# Coupled channel description of hadron scattering off nuclei

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We built a code which describes scattering of hadrons off nuclei. The theoretical framework is that of the Coupled Channel Model (CCM) proposed in Refs. [ 1, 2]. This is a general formulation applicable to collisions between a nuclear projectile having mass number A≤4 and any target nucleus.

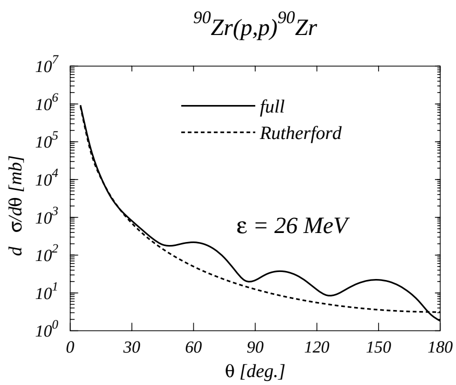


Figure 1. Elastic scattering cross section of protons of 26 MeV energy off $^{90}$Zr nucleus. The full line show the complete calculation, the dashed line the Rutherford cross section.

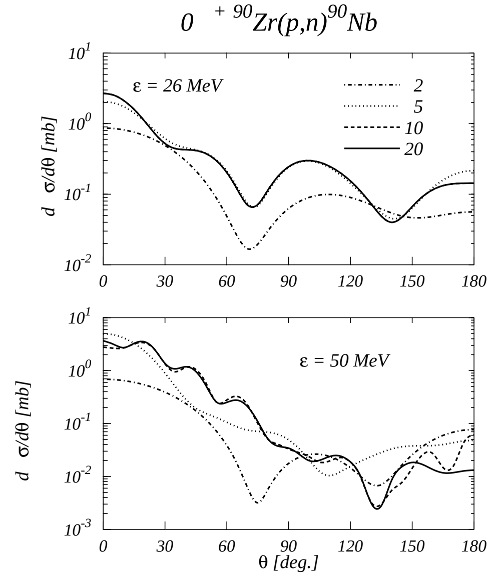


Figure 2. Differential cross sections for the excitation for the reaction indicated in the label. The various lines show the results obtained by using a different number of partial waves, as indicated in the labels. The upper panel shows the results for proton energy of 26 MeV, the lower panel for energies of 50 MeV.

The input required by the model are transition densities describing the excitation of the target nucleus from the initial to its final state, the optical potential describing the projectile-target elastic interaction, and the interaction between target nucleon and projectile for the transition in question.

We show in Fig. 1 the effect of the nuclear optical potential for elastic scattering. In this figure we show the cross section of protons having energy of 26 MeV elastically scattered off $^{90}$Zr nuclei. The dashed line represents the Rutherford cross section, i.e. the cross section obtained by considering that only the Coulomb interaction is acting between projectile and nucleus. The full line has been obtained by adding to the Coulomb interaction the nuclear optical potential parameterized as indicated in Ref. [ 3].

In Fig. 2 we present the results of a convergence test. We have calculated the cross section for the charge-exchange reaction $^{90}$Zr(p,n)$^{90}$Nb which excites the $0^+$ multipole. The calculations have been repeated for two different energies of the protons, 26 and 50 MeV. In the figure we show the convergence of the results by increasing the number of partial waves used to describe the process. The number of partial waves required to reach the convergence at 26 MeV is smaller than that required at 50 MeV.

The program is aimed to be used together with the transition densites produced by continuum Random Phase Approximation calculations [ 4].

**REFERENCES**


1. V. A. Madsen, Nucl. Phys. 80 (1966) 177.
2. C. Wong, J. D. Anderson, V. A. Madsen, F. A. Schmittroth, M. J. Stomp, Phys. Rev. C 3 (1971) 3.
3. R. L. Varner, W. J. Thompson, T. L. McAbee, E. J. Ldwig, T. B. Clegg, Phys. Rep. 201 (1991) 57.
4. V. De Donno, G. Co', M. Anguiano, A. M. Lallena, Self-consistent Continuum Random Phase Approximation calculations with finite-range interactions. arXiv:1011.5088,nucl-th.