NEW EVIDENCE FOR PARITY INVERSION IN ^{11}Li FROM ^{9}Li AND γ-RAY COINCIDENCES[1]

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The structure of neutron-unbound ^{10}Li remains an open question and thus the complete understanding of the two-neutron halo nucleus ^{11}Li. Indeed the knowledge of the (n+^{9}Li) interaction is of essential importance to theoretical calculations of the three-body Boromean system (n+n+^{9}Li).

The first case of an intruder state in the shell structure of nuclei was the appearance of the $1/2^{+}$ state from the sd-shell as the ground state in the light p = shell nuclei. This parity inversion has long ago been clearly observed experimentally in the case of ^{11}Be. It is theoretically predicted[4] that this trend should continue in the lighter p-shell N = 7 isotones, and therefore the ground state of ^{10}Li is expected to be an s-state.

First experimental evidence for a neutron s-state at very low energy has been provided by the work of Kryger et al.[5] Several papers deal with a p-state around 240-250 KeV (see Bohlen,[6] Young,[7] Caggiano[8]). The possibility that the s-state could represent a decay to the first excited state in ^{9}Li could not be unambiguously refuted, although the observation by Zinser et al[9] of a sizeable final state interaction in the single neutron stripping of ^{11}Li strongly suggests that this state couples to the ground state of ^{9}Li.

An experiment was recently performed at the National Superconducting Cyclotron Laboratory of Michigan State University to investigate the possibility that the low decay energy state is not the ground state and feeds into the excited state of ^{9}Li with the subsequent emission of a 2.7 MeV γ-ray. Neutron and γ-ray coincidences from the breakup of ^{11}Be into the channels of ^{10}Li and +^{11}Be were measured using the MSU neutron walls and the BaF_2 array of ORNL-NSCL-TAMU. The γ coincidences give a feeding of ^{9}Li* in the proton stripping reaction of about 4%, which is in good agreement with a recent shell-model calculation.[10] This very small observed intensity leads to the conclusion that the ground state of ^{10}Li is an s-state built on the ground state of ^{9}Li.

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