Contribution ID: **34** Type: **not specified**

Statistical multi-step direct reaction models and the RPA

Friday, 15 June 2018 12:00 (20 minutes)

Nucleon-induced pre-equilibrium reactions are now recognized as consisting almost exclusively of direct reactions in which incident nucleons induce excitations over a wide range of energy in the target nuclei. At low energies, one step reactions dominate. As the incident energy increases, multi-step reactions become important too. Tamura, Udagawa and Lenske pioneered the use of the RPA response function to describe the nuclear excitation in calculations of one-plus-two-step reactions of this type [1]. Modern calculations can describe both the excitation of low-energy collective states and the more uniform higher energy part of the spectrum, but are limited to a single direct interaction step [2]. However, it has been argued that the time scale of the two-step reaction is too short to permit the residual interaction to modify the response function to the RPA one [3]. Explicit calculations corroborate this conclusion [4]. The response function in this case would then be better approximated by the bare particle-hole one [5, 6]. Our objective here is to analyze the properties of the RPA response function and compare these to those of the bare particle-hole one.
We used the Skyrme RPA code of G. Colò and collaborators [7] to study the collective and non collective excited states within the RPA for several nuclei and spin/parity from 1+ to 5-. By our definition, collective states show larger (or smaller) than average transition strengths, spread over a large number of particle-hole states and tend to be shifted in energy. We find them to be interspersed with non-collective state up to an energy of about 20 MeV in our calculations, although we could define no clear separation point between the states we considered collective and those we did not. At higher energies, the RPA excited states are predominantly well-localized particle-hole states of an average width that grows roughly with the square of the excitation energy. The non-collective states satisfy the statistical assumption of Tamura, Udagawa and Lenske in the sense that an average over the RPA modes in an energy range of a few times the average width of the modes reduces to an incoherent sum over the underlying particle-hole modes. The average RPA transition strengths and widths of the states were found to be independent of the spin and parity .

[1] T. Tamura, T. Udagawa, and H. Lenske, Phys. Rev. C 26, 379 (1982).
[2] M. Dupuis, Eur. Phys. J. A 53, 111 (2017).
[3] H. Nishioka, H. A. Weidenmüller, and S. Yoshida, Ann. Phys. (N.Y.) 183, 166 (1988).
[4] C. A. Pompeia, B. V. Carlson, Phys. Rev. C 74, 054609 (2006)
[5] A. J. Koning, M. B. Chadwick, Phys. Rev. C 56, 970 (1997).
[6] T. Kawano, S. Yoshida, Phys. Rev. C 64, 024603 (2001).
[7] G. Colò, L. Cao, N. Van Giai, L. Capelli, Comp. Phys. Comm. 184, 142 (2013).

Primary authors: Mr CHIMANSKI, Emanuel V. (Instituto Tecnológico de Aeronáutica,NAPC-Nuclear Data Section, International Atomic Energy Agency); Dr CAPOTE, Roberto (NAPC-Nuclear Data Section, International Atomic Energy Agency); Prof. CARLSON, Brett V. (Instituto Tecnológico de Aeronáutica); Dr KONING, Arjan (NAPC-Nuclear Data Section, International Atomic Energy Agency)

Presenter: Mr CHIMANSKI, Emanuel V. (Instituto Tecnológico de Aeronáutica,NAPC-Nuclear Data Section, International Atomic Energy Agency)

Session Classification: Nuclear reactions

Track Classification: Nuclear reactions