Microscopic dynamics study of multinucleon transfer in ^{40}Ar induced collisions at 15 MeV/nucleon for the production of neutron rich isotopes

K. Palli[1], G.A. Souliotis[1], T. Depastas[1], O. Fasoula[1], S. Koulouris[1], M. Veselsky[2], and A. Bonasera[3]

[1] Laboratory of Physical Chemistry, Department of Chemistry, University of Athens, Greece,
[2] Institute of Experimental and Applied Physics, Czech Technical University, Prague, Czech Republic,
[3]Cyclotron Institute, Texas A&M University, College Station, Texas, USA

About half of nuclei heavier than iron in the universe are produced by the rapid neutron capture process (r-process), taking place in supernova explosions and in the merging of neutron stars. To understand this astrophysical process, it is imperative to study the production of isotopes far from the beta-stability line. The main routes to produce neutron-rich isotopes are fission and high-energy projectile fragmentation reactions. In addition, neutron-rich isotopes can be abundantly produced in peripheral multinucleon transfer reactions at energies from the Coulomb barrier to the Fermi energy (30 MeV/nucleon).

In this work, we study the reaction of an ^{40}Ar beam with a ^{64}Ni target at 15 MeV/nucleon [1]. The experimental data presented here were obtained with the MARS spectrometer at the Cyclotron Institute of Texas A&M University along with measurements of the ^{86}Kr + ^{64}Ni reaction [2]. Moreover, we present our calculations performed with the microscopic Constrained Molecular Dynamics model (CoMD) [3]. The de-excitation of the hot projectile-like fragments is performed by the code GEMINI [4].

Our efforts focus on the description of the experimental mass and momentum distributions. We tried to optimize the CoMD code and gain insight into the reaction mechanisms at play in the production of neutron-rich isotopes. In the future, we plan to study other key multinucleon transfer reactions that lead to the production of neutron-rich nuclei toward the neutron drip line and expect to gain valuable information on the path of the r-process.

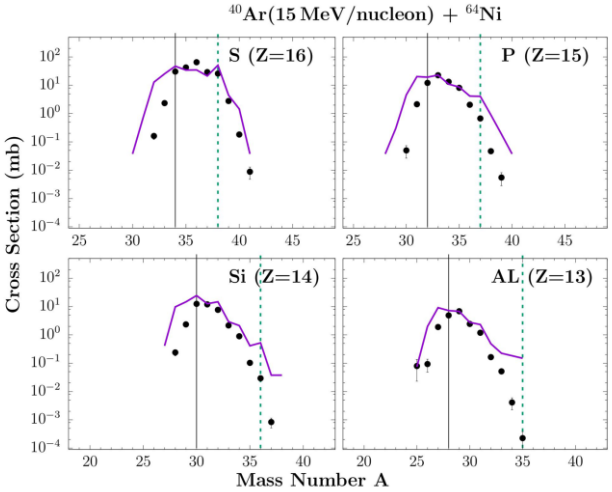

Figure: Mass distributions for the reaction ^{40}Ar + ^{64}Ni for Z=13-16. Black circles: Experimental data, Purple line: CoMD calculation

[1] A. Papageorgiou, G.A. Souliotis et al., Journal of Physics G **45**, 095105 (2018).

[2] G. A. Souliotis et al., Phys. Rev. C **84**, 064607 (2011).

[3] M. Papa et al., Phys. Rev. C **64**, 024612 (2001).

[4] R. Charity et al., Nucl. Phys. A **483**, 371 (1988).

[5] P.N. Fountas, G.A. Souliotis et al., Phys. Rev. C 90, 064613 (2014).