Isospin conserving model for the TTIK technique

Authors: Leonid Grigorenko[1]; Mishel Khirk[1]

Co-authors: Dmitriy Lanskoy [2]; Pavel Sharov [1]

[1] *Joint Institute for Nuclear Research*

[2] *Faculty of Physics, Lomonosov Moscow State University*

Corresponding Authors: lgrigorenko@yandex.ru, mskhirk@jinr.ru

Neutron scattering by exotic nuclei is a class of reactions that cannot now be directly studied experimentally. Resonance proton scattering of exotic nuclide on a thick target in inverse kinematics (TTIK) is an elegant and powerful experimental method that provides, an opportunity to infer the properties of neutron scattering on exotic nuclei based on studies of observed isobaric-analog state (IAS) in the ^{A}Z+p channel and using the isospin symmetry concept [1-6]. However, in recent decades no attempt has been made to carry out a theoretical analysis of this technique, correctly using this concept of isospin symmetry.

To analyze and interpret the data from such experiments, we developed an isospin-conserving coupled channel model (ICM) [7], which, unlike previously used models, takes into account the most important features of such scattering, namely: the connection between isobaric channels and dynamics of the isospin structure of studied nuclear systems. In the framework of the developed model, which explicitly conserve isospin, the example of the ^{8}He+p system was used to illustrate how strongly the mixing of isospin T = 3/2 and T = 5/2 can influence to the observable characteristics of ^{9}He resonances, which have pure isospin T = 5/2. Also, calculations in this model for the case of narrow resonances predict qualitatively different phase shifts for the ^{8}He+p resonances with dominant isospins T = 5/2 and T = 3/2 with a very unusual profile for the T = 5/2 states. This model prediction may be extremely important for the correct identification of the isospins of the observed resonances in such experiments.

Using ICM model we gave another interpretation of the latest ^{8}He+p data obtained in the TTIK experiment than that proposed in the work [5]. We also show that there may be more interpretations and, if we want to achieve unambiguity in the interpretation of such experiments, it is necessary to take into account the neutron emission channel.

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