

BETA DECAY OF ^{44}Ar AND WEAK COUPLING PREDICTIONS
FOR NEUTRON RICH ARGON AND POTASSIUM NUCLEI

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The spallation reaction $^{51}\text{V}(p, 6\text{pxn})$ has been used at $E_p=600$ MeV to investigate the beta decay of neutron rich argon isotopes. Argon nuclides were isotopically separated in the Isolde on-line mass separator and for mass position 44, the subsequent beta decays to ^{44}K have been studied via delayed γ -ray multianalysis and γ - γ coincidence techniques. No activities other than ^{44}Ar and its radioactive filiation were present in the spectra. The decay scheme of ^{44}Ar involves nine excited states in ^{44}K and includes γ rays observed previously by Hudis et al.¹, but significant differences in the interpretation result from the γ - γ coincidence experiment with two Ge(Li) detectors where 10^6 γ - γ events have been accumulated. In particular the first excited level in ^{44}K is found at 182.6 keV whereas in the ($t, ^3\text{He}$) experiment reported by Ajzenberg-Selove and Igo² no excited levels were seen below 383 keV. γ -ray branching ratios in ^{44}K have been established and give a satisfactory in-out intensity balance for each level. The log ft values, reported in Table I, have been deduced using -32.27 ± 0.02 MeV for the mass excess of $^{44}\text{Ar}^3$ and the half-life value : $T_{1/2} = 11.87$ min.¹ A possible weak ground state transition has been neglected. Allowed transitions excite the levels at 1886, 2326 and 2574 keV levels.

The low energy excited states of Ar, K and Sc isotopes may be viewed as particle-hole states around the closed-shell core of ^{40}Ca . It has been shown recently⁴ that the proton removal energy, $R_{\pi}(A, Z)$, for the lowest $3/2^+$ and $1/2^+$ levels in odd-even K and Sc isotopes fits with the theoretical prediction derived from the weak-coupling model using the expression :

$$R_{\pi}(A, Z) = R_{\pi}(^{39}\text{K}) - (a-b/4)(A-39) - (b/2-c)(Z-19) \quad (1)$$

the parameters a, b and c being defined by the usual Bansal-French-Zamick weak coupling method and $(a-b/4)$ being adjusted separately for d $3/2$ and s $1/2$ hole states. In the same way, we can define

$R_{2\pi}(A, Z)$ as the energy required to remove two protons from a nucleus to reach $M^*(A, T_Z)$:

$$R_{2\pi}(A, Z) = R_{2\pi}(^{38}\text{Ar}) - (2a-b/2)(A-38) - (b-2c)(Z-18) \quad (2)$$

and compare calculated values with data for the lowest $7/2^-$ states in odd K and Ar isotopes. The experimental data display the predicted regularities, the quantity $(a-b/4)$ being taken as the mean of the values obtained for $d3/2$ and $s1/2$ hole states. From the weak coupling model an estimate for the excitation energy of the lowest positive parity state in even K isotopes can be calculated. This value for ^{44}K ($E_x \approx 1.4$ MeV) suggests a negative parity for the first five excited states observed in this work.

REFERENCES

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Table I. Beta branching and log ft values in the ^{44}Ar decay

Final state in ^{44}K (keV)	I_β (%)	log ft
182.6 ± 0.1	< 10	> 6.9
382.9 ± 0.1	0.14 ± 0.1	$7.7 \pm \begin{matrix} 0.4 \\ 0.2 \end{matrix}$
519.8 ± 0.4	< 0.1	> 8.7
1051.3 ± 0.1	< 0.3	> 7.9
1076.7 ± 0.1	< 0.1	> 8.4
1459.5 ± 0.3	1.5 ± 0.4	$6.9 \pm \begin{matrix} 0.3 \\ 0.1 \end{matrix}$
1886.0 ± 0.1	93.0 ± 0.6	4.66 ± 0.05
2325.8 ± 0.2	3.2 ± 0.2	5.6 ± 0.1
2574.2 ± 0.3	2.2 ± 0.1	5.4 ± 0.1