^{86}Sr States Homologous to the Low-lying States of ^{85}Rb

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In connection with our discussion [1] on possible cases of homology, we have to see whether, independently of the energy values, states with similar wave functions appear in the pair of nuclei ^{85}Rb and ^{86}Sr.

In particular we should search for states in ^{86}Sr whose wave functions may resemble the wave function of a low lying state in ^{85}Rb, coupled to a spectator $p_{1/2}$ proton. Our preliminary calculations do indeed show the occurrence of these states, with a clear signature.

The same model space and single particle energies as for ^{85}Rb [1] (only changing the allowed occupation numbers) have been used to calculate using the computer code OXBASH [2] the spectrum of ^{86}Sr.

The "positive" cases are illustrated in table 1, where we show the energy eigenvalues and percentage of different components for the homologous states found in the shell model calculations for the residual nuclei of the pair of reactions ^{88}Sr$(\vec{p},\alpha)^{85}$Rb and ^{89}Y$(\vec{p},\alpha)^{86}$Sr. As can be seen from the table 1, the first two homologous cases ($5/2^-$ and $9/2^+$) correspond to rather pure single particle states. In fact the ground state $5/2^-$ corresponds to an essentially pure hole state in the $f_{5/2}$ orbital. Similarly the $9/2^+$ state is a dominantly pure particle state in the $g_{9/2}$ orbital, with two holes in the $f_{5/2}$ orbital. Note however that the homology also seems to appear for states, as the $7/2^-$ and $5/2^+$ states, that are not of single particle nature, but involve a recoupling of a pair of neutrons.

The wave functions of the homologous states in ^{86}Sr display a weak-coupling character, being similar to the wave functions of the corresponding parent states. For this reason homologous states can clearly singled out in ^{86}Sr in close corrispondence with the parent states in ^{85}Rb, not only for the pure [1πh, $J'(2\nu h)=0$] configuration, but also for the configurations where the two neutron holes are coupled to nonzero angular momentum [$J'(2\nu h)\neq 0$], in spite of their excitation energy and of the density of neighboring levels.

Precise tests of these wave functions, both for parent and son states, are a necessary requirement to assess, also in this case, the validity of the homology concept. To this aim calculations of spectroscopic factors for one nucleon transfer reactions and electromagnetic reduced transition probabilities are in progress.

References

[1] Elsewhere presented in Jahresbericht 2001
[2] B.A. Brown, A. Etchegoyen, W.D.M. Rae: MSU-NSCL (1985) Report No. 524. 271.
[3] H. Sievers: NDS **62** (1991).

Table 1: Energy eigenvalues and percentage of different components (squared amplitudes) for the homologous states of ^{85}Rb and ^{86}Sr. The experimental energy values of ^{85}Rb are from ref. [3]

^{85}Rb					^{86}Sr		^{85}Rb					^{86}Sr	
G.S. $J^\pi=5/2^-$					2^+ 2.117	3^+ 2.848	0.514 MeV $J^\pi=9/2^+$ (Exp) 0.514 MeV $J^\pi=9/2^+$ (Th)					5^- 2.489	4^- 3.572
	Partition order of orbits							Partition order of orbits					
%	$f_{5/2}$	$p_{3/2}$	$p_{1/2}$	$g_{9/2}$	%	%	%	$f_{5/2}$	$p_{3/2}$	$p_{1/2}$	$g_{9/2}$	%	%
3.36	4	3	2				7.20	4	3	1	1	20.02	10.91
9.70	5	3	1		5.98	7.06	9.01	4	2	2	1		
8.79	5	2	2				1.19	5	3	0	1	1.26	4.83
18.99	4	4	1		29.74	29.84	3.94	5	3	0	1	5.47	18.62
58.78	5	4	0		43.17	43.60	75.19	4	4	0	1	56.22	44.96
							3.47	6	2	0	1	2.15	2.87
0.869 MeV $J^\pi=7/2^-$ (Exp) 0.778 MeV $J^\pi=7/2^-$ (Th)					3^+ 2.847	4^+ 3.258	0.950 MeV $J^\pi=5/2^+$ (Exp) 1.087 MeV $J^\pi=5/2^+$ (Th)					3^- 3.729	2^- 4.705
	Partition order of orbits							Partition order of orbits					
%	$f_{5/2}$	$p_{3/2}$	$p_{1/2}$	$g_{9/2}$	%	%	%	$f_{5/2}$	$p_{3/2}$	$p_{1/2}$	$g_{9/2}$	%	%
4.94	4	3	2				8.98	4	3	1	1	10.64	13.08
11.38	5	3	1		7.06	43.84	8.53	4	2	2	1		
9.10	5	2	2				1.70	5	2	1	1	2.05	12.17
17.65	4	4	1		29.84	6.06	4.22	5	3	0	1	7.38	18.32
56.07	5	4	0		43.60	47.19	73.38	4	4	0	1	50.66	41.08
							3.19	6	2	0	1	1.84	2.61