Studies of "stretched" M4 resonances at CCB

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The structures of stretched excitations are dominated by a single particle-hole component for which the excited particle and the residual hole couple to the maximal possible spin value available on their respective shells. In light nuclei they appear as high-lying excitations resulting from the $p_{3/2} \rightarrow d_{5/2}$ stretched transitions [1]. Due to the expected low density of other one-particle-one-hole configurations of high angular momenta in this energy region, their configurations should be relatively simple. Therefore, their theoretical interpretation could provide clean information about the role of continuum couplings in stretched excitations.

The decays of stretched resonances are expected to be dominated by the proton and neutron emission, however, their decay patterns are poorly known experimentally, thus far. The direct measurement of stretched states decay paths should provide data which can be used as a very demanding test of state-of-the-art theory approaches, like for example, Gamow Shell Model (GSM) [2] which is an adequate tool for the theoretical description of these excitations.

The results of the first experimental studies on the decay of the 21.47-MeV stretched resonance in ^{13}C will be presented. It was investigated in a $^{13}\mathrm{C}(p,p')$ experiment at 135 MeV proton energy, performed at the Cyclotron Centre Bronowice (CCB) at IFJ PAN in Krakow. The information on the proton and neutron decay branches from the 21.47-MeV state in ^{13}C was obtained by measuring the protons inelastically scattered on a ^{13}C target in coincidence with γ rays from daughter nuclei and charged particles, from the resonance decay. The experimental results were compared with theoretical calculations from the GSM, extended to describe stretched resonances in p-shell nuclei. A very good agreement obtained between the measured and predicted properties of the 21.47-MeV state in ^{13}C was obtained.

In a similar measurement at CCB, the decays of stretched resonances in ^{16}O nucleus were also investigated. A triplet of close lying states in ^{16}O, namely at 17.79, 18.98, and 19.80 MeV, was populated. The decay channels via p and α emission were identified by studying the γ rays from daughter nuclei in coincidence with scattered protons. The quantitative information on the decay branching ratios could be extracted from a systematic analysis of the proton-γ matrix. The physical interpretation of the results would largely profit from theoretical calculations, which are not available at the moment. However, the obtained results support the extension of the investigation of the stretched states decays in other nuclei such as ^{14}N, using the present method.

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