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

Project name: Sensitivity study for the ^{20}Ne(d,p)^{21}Ne Transfer Reaction to certainties in the interaction parameters

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Project outline and aims:
The main aim of this project will be to study the sensitivity of different input parameters for the interaction for the ^{20}Ne(d,p)^{21}Ne transfer reaction perfomed at 22 MeV deuteron energy. The ^{20}Ne(d,p)^{21}Ne was perfomed to cover the Gamow window and therefore covered the excitation energies range varying from 6.9-8.5 MeV of the ^{21}Ne. The aim of this experiment was to investigate and extract spectroscopic information presently scarce [1],[2] within the region of interest relevant for the s-process abundances. Further details on the astrophysical motivation of this reaction will be shortly available alongside with experimental details in the Journal of Physics: Conference Series [3].

Sixteen different states have been extracted for which only thirtheen are available in literature. The extraction of the transfer angular momentum distribution will be performed through the first or second order Born approximation calculation.

Methodology:
As an approximation to the interaction, the distorted waves Born approximation (DWBA) of single nucleon transfer will be used. However in order to identify the different parameters which will be appropriate in such a calculation, a sensitivity study of parameters (e.g in the optical model potentials) will be necessary. Optical model potential are indeed used to describe average interaction between a projectile and a target and if input happens to be too sensitive to a given energy and target, then the approximation of an average interaction may turn out not to be correct.

In order to study this sentivity, the program "brush" which allows "twofnr" and "FRESCO" data set related code to be generated will be used. This will allow the flexibility for either using twofnr or FRESCO as required. Twofnr is a set of codes specialised to transfer reaction calculations. FRESCO however is a Coupled-Channels program that can have finite-range interactions among any number of mass partitions, and any number of nuclear excitations in each partition. Both codes would be appropriate for the present project.

Key references:
1. M. Taggart et al., POS(NIC XI)**045**, (2010).
2. A.Best et al., Phys Rev. C**83** , 052802(R) (2011).
3. C.T.Nsangu et al, Journal of Physics: Conference Series, in preparation.