Shell Model Calculations of Low Lying States of ^{87}Y ◇

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The structure of low lying levels of ^{87}Y has been studied in the framework of the shell model. The calculations have been performed in parallel for both nuclei ^{87}Y and ^{88}Y, since our interest is to establish levels in ^{88}Y homologous to states in ^{87}Y. The shell model calculations will be compared with data from the ^{91,90}Zr$(\vec{p},\alpha)^{88,87}$Y reactions [1]. Here we present the results for ^{87}Y. The calculation is based on the usual one- and two-body Hamiltonian

$$H \;=\; \sum_i \epsilon_i a_i^\dagger a_i \;+\; \sum_{ijkl} V_{ijkl} a_i^\dagger a_j^\dagger a_k a_l$$

For the two-body matrix elements V_{ijkl} the set GW-BXC is used [2], which are essentially G-matrix effective interactions based on the realistic Paris potential. The calculation has been performed with the OXBASH code [3]. The problem of large configuration mixing involving states associated with the proton-holes is reflected in the case of ^{87}Y. The predicted lowest part of the spectrum and the corresponding wave functions are reported in table 1. The model space is shown in fig. 1a-c. The single particle energies used in the calculations are: -8.9 MeV, -12.62 MeV, -9.61 MeV, -5.07 Mev for the $f_{5/2}$, $p_{3/2}$, $p_{1/2}$, $g_{9/2}$ proton orbitals, respectively and -0.664 MeV for the $g_{9/2}$ neutron orbital.

Negative-parity states of the form $[\pi(j)^{-1}\nu(g_{9/2})^{-2})_{I_\nu}]_I$ (Fig. 1a,b) and positive-parity states of the form $[\pi[(j_1)^{-1}(j_2)^{-1}(g_{9/2})]_{I_\pi}(\nu(g_{9/2})^{-2})_{I_\nu}]_I$ (Fig. 1c) are used.

Only the lowest $1/2^-$ and $9/2^+$ states can be assigned to dominant proton single particle configurations $(p_{1/2})^{-1}$ and $(p_{1/2})^{-2}(g_{9/2})$, respectively. In case of the spins $3/2^-$ and $5/2^-$, the lowest states are still associated dominantly to the proton $(p_{1/2})$ state, but with a recoupling of the two $(g_{9/2})$ neutron holes. The states collecting most of the single-hole character are predicted to lie at higher excitation energy, precisely at 1.00 MeV for the $5/2^-$ and 1.46 MeV for the $3/2^-$.

References

[1] P. Guazzoni et al., Zeit.Phys. **A** (to be published)
[2] A. Hosaka et al., Nucl.Phys. **A444** (1985) 76
[3] A. Etchegoyen et al., MSU-NSCL Report **524** (1985)

E(MeV)		J^π	j				CONFIGURATION
Exp.	Th.		$p_{1/2}$	$p_{3/2}$	$f_{5/2}$		
0.000	0.000	$1/2^-$	87.05	5.14	7.81		$[\pi(j)^{-1}\nu(g_{9/2})^2_{I\nu}]_I$
0.794	0.691	$5/2^-$	57.39	3.01	39.59		$[\pi(j)^{-1}\nu(g_{9/2})^2_{I\nu}]_I$
0.982	0.689	$3/2^-$	77.68	17.70	4.62		$[\pi(j)^{-1}\nu(g_{9/2})^2_{I\nu}]_I$
1.184	1.464	$3/2^-$	10.87	78.21	10.92		$[\pi(j)^{-1}\nu(g_{9/2})^2_{I\nu}]_I$
1.201	1.000	$5/2^-$	26.65	3.61	69.74		$[\pi(j)^{-1}\nu(g_{9/2})^2_{I\nu}]_I$
			j_1j_2				
			$p_{1/2}(2)$	$p_{1/2}p_{3/2}$	$f_{5/2}p_{1/2}$	$f_{5/2}p_{3/2}$	
0.382	0.379	$9/2^+$	77.16	7.14	14.61	1.09	$[\pi[(j_1)^{-1}(j_2)^{-1}(g_{9/2})]_{I\pi}$ $[\nu(g_{9/2})^2]_{I\nu}]_I$

Table 1: Configuration mixing of states in ^{87}Y.

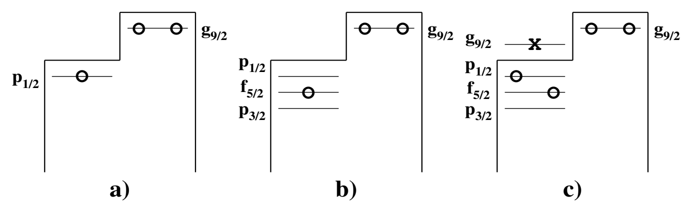

Fig. 1: a-c: Particle hole configurations.

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