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INCOMPLETE FUSION IN THE $^{12,13}C$ + ^{48}Ti REACTIONS

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The $^{12,13}C$ + ^{48}Ti reactions were studied by means of γ-ray spectrometry of residual nuclei and charged-particle spectroscopy. In particular, production cross sections for individual exit channels were measured using Ge detectors in the energy range 20-60 MeV. Charged-particle angular distributions between 10 and 170 degrees were measured using Si telescopes, at 46 and 47.5 MeV for the reactions induced by ^{13}C and ^{12}C, respectively [1].

In both cases, residual mass and charge distributions show that the relative yields of the exit channels including at least one α-particle are larger than those predicted by statistical calculations performed assuming that the observed cross section (besides inelastic scattering and nucleon transfer) goes into complete fusion.

Alpha-particle double differential cross sections show a marked forward-backward asymmetry in the center of mass, in contrast to proton angular distributions which are consistent with a symmetric emission by a fully equilibrated system. The non-statistical part of the α cross section is characterized by an angular distribution monotonically decreasing with increasing angle, with a superimposed bump centered around the grazing angle. In the angular dependence of energy spectra one component can be recognized which is peaked at a constant energy corresponding roughly to the projectile velocity. The second component shows a decrease of the most probable energy with increasing angle.

Moreover, massive transfers leading to ejectiles below and above projectile mass are observed, with total cross sections amounting to a few mb each, and with angular and energy distributions characteristic of quasi-elastic transfers.

The ensemble of our experimental results is consistent with a limitation to the complete fusion process at an angular momentum as low as 22 $\hbar$, to be compared with the grazing angular momentum (derived from elastic scattering analysis) of 26 $\hbar$. This limitation seems to be related to entrance channel effects rather than to the compound nuclei yrast lines, which lie at higher angular momenta at the investigated energies. This observation is in agreement with the systematics [2], being the mass asymmetry parameter $A_1/(A_1+A_2)$ in the entrance channel rather low. A comparison of this behaviour with that of a more symmetric system leading to the same compound nucleus of the ^{12}C + ^{48}Ti reaction (^{30}Si + ^{30}Si) is under way.

1) H.Dumont et al; in Dynamics of Heavy Ion Collisions, N.Cindro, R.Ricci and W.Greiner editors, North Holland 1981.
2) S.M.Lee; Proc. of the Tsukuba Symp. on Heavy Ion Nuclear Physics, March 1981