CORRELATION OF ^{8}Be FRAGMENTS AND ALPHA PARTICLES EMITTED IN THE INTERACTION OF ^{12}C WITH ^{93}Nb AT AN INCIDENT ENERGY OF 400 MeV

S.V. Förtsch[1], G. Capezzali[2], F. Cerutti[2], S.H. Connell[3], A.A. Cowley[4], E. Gadioli[2], J.J. Lawrie[1], L.J. Mudau[1,5], R. Neveling[1], E. Sideras-Haddad[3], F.D. Smit[1], G.F. Steyn[1]

[1]*iThemba LABS*
[2]*Dipartimento di Fisica, Università di Milano and INFN, Sezione di Milano, Italy*
[3]*School of Physics, Witwatersrand University, Johannesburg*
[4]*Department of Physics, University of Stellenbosch, Stellenbosch*
[5]*Department of Physics, University of Western Cape, Bellville*

Emission of Intermediate Mass Fragments (IMF) is quite a common feature in heavy ion reactions. Many different experimental as well as theoretical studies have been carried out to explain these processes in reactions involving a variety of nuclei at relative energies varying from a few Mev/amu up to several hundred MeV/amu. Despite numerous attempts the subject is still widely debated and a generally accepted theoretical description of the dominant reaction mechanisms which would explain the observed spectra of the emitted particles and fragments is still lacking.

Previous inclusive studies, of IMFs emitted in the interactions of ^{12}C and ^{16}O with medium to heavy-mass nuclei at incident energies of some tens of MeV/amu, have convincingly demonstrated that the IMFs can originate from two unrelated mechanisms: binary fragmentation of the projectile, a break-up mechanism proposed long ago and nucleon coalescence, a statistical process occurring during the nucleon-nucleon cascade interaction by which the nuclei produced in the complete or partial fusion of the projectile and the target, reach a state of thermal equilibrium.

The assumption however of a pure break-up mechanism, as originally hypothesized by Serber to explain the break-up of the deuteron as a process in which the fragmentation of a loosely bound nucleus into two fragments is triggered by the nuclear field acting as a perturbation, could not be applied in these studies. The fragments produced in the interactions between heavier nuclei, although showing phenomena and characteristics expected for a binary fragmentation process, are emitted at lower kinetic energies and have broader energy distributions than predicted by the Serber formalism. This seems to imply either a significant initial state interaction between the projectile and the target, and/or a final state interaction of the observed fragment with the residual nucleus. Furthermore, binary fragmentation of the projectile can be considered either as a peripheral reaction whereby the emitted fragments are detected without further interactions with the target (*quasi-elastic* fragmentation), or in terms of a final state interaction in which the stable fragments further interact with the target nucleus (*inelastic* fragmentation).

In order to ascertain the relative importance of these two break-up mechanisms as well as of nucleon coalescence, a coincidence experiment was recently performed at iThemba LABS by measuring the correlations between $^{8}Be_{gs}$ fragments and α-particles emitted in the interaction of ^{12}C with ^{93}Nb at an incident energy of 400 MeV. Since it seems improbable that the unstable $^{8}Be_{gs}$ fragments will survive any further interactions after projectile break-up, the analysis in this case is somewhat simplified by considering

mainly a possible initial state interaction between ^{12}C and ^{93}Nb prior to the break-up of ^{12}C as well as final state interactions of the partnering α-particle with ^{93}Nb. The experimental findings as well a possible interpretation of these data will be presented.