EXPLORING LIGHT NEUTRON RICH NUCLEI VIA THE (^{7}Li,^{7}Be) REACTION

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Far from the β stability the standard representation of nuclei, based on the assumption of mean field dynamics, turns out to be often inadequate. From a theoretical point of view the explanation of observed phenomena has been a precious benchmark supporting a strong development of refined theories based on the microscopic description of nuclei. In this context particular attention has been paid to the description of special correlations such as the Dynamical Core Polarisation (DCP), i.e. the coupling of the loosely bound valence nucleon to the excited states of the core. A microscopic treatment of the DCP for example, has been demonstrated crucial to explain the well known inversion between $2s_{1/2}$ and $1p_{1/2}$ orbitals in ^{11}Be ground state [1].

Experimental signatures of the DCP correlations are found in charge exchange reactions. One of the most striking observation is the appearance of very narrow resonances embedded in the continuum (BSEC), where the valence nucleon remains for long time bound to the core even when the energy transferred to the whole nucleus by the direct process would be enough to immediately remove it. Particularly interesting for this phenomenology is the exploration of nuclei for which an integer number of α particles is coupled to three extra neutrons. Examples are represented by ^{7}He, ^{11}Be, ^{15}C, ^{19}O and heavier systems. For these nuclei one can assume that single particle excitations at low energy are mainly due to the three valence neutrons. The pairing of two of the three neutrons to the inner core gives an effective soft core, which can be dynamically polarized, also at low excitation energy, by the interaction with the remaining neutron.

A systematic study of these and other phenomena over the above mentioned chain has been started by our group in the recent years via the (^{7}Li,^{7}Be) reaction at 56 MeV incident energy at the IPN-Orsay. The ^{11}Be and ^{15}C energy spectra were measured via the ^{11}B(^{7}Li,^{7}Be)^{11}Be and ^{15}N(^{7}Li,^{7}Be)^{15}C reactions [2]. In addition the ^{7}He and ^{19}O spectra have been measured with the same technique and the analyses are in progress. Preliminary results will be shown at the Conference.

The observed spectra show the presence of narrow resonances, several MeV beyond the neutron emission threshold together with a broad bump connected to the SDR mode. Microscopic QRPA calculations for ^{11}Be and ^{15}C, fully accounting for the 1p-1h configuration with average inclusion of 2p-2h ones, demonstrate that similar states cannot be described in a similar scheme. More sophisticated calculations in the framework of DCP model [3] indicate the BSEC nature of these resonances.

Conclusive results are also obtained for the reaction mechanism [4] through a microscopic analysis of the angular distributions and the spin flip probabilities for the ^{11}Be and the ^{15}C cases. The calculations are able to well reproduce both the angular distributions and the spin flip probabilities, showing the negligible role of two-step mechanisms and the dominance of nucleonic spin transfer at these energies.

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[3] C. Nociforo, Ph.D. thesis, Università di Catania, 2001.
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