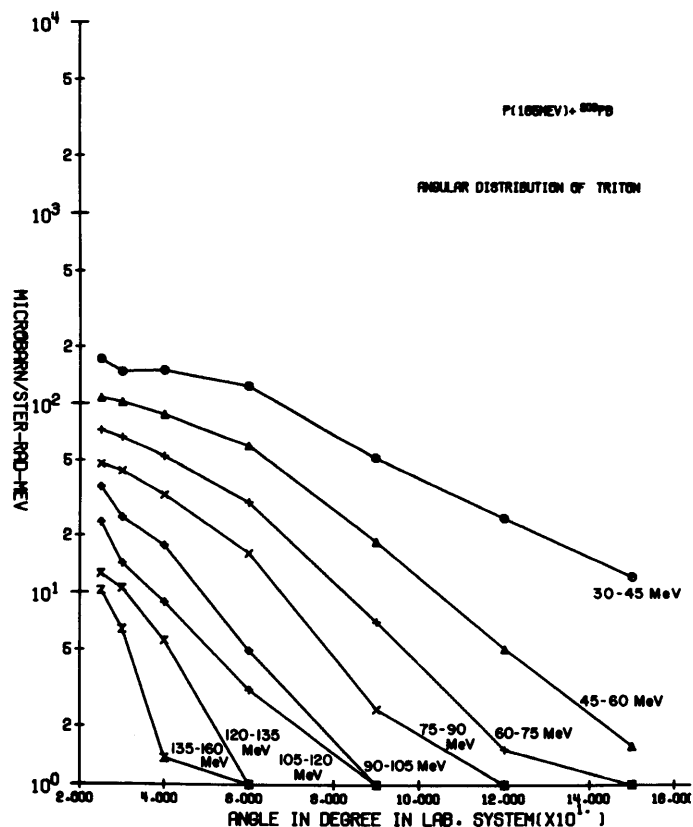


Figure 1. Angular distributions of tritons from the bombardment of 165 MeV protons on ^{208}Pb . The various curves are for different regions of the outgoing triton energy spectrum.

tive to the protons, supports the contention that the more complex particles are formed by successive nucleon pickup.

The only calculation presently available to which the data can be compared are semi-classical calculations. Cascade calculations predict a prominent quasi-elastic peak in the proton spectrum and this is not observed. For the more complex particles, only calculations, also semi-classical, using the exciton model are available. These only predict the angle

integrated spectra but even for this the agreement between experiment and calculation is poor in both magnitude and shape.

As expected, the angular distributions for the various (fast) particles were forward peaked, the more strongly so the higher the particle energy. Figure 1 shows, as an example, the angular distributions of tritons from ^{208}Pb . Angular distributions were not greatly dependent on exit particle species or on target.

DECAY MODES OF THE NUCLEAR CONTINUUM EXCITED IN PROTON-NUCLEUS INTERACTIONS

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In plane particle-gamma coincidences have been measured following 80 MeV proton bombardment of ^{62}Ni using the cyclotron facilities of the two institutions. Particles were detected in a three element silicon and intrinsic germanium telescope placed at 25.5° , 35° , and 45.5° and three Ge(Li) gamma-ray detectors were located at 135° , -75° , and -138° with respect to the beam.

A preliminary analysis shows that discreet gammas corresponding to transitions among the low lying levels of various nickel isotopes are in coincidence with a proton spectrum consisting of a peak, FWHM=10 MeV, centroid about 10 MeV above threshold for each case, and a tail towards lower energies (see Fig. 1). The peaks in these spectra can be understood to arise from mechanisms such as $^{62}\text{Ni}(p,p')^{62}\text{Ni}^* \rightarrow x\tilde{n} + ^{62-x}\text{Ni}$, where x is the number of evaporation neutrons. The tails reflect the role of processes such as $^{62}\text{Ni}(p,pxn)^{62-x}\text{Ni}$. More detailed analysis is now in progress.

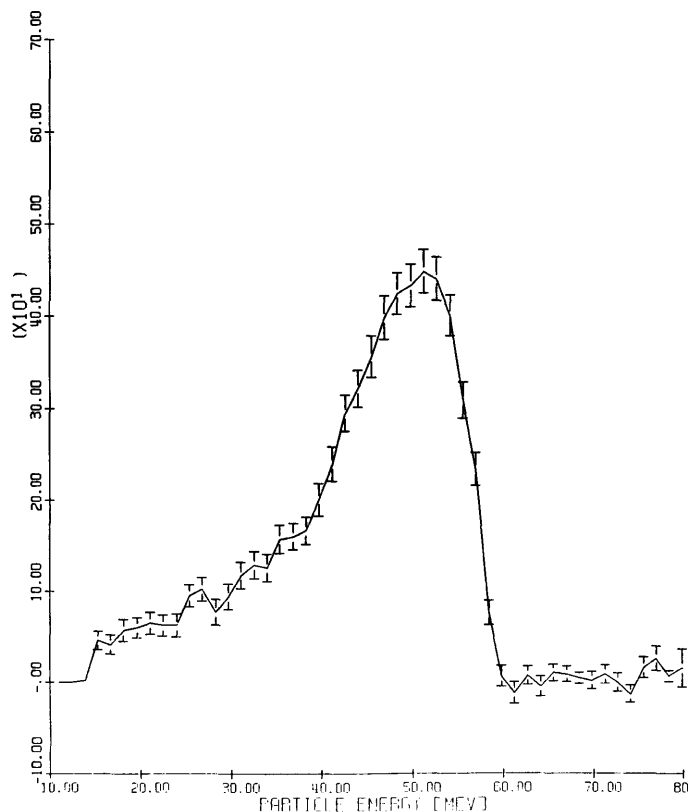


Figure 1. Protons in coincidence with the 1333 keV gamma-ray of ^{60}Ni . Both accidental coincidences and compton background have been subtracted from this spectrum.