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Experimental studies of ^{10}B(^{7}Li, ^{6}Li)^{11}B and ^{10}B(^{7}Li, ^{6}He)^{11}C reactions

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The angular distributions of ^{7}Li$_{g.s.}$, and ^{6}He$_{g.s.}$, ^{6}Li$_{g.s.}$, ^{6}Li$_{3.56}$ reaction products of one-nucleon transfer in ^{7}Li+^{10}B interaction were measured at E_{7Li}=58 MeV of U-400 @ FLNR JINR, Dubna. One of the aim of our studies was to compare the spatial dimension parameters of A=6 isobar triplet nuclei obtained in the direct one-step n , p-transfer reactions. The ^{6}Li$^*_{3.56}$ is the IAS of ^{6}He$_{g.s.}$. The angular distributions of ^{10}B(^{7}Li,^{6}He)^{11}C, ^{10}B(^{7}Li,^{6}Li)^{11}B and ^{10}B(^{7}Li,^{6}Li$^*_{3.56}$)^{11}B were measured under the same experiment for the first time. The analysis to derive the angular distributions was performed by using the finite-range coupled reaction channel approach. To microscopically derive the angular distributions concerning the $1n$- and $1p$- transfer processes some ingredients were needed, such as optical potential and spectroscopic amplitudes. For the optical potential in each partition the double- folding São Paulo potential [1,2] was used in both real and imaginary parts. Couplings with the first excited states of the projectile and target nuclei were explicitly included in the coupled equations scheme. The $1n$- and $1p$- spectroscopic amplitudes used in the single particle states were determined by shell model calculations, using the NuSHellX code [3].

Fig.1 shows the coupled scheme used in the one-nucleon transfer reactions calculation. A good agreement between theory and experiment was obtained for the elastic scattering and the transfer to the ^{6}Li$_{g.s.}$(1$^+$) + ^{11}B$_{g.s.}$(3/2$^-$) channel. On the other hand, the theory overestimates the data of one-neutron transfer populating the ^{6}Li$^*_{3.56}$ (0$^+$) + ^{11}B$_{g.s.}$(3/2$^-$). The same thing occurring with one-proton transfer populating the ^{6}He$_{g.s.}$(0$^+$) + ^{11}C$_{g.s.}$(3/2$^-$) channel. The reason is that the CRC calculations did not account for the breakup process of the ^{6}Li and when it is left in its 0$^+$ excited state or the breakup effect on the ground state of the ^{6}He nucleus. To show the relevance of the breakup process on the ^{6}Li$_{3.56}$(0$^+$) excited state, we include the coupling between the g.s. and the 0$^+$ (3.56 MeV) from the single particle excitation approach as used in the CDCC calculation. So, a bin-state was set to describe the scattering between the ^{4}He$_{g.s.}$ and the p-n system inside the ^{6}Li. To properly include this configuration, the p-n valence particles were considered with spin j=0. The theoretical analysis when the breakup process of the ^{6}Li$_{3.56}$(0$^+$) excited state is included in the CRC calculation gives a good description of the measured ^{6}Li$_{3.56}$(0$^+$) + ^{11}B$_{g.s.}$(3/2$^-$) channel. This research was funded by the Russian Science Foundation, project No. 24-22-00117. Brazilian authors were supported by CNP, FAPERJ, CAPES, and INCT-FNA (research project No. 464898/2014-5).

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