Decay Competition in IMF Production in the Collisions $^{78}Kr+^{40}Ca$ and $^{86}Kr+^{48}Ca$ at 10 AMeV

B. Gnoffo[1,2], S. Pirrone[2], G. Politi[1,2], M. La Commara[3,4], J.P. Wieleczko[5], E. De Filippo[2], P. Russotto[2], M. Trimarchi[2,6], G. Ademard[7], M. Vigilante[3,4], L. Auditore[2,6], C. Beck[8], I. Berceanu[9], E. Bonnet[5], B. Borderie[7], G. Cardella[2], A. Chbihi[5], M. Colonna[10], S. De Luca[2,6] , A. D'Onofrio[4,11], J.D. Frankland[5], G. Lanzalone[10,12], P. Lautesse[13], D. Lebhertz[5], N. Le Neindre[14], I. Lombardo[3,4], N. S. Martorana[1,10] , S. Norella[2,6], K. Mazurek[5], A. Pagano[2], E.V. Pagano[1,10], M. Papa[2], E. Piasecki[15], F. Porto[2], L .Quattrocchi[1,2], F. Rizzo[1,10], G. Spadaccini[3,4], A. Trifirò[2,6], G. Verde[2,7]

[1]Dipartimento di Fisica e Astronomia, Università di Catania, Italy [2]INFN Sezione di Catania, Italy [3]Dipartimento di Fisica, Università Federico II Napoli, Italy [4]INFN Sezione di Napoli, Italy [5]GANIL Caen, France [6]Dipartimento di Fisica, Università di Messina, Italy [7]IN2P3 - IPN Orsay, France [8]N2P3 - IPHC Strasbourg, France [9]IPNE, Bucharest, Romania [10]INFN Laboratori Nazionali del Sud, Italy [11]Dipartimento di Matematica e Fisica - Seconda Università di Napoli, Caserta, Italy [12]Università Kore, Enna, Italy [13]IN2P3 - IPN Lyon, France [14]IN2P3 - LPC Caen, France [15]University of Warsaw, Poland

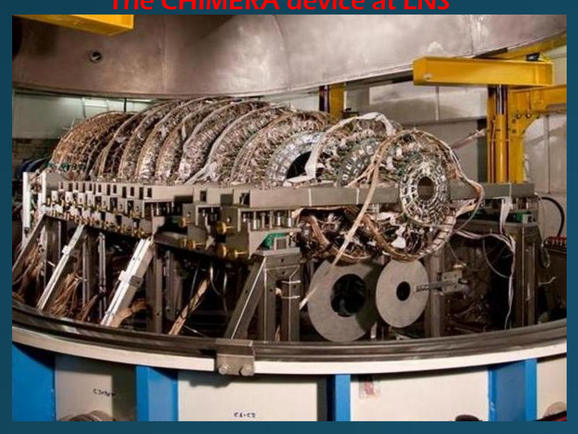
The Program - Isospin Effects on CN Decay

The collisions in the, so called, low energy domain (E=15 AMeV) are characterized by the competition between fusion process and dynamical binary processes. The compound nucleus disexcitation modes produce particles in a wide mass range; in particular the production of the Intermediate Mass Fragments, IMFs, is very interesting because of many features that are not well understood yet. The N/Z ratio, strongly correlated to the isospin degree of freedom, has important effects on the characteristics of the fragments production and it is expected to play a crucial role in the competition among the different decay channels. Formation and decay modes of composite systems have been studied in the reactions $^{78}Kr+^{40}Ca$ and $^{86}Kr+^{48}Ca$ at 10 AMeV at INFN-LNS in Catania [1,3]. The experiment complements the data already obtained at 5.5 MeV/A for $^{78,82}Kr+^{40}Ca$ reactions studied at GANIL by using the INDRA detector [4].

The Method - The CHIMERA Device

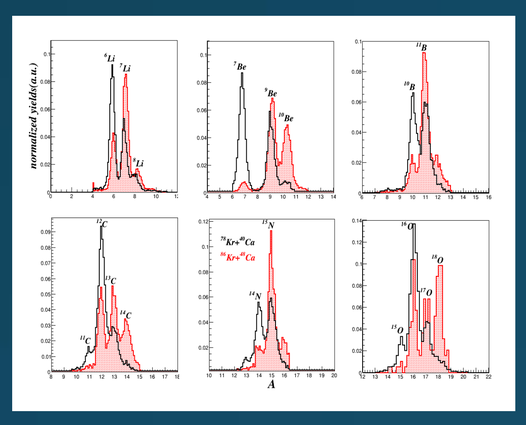
The experiment was performed at INFN-LNS with the 4π multidetector for charged particle CHIMERA [5,6]. This device combines different identification methods as DE-E, TOF and Pulse Shape Discrimination for Silicon and CsI(Tl) signals, providing a complete discrimination in charge and/or mass of the main reaction products.

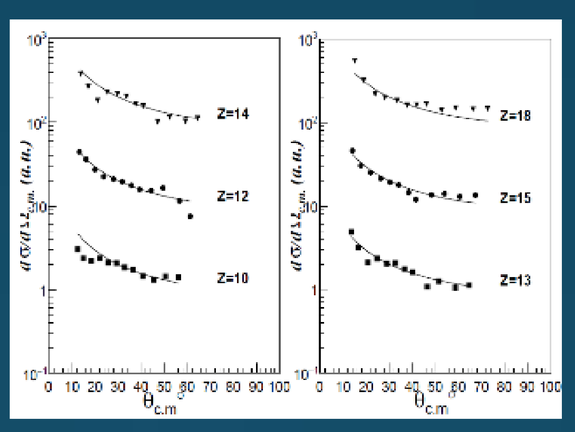
The CHIMERA device at LNS

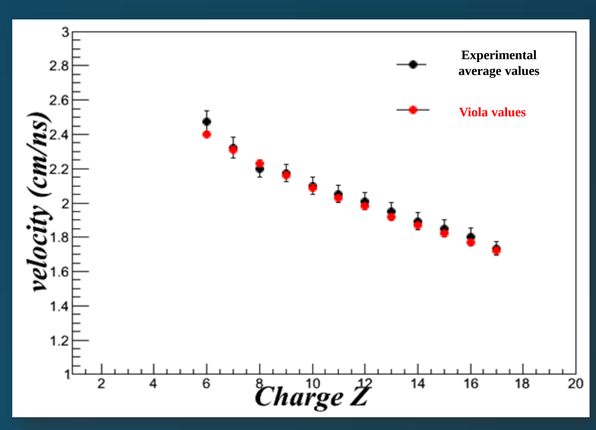


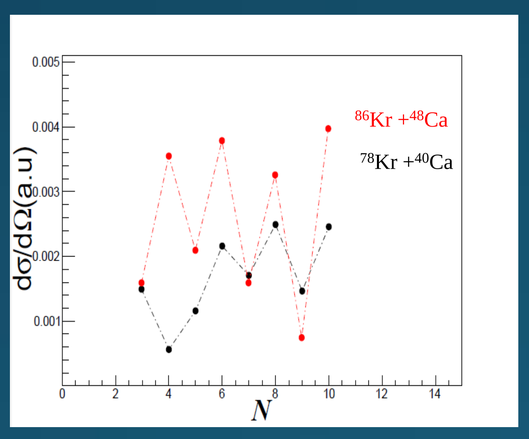
The Results - IMF Characteristics

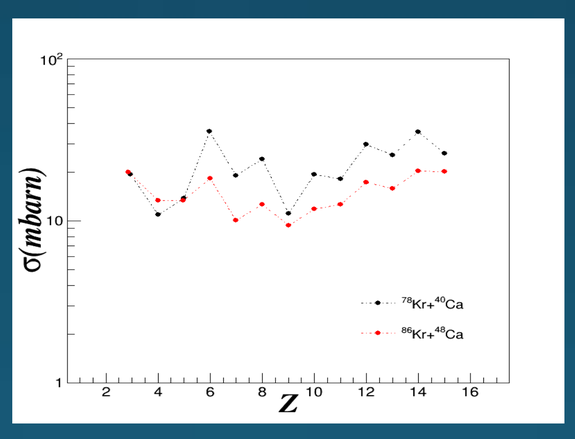
The IMF production shows strong differences in the relative abundance of elements with 2<Z<9 in the two systems. The mean value of the velocity in CM frame, nearly independent of the emission angle and the angular distributions that follow a 1/sinϑ behavior suggest a strong relaxation of the degrees of freedom. The odd – even staggering effect is stronger for the n-poor system in the charge distribution; on the contrary it is more pronounced for the n-rich system in the yields vs N. Yields are compared to the theoretical prediction of the GEMINI++ model [7] .

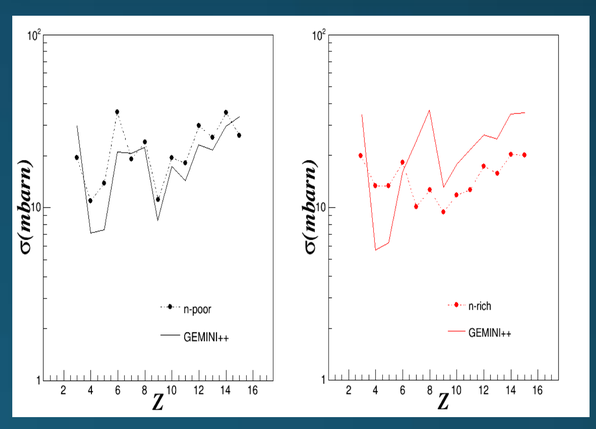






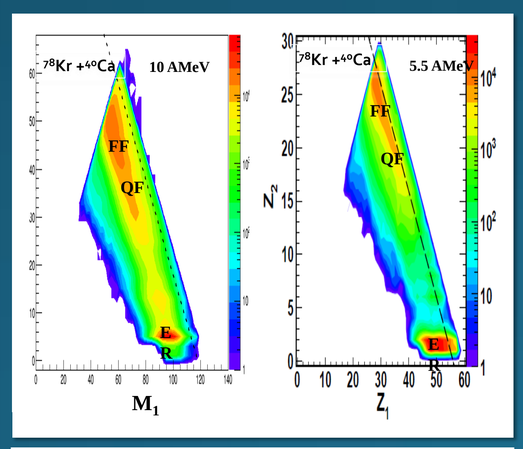


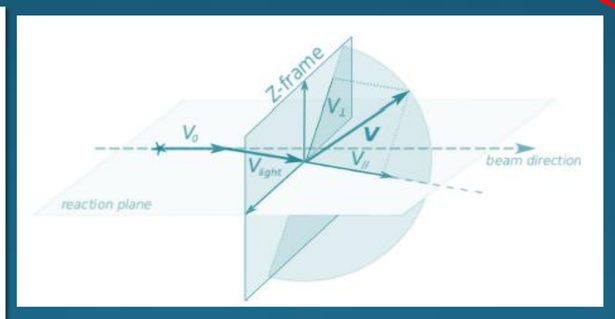


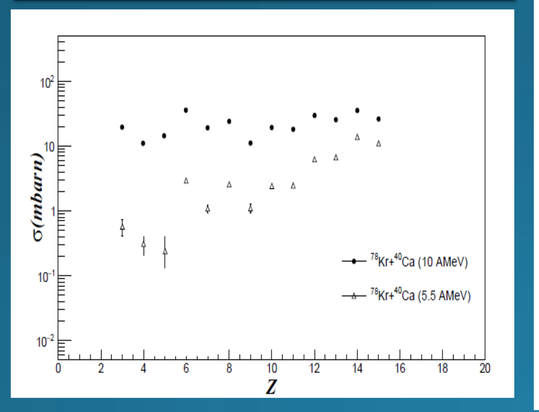


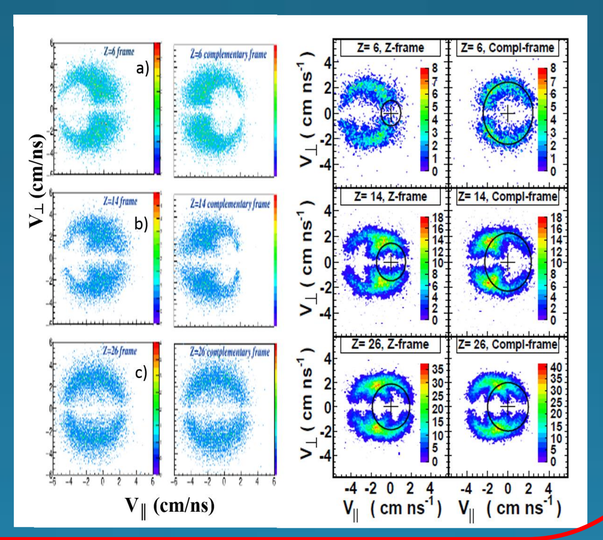
The Results - Comparison in the $^{78}Kr+^{40}Ca$ at two different energies

The comparison between the results of the IMFs cross section production in the reaction $^{78}Kr+^{40}Ca$ at 10 MeV and 5.5 MeV bombarding energy, shows a stronger production of IMFs at higher energy. This result could be due to secondary emissions by the light IMFs as suggested by a preliminary analysis of the relative velocity of alpha and IMF, projected in the fragment frame.









References

[1] G. Politi et al., JPS: conf. Proc., 6 , 030082 (2015)

[2] S. Pirrone et al., EPJ of Conf. 122 13001 (2016)

[3] B. Gnoffo et al., Nuovo Cimento C39, 275 , (2016)

[4] G. Ademard et al. , PRC 83, 054619, (2011)

[5] A. Pagano et al., Nucl. Phys. A 734, 504 , (2004)

[6] G. Politi et al., IEEE Nuclear Science Symposium Conference Record N28, 1140 , (2006)

[7] R. Charity et al., Nuc. Pnys. A 476, 516 ,(1988)