INTRANUCLEAR CASCADE CALCULATIONS OF THE $^{4}He + ^{59}Co$ SYSTEM

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Intranuclear cascade (INC) calculations have been carried out in order to compare with recoil range, mass and charge distribution data[1] for reactions of E/A = 10-50 MeV ^{4}He ions with ^{59}Co. The CLUST code[2] with the "no breakup" option has been used for these calculations at E_α = 48.8, 92.4, 149.5 and 198.9 MeV. From the recoil range data, linear momentum transfer (LMT) distributions were derived for comparison with the calculations.

A plot of the calculated and experimental values of the average LMT, $\langle p_\parallel \rangle/A$, is shown in Fig. 1. The values of $\langle p_\parallel \rangle/A$ are observed to be near the beam momentum at low energies, indicating the dominance of fusion-like processes and increase at a rate somewhat less than the beam momentum up to E/A = 25 MeV. In the energy range from E/A ~ 25-35 MeV, $\langle p_\parallel \rangle/A$ reaches saturation and then decreases at higher energies. General agreement is observed between calculation and experiment, although the calculation underpredicts the data by about 10 percent in the saturation region.

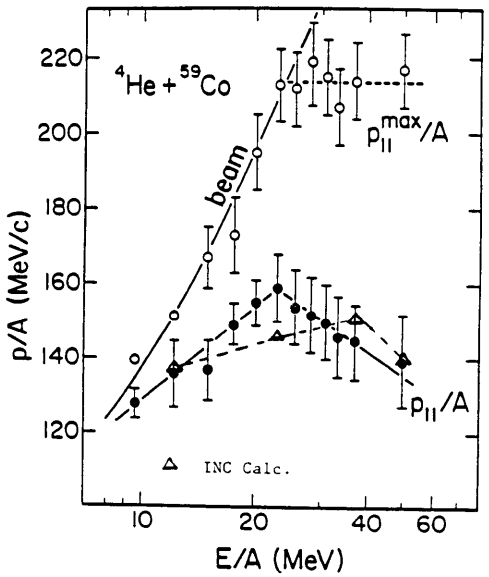

Figure 1. The average (solid circles) and maximum (open circles) longitudinal momentum transfer per projectile nucleon as a function of α-bombarding energy. The solid line represents the incident projectile momentum per nucleon.

From the experimental recoil range data, it was observed that, for a given incident energy, the average longitudinal velocity, $(v_\parallel)$, of isobaric residual nuclei far removed from the compound nucleus ($\Delta A > 10$) begins to saturate. At E_α = 149.5 MeV, the saturation value of $(v_\parallel)$ is 0.43 ± 0.02 $(MeV/amu)^{1/2}$. Interestingly, the INC calculations show very similar behavior for which $(v_\parallel)$ saturates to about 0.47 $(MeV/amu)^{1/2}$.

In summary, the result of the comparison of LMT of experimental data with INC calculations is consistent with those from Ref. 3. We have also found that the distribution of LMT values for the $\alpha + ^{59}Co$ data can be accounted for by the INC model. However, it should be noted that the calculations overpredict the compound nucleus formation.

1) J. Jastrzebski, et al., Physics Letter 136B, 153 (1984).

2) G.J. Mathews, et al., Phys. Rev. C 25, 2181 (1982).

3) L.W. Woo, et al., Phys. Lett. 132B, 283 (1983).