Binary reactions explored with PRISMA+CLARA

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Precision studies of the M, Z, Q-value distributions of nuclei populated in binary reactions, and the determination of their differential and total cross sections is an active area of investigation at LNL [1]. Recent experiments concentrated on closed shell nuclei, being almost ideal cases for quantitative comparison with state-of-art calculations. In particular, we have studied multinucleon transfer processes for the system ^{40}Ca+^{96}Zr close to the Coulomb barrier, in a particle-γ coincidence experiment, using the large solid angle magnetic spectrometer PRISMA, coupled to the CLARA γ-array [2]. A clear identification of the nuclear charge and mass of projectile-like fragments has been obtained up to several proton stripping and neutron pick-up transfer channels. From the mass distribution and from comparison of obtained yields with calculations, we can learn about how degrees of freedom of different complexity, namely single particle, pair or even cluster transfer modes, act in the transfer process. Interesting γ transitions have been observed close to the excitation energy region in ^{42}Ca expected for pairing vibrational states. Fig.1 (left side) shows, as an example, the γ spectra obtained for ^{42}Ca and ^{40}Ar. On the right side we show the γ spectra of the correlated (undetected) heavy partners. From these spectra we could measure the effect of nucleon evaporation from primary fragments. This evaporation effect should become more important as one moves to very neutron rich projectiles, where we also expect a change in the population pattern of stripping and pick-up of protons and neutrons.

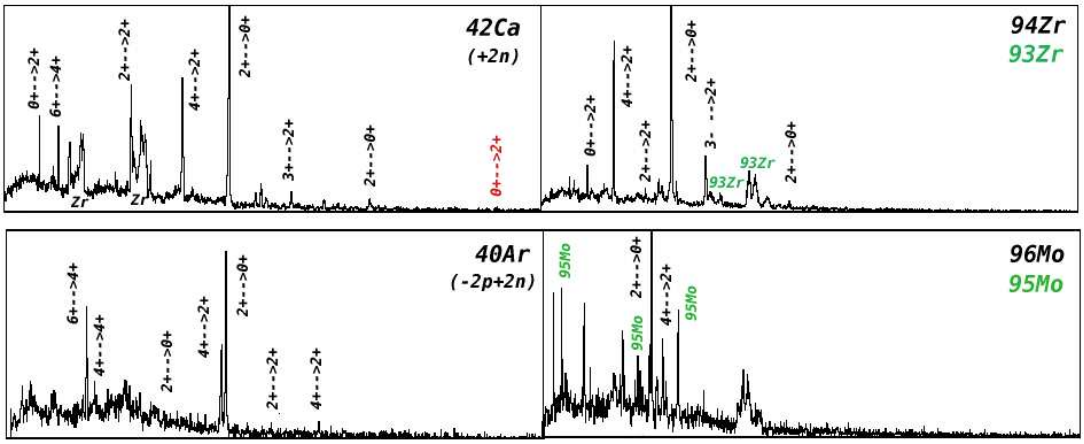

Figure 1: *γ spectra of light and heavy partner of the $+2n$ and $-2p+2n$ channels in the reaction ^{40}Ca+^{96}Zr measured at $E_{\rm lab}$ =152 MeV.*

A presentation will focus mainly on the ^{40}Ca+^{96}Zr reaction, but a more general discussion will be done on preliminary results coming from ongoing studies of heavier combinations, ^{90}Zr+^{208}Pb, and of ^{40}Ar+^{208}Pb. This last reaction has been studied in a very recent test with the beams delivered by the new positive injector for heavy ions PIAVE at LNL.

[1] S. Szilner et al., Phys. Rev. C 71, 044610 (2005); Eur. Phys. J. A 21, 87 (2004);
[2] A.M. Stefanini et al., Nucl. Phys. A 701, 217c (2002); A. Gadea et al., Eur. Phys. J. A 20, 193 (2004). .