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Core excitation in ^{98}Cd

Matjaž Vencelj[1], Cyrus Baktash[2], Paul Fallon[3], Paul Hausladen[2], Andrej Likar[1,4], Matej Lipoglavšek[1] and Chang-Hong Yu[2]

[1] 'Jožef Stefan' Institute, Ljubljana, Slovenia
[2] Oak Ridge National Laboratory, USA
[3] Lawrence Berkeley National Laboratory, USA
[4] Faculty of Mathematics and Physics, University of Ljubljana, Slovenia

E-mail: matjaz.vencelj@ijs.si

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Abstract
Using a ^{58}Ni (^{46}Ti, α2n) reaction, a total of 24 different residual nuclei were identified. Among them were ^{98}Cd and ^{97}Ag. The level scheme of ^{98}Cd was extended to $J^\pi = (15^+)$. An isomeric state at 6634 keV excitation energy was confirmed. This state decays by a 4207 keV transition feeding the known 8^+ state. The level scheme of ^{97}Ag was also extended to $J^\pi = (33/2^+)$ and the half-lives of two isomeric states were measured. Experimental energies of the excited states were compared with the results of *ab initio* shell-model calculations based on a realistic two-nucleon interaction. The Gammasphere Ge array, coupled with the Microball and the Neutron Shell ancillary particle detectors, was used at the 88 inch cyclotron at Lawrence Berkeley National Laboratory, USA.

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1. Introduction

Nuclei in the vicinity of ^{100}Sn, which is the heaviest particle-bound self-conjugate doubly magic nucleus, are regularly studied for their shell structure properties and are a crucial test ground for large-scale *ab initio* shell model calculations.

The apparently low transition probability [1] of the $J^\pi = 8^+$ isomer in ^{98}Cd, equivalent to a nonphysically small proton polarization charge, led to a proposal of the existence of an additional, spin-gap 12^+ isomer, feeding the isomeric 8^+ state.

2. Experiment

The experiment was performed at the 88 inch cyclotron of the Lawrence Berkeley National Laboratory, using the Gammasphere Ge detector array, along with the Microball charged particle detector array around the target and the Neutron Shell liquid scintillator system covering 1π of the solid angle in the forward direction. The efficiencies for proton, alpha and neutron detection were at 80, 46 and 21%, respectively. The trigger system demanded two Compton-suppressed Ge detector signals within a time window of 800 ns after the reaction. In addition, an online discriminated neutron signal was demanded.

The fusion–evaporation reaction used was a beam of ^{46}Ti at 175 MeV on a 2 mg cm^{-2} ^{58}Ni target, backed with 10 mg cm^{-2} of gold to stop all residual nuclei.

3. Results and discussion

A total of 24 different nuclei were identified in this experiment. They are shown in figure 1, along with the reaction channels and relative population ratios. The latter were obtained for each residual nuclide by fitting the intensities of their characteristic transitions in γ-ray spectra, gated by appropriate numbers of protons, alpha particles and neutrons. The intensities were corrected for their branching ratios, for energy dependence of the Gammasphere efficiency, for efficiencies of different particle detectors and for the effect of the neutron detector trigger. Relative population ratios may be converted to partial cross-sections by multiplying them with the total cross-section, which is estimated to be 500 mb, according to a calculation with the code PACE 4 [2].

In ^{98}Cd, the existence of the 6634 keV (12^+) core-excited isomer [3] was confirmed. The half-life of the isomer was measured to be 230(+80 − 90) ns. This explains the seemingly low transition probability and the resulting unphysical valence proton effective charge in the previous level scheme. The level scheme was extended tentatively to $J^\pi = (15^+)$. Multipolarities of the transitions were also

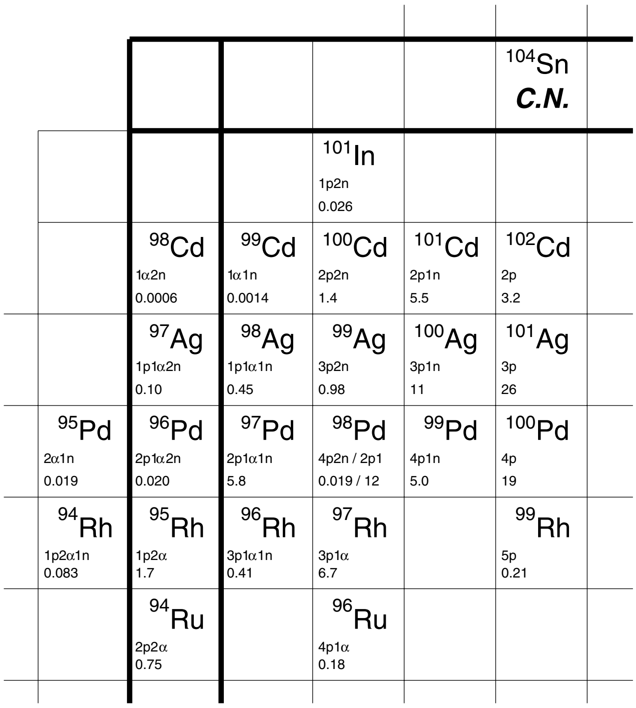

Figure 1. Part of the nuclidic chart showing the nuclei identified in the experiment. The reaction channel and relative population (in %) are also indicated.

Table 1. Energies, relative intensities and angular distribution coefficients of the transitions measured in ^{98}Cd.

E (keV)	I (%)	A_2
146.5(2)	33(20)	1.8(15)
197.6(1)	40(19)	0.6(6)
687.7(2)	91(18)	0.6(8)
1165 (1)	113(38)	1.1(3)
1395.1(3)	100(21)	0.7(5)
4207 (1)	63(18)	1.0(8)

determined from the angular distribution of the gamma-rays, confirming the level scheme assignments. Energies of the measured transitions, along with their relative intensities and angular distribution coefficients, are listed in table 1. The level scheme of ^{97}Ag was extended to $J^\pi = (33/2^+)$ and half-lives of the $(21/2^+)$ and $(31/2^+)$ isomeric states were measured.

A shell model calculation was also performed, based on the realistic CD-BONN two-nucleon potential [4]. The model space included valence particles on top of the ^{78}Sr core and allowing neutrons from below the ^{100}Sn core gap into $2d_{5/2}$ and $1g_{7/2}$ orbits. Calculation was truncated to at most two holes in the neutron $1g_{9/2}$ orbit. Results of the calculation agree very well with the experimental data. Details of the experimental results and the calculation will be presented in a forthcoming paper.

References

[1] Górska M *et al* 1997 *Phys. Rev. Lett.* **79** 2415
[2] Tarasov O and Bazin D 2003 *Nucl. Instrum. Methods* B **204** 174
[3] Blazhev A *et al* 2004 *Phys. Rev.* C **69** 064304
[4] Machleidt R, Sammarruca F and Song Y 1996 *Phys. Rev.* C **53** R1483