

SEQUENTIAL NEUTRON EMISSION IN ^{16}O INDUCED REACTIONS ON ^{27}Al
AND ^{64}Ni AT 6-12 MeV/u BOMBARDING ENERGY

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The correlation measurements between neutrons and projectile-like fragments (PLF) have been extended up to 9 MeV/u above the Coulomb barrier. In all cases the total neutron yield can be explained assuming only two isotropically emitting sources: (i) statistical evaporation from the fully accelerated target-like fragment and (ii) sequential emission of fast forward directed neutrons from fully accelerated exited PLF.

Conclusive evidence for sequential ejectile decay was deduced from the observation of distinct peaks in the relative energy spectra ($E_{\text{PLF-n}}$) for Z=6 and Z=8 fragments emitted together with neutrons. These structures appeared also in the n velocity plots and could be attributed to known n-unstable states in ^{13}C and ^{17}O . For the quasielastic component, the isotope ^{17}O could be unambiguously identified by Q-value considerations. That suggests a direct excitation process, n pick-up from the target, prior to the sequential PLF decay. On the basis of the striking similarities of the quasielastic and deep-inelastic $E_{\text{PLF-n}}$ distributions it seems most likely that this reaction mechanism is also responsible for the fast forward directed neutrons in the strongly damped region.

Our results provide no significant evidence for preequilibrium effects. Preequilibrium neutron emission can be excluded with an upper limit estimate (expressed in n multiplicities):

$$M_{PE} < 0.2 \quad (\text{for } 123 \text{ and } 143 \text{ MeV, } {}^{64}\text{Ni target})$$

$$M_{PE} < 0.12 \quad (\text{for } 192 \text{ MeV, } {}^{64}\text{Ni target})$$

$$M_{PE} < 0.1 \quad (\text{for } 94 \text{ MeV, } {}^{27}\text{Al target})$$

$M_{PE} < 0.2$ corresponds to less than 5 % of all neutrons emitted in the DI region at 192 MeV bombarding energy.

The multiplicities and nuclear temperatures of the heavy fragments are in all cases in good agreement with evaporation calculations. For ${}^{64}\text{Ni}$, the ratios of the observed neutron multiplicities are close to the respective mass ratios for all Q-values. Differences between both reactions can be explained by the different N/Z ratio and neutron binding energy for the ${}^{27}\text{Al}$ and ${}^{64}\text{Ni}$ target nuclei. Our results indicate rapid equilibration of the excitation energy even for systems, as light as these.

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