Low-Lying Levels in $^{47}$V.

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Summary. — The low-lying levels of $^{47}$V have been investigated through the $^{47}$Ti(p, n)$^{47}$V reaction with proton energies between 3.6 and 5.3 MeV and through the $^{40}$Ca($^{10}$B, 2pn)$^{47}$V reaction at $E_{p\gamma} = 25$ MeV. From single and $\gamma$-$\gamma$ coincidence spectra the decay scheme has been obtained. Angular distributions in the heavy-ion reaction, conversion coefficient and lifetime measurements have been performed to determine the multipolarity of transitions and to assign spin and parity of several levels.

1. - Introduction.

The $^{47}$V level scheme has already been investigated through the $^{47}$Ti(p, n)$^{47}$V, $^{50}$Cr(p, a)$^{47}$V, $^{49}$Ti($^{3}$He, d)$^{47}$V and $^{46}$Ti(p, $\gamma$)$^{47}$V reactions (1,3).

The spin of the ground state is known (1) to be $\frac{3}{2}^-$. A $\frac{5}{2}^-$ value has been suggested for the spin of the first excited state on the basis of systematics, theoretical predictions and angular-correlation measurements (2,3). The value $\frac{5}{2}^-$ for the $J^\pi$ of the second excited state is based on the very high strength

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with which it is populated in the $^{48}\text{Ti}(^{3}\text{He}, d)^{47}\text{V}$ stripping reaction \(^1\). These three levels could be considered as originating from the \((1f_2)^3\)-configuration. No information was available about \(\frac{3}{2}^-, \frac{1}{2}^+\) and \(\frac{5}{2}^-\) states which are the other expected spin values in a \((1f_2)^3\)-configuration.

The 260 keV third excited state has \(^2\) \(J = \frac{3}{2}^+\). Analogy with some other odd nuclei in the same region, which show low-energy positive-parity levels \(^4\), suggests the interpretation of this level as due to a hole in the \(1d_{\frac{3}{2}}\)-shell.

This work was performed to investigate the low-lying negative- and positive-parity states of \(^{47}\text{V}\).

The $^{47}\text{Ti}(p, n)^{47}\text{V}$ reaction was used to study the \(\gamma\)-decay of the levels up to about 1.3 MeV excitation energy, to measure conversion coefficients and to obtain by pulsed-beam technique upper limits for the lifetime of the first two excited states.

The \(\gamma\)-decay of $^{47}\text{V}$ levels up to 2.6 MeV excitation energy was investigated through \(\gamma\)-\(\gamma\) coincidences in the $^{40}\text{Ca}(^{10}\text{B}, 2\text{pn})^{47}\text{V}$ reaction. Information about spins, from angular-distribution measurements, and about lifetimes with the plunger method, was obtained in the same reaction.

2. – Experimental set-up.

\(a\) $^{47}\text{Ti}(p, n)^{47}\text{V}$ reaction.

The measurements were carried out at the 5.5 MV Van de Graaff accelerator of the Laboratori Nazionali di Legnaro.

Targets of $^{47}\text{Ti}$ (79.5\% enriched) evaporated onto carbon backings were used in all types of measurements.

Single \(\gamma\)-spectra were taken at a proton energy ranging from 3.6 MeV to 5.3 MeV, with a typical beam current of about 0.5 \(\mu\)A. The gamma-rays were detected in a 52 cm\(^2\) Ge(Li) counter placed at 55\(^\circ\) to the beam axis. A typical spectrum, taken at 5.150 MeV proton energy, is shown in Fig. 1.

The lifetime upper limits for the first two excited states were obtained by pulsed-beam technique (3 MHz repetition frequency, 1.5 ns f.w.h.m.) The \(\gamma\)-spectra were observed with a 1 in.\(\times\)1 in. NaI(Tl) scintillator coupled to an XP 1021 phototube. To avoid the prompt contribution of a 57 keV X-ray line due to some crucible tantalum present in the target, the lifetime of the second excited state was measured by recording the time spectrum of the 88 keV line following the 58 keV transition. The direct feeding of the 88 keV level was suppressed by gating the spectrum with the 58 keV signal in a second counter.

\(^4\) P. R. MAURENZIG: *Topical Conference on the Structure of \(1f_\frac{3}{2}\) Nuclei* (Legnaro, 1971), p. 469.