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Systematic optical potentials for cluster-structured nuclei reactions

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Within the IANNA framework, we propose new instruments for nuclear reactions measurements, systematical data and theoretical analyses. In Seville (Spain), we have the National Accelerator Centre (CNA), where a permanent experimental setup is coupled to the 3MV tandem accelerator. Such a setup is based on MARS (Modular Apparatus for nuclear Reactions Spectrometry). With MARS, first exploratory measurements are being performed to the 6Li+12C system. Within the IANNA collaboration, experimental campaigns on 12,13C+119,120Sn (2023) and 12,13C+64Zn (2024) were recently carried out in the LAFN (São Paulo, Brazil). Data analyses are ongoing.

With these data, we propose to study the optical potential (OP) strengths, and their energy dependence, in reactions involving stable, tightly and weakly bound, and exotic nuclei projectiles on different targets, at energies around the respective Coulomb barriers.

Moreover, we analyze experimental elastic scattering angular distributions of 4,6He, 6,7Li, 9,10,11Be and 8B impinging on 64Zn and 120Sn targets. Within the data set, we report on optical model (OM) calculations and the determined OP, with the respective uncertainties quantification, based on the double-folding (DF) São Paulo potential (SPP). Within the SPP approach, the best-fit parameters, from OP study, correlate with projectile breakup process, at scattering energies around the Coulomb barrier. Thus, we propose optimum energies for which the projectile breakup shows to be favored, as a function of the projectile breakup Q-value and the Coulomb barrier of the system. The results show to be systematical, when analysing different weakly bound nuclei projectiles impinging on targets with different masses (and atomic numbers). The OP and their capability of predicting optimum projectile breakup yields, as a function of energy, represents important tools for other applications such as planning new experiments on weakly bound nuclei reactions or extrapolating it to Astrophysical systems/energies.

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