TALENT Course 6: Theory for exploring nuclear reaction experiments
Outline project proposal

Project name: Microscopic folding potentials for inelastic reactions

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Project outline and aims:

We study to what extend the use of effective nucleon-nucleon (NN) interactions in inelastic scattering reactions. The potentials needed for the calculation of inelastic cross sections will be constructed by folding the NN interaction with transition densities calculated in an appropriate structure model. Under certain assumptions (e.g. rotor model), these transition densities can be related to the derivative of the ground state density. This approximation is tested for proton inelastic scattering in different light nuclei.

Methodology:

We will start with the derivation of the single folding potential for a general density dependent nucleon-nucleon interaction. Diagonal and transition potentials will be constructed for required multipoles [1, 2]. Only the spin-independent part of the isoscalar and isovectorial terms of the interaction will be considered.

Using JLM or M3Y nucleon-nucleon interaction, we will write a code to compute simple folding potentials. These potentials will serve as input for FRESCO or similar codes for the calculation of inelastic cross sections. We can then consider inelastic reactions like ^{10}Be(p,p') [3] and compare with experimental data. By comparing the transition density for ^{10}Be between the 0^+ ground state and the first 2^+ excited state with the popular prescription based on the derivative of the ground state density, we can estimate the sensitivity of the potential to the density and the accuracy of the rotor approximation for ^{10}Be.

Afterwards, we can move to double folding potentials. Only the excitation of the projectile will be considered. As a test example in this part, we can study the effect of the inelastic channel in the elastic scattering of ^{10}Be on ^{12}C [4].

Key references:

[1] G. Satchler and W. Love, Phys. Rep. **55**, 183 (1979).

[2] M. Takashina, Y. Kanada-En'yo, and Y. Sakuragi, Phys. Rev. C **71**, 054602 (2005).

[3] M. Takashina and Y. Kanada-En'yo, Phys. Rev. C **77**, 014604 (2008).

[4] J. C. Zamora et al., Phys. Rev. C **84**, 034611 (2011).