Investigation of the Two Quasiparticle Rotational Band at 1172 keV in $^{172}$Yb and Determination of the $g_K$-Factor of the $3^+ 3$ Band Head

H. F. WAGNER* and J. LANGE**
Institut für Strahlen- und Kernphysik, Bonn, Germany
Received November 2, 1970

Investigations of the rotational band based on the $3^+ 3$ two quasiparticle state in $^{172}$Yb have shown that some of its properties can be well described by the collective model of Bohr and Mottelson. As a result of these investigations we have derived the ratio $(g_K - g_R)/Q_0 = -0.0136 \pm 0.0007$. The magnetic $g$-factor of the band head has also been determined by an integral angular correlation measurement perturbed by an external magnetic field. As a result we found $g = 0.201 \pm 0.030$. Using this value and our result of $(g_K - g_R)/Q_0$ we have calculated the $g_R$-factor of the two quasiparticle state as $g_R = 0.283 \pm 0.018$ which is out of the errors smaller than the $g_R$-factor of the ground state rotational band. An analysis of our angular correlation experiments gave for the mixing parameter $\delta$ of the $K$-forbidden 1094 keV intraband transition:

$\delta = -3.63^{+0.14}_{-0.06}$

in agreement with the results of other authors.

I. Introduction

Many investigations of the level scheme of $^{172}$Yb (Ref. 1–13) have established the existence of a rotational band based on the isomeric state at 1172 keV with the spin sequence $3^+, 4^+, 5^+, 6^+$ and the ex-

---

* Present address: Department of Physics, University of Kabul, Afghanistan.
** Department of Physics, Vanderbilt University, Nashville, Tennessee.

4 Günther, C., Blumberg, H., Engels, W., Strube, G., Voss, J., Lieder, R. M.,
5 Blumberg, H., Speidel, K. H., Schlenz, H., Weigt, P., Hübel, H., Göttel, P.,
6 Kleinheinz, P., Vukanović, R., Zupančič, M., Samuelsson, L., Lindström, H.:
Two Quasiparticle Rotational Band at 1172 keV in $^{172}$Yb

The citation energies 1172.3, 1262.9, 1375.7, and 1510.0 keV [see Fig. 1 of Ref. 14]. Since the $3^+$ state is interpreted as a two quasiparticle configuration\textsuperscript{3,7} it is very interesting to study the structure and the properties of such a rotational band. We have therefore determined in a series of experiments the $g$-factor, the quadrupole moment\textsuperscript{14,15} and the half life of the band head. Using these data and the well known multipole mixing parameters $\delta^2$ of the rotational transitions\textsuperscript{8} as well as their half lives\textsuperscript{16} we have tried to interpret the properties of this two quasiparticle rotational band within the theory of Bohr and Mottelson\textsuperscript{17}. As a result we were able to calculate the factors $g_R$ and $g_K$ as well as the intrinsic quadrupole moments of the excited rotational states.

II. Discussion of the Two Quasiparticle Rotational Band at 1172 keV in the Collective Model

In order to investigate to what extend a rotational band built upon a two quasiparticle state can be described by the collective model of Bohr and Mottelson, we have used the published experimental data of other authors\textsuperscript{8,14,16} as well as the results of our own measurements.

The first prediction which we have investigated was the constancy of the ratio $(g_K - g_R)/Q_0$ within the rotational band. This ratio can be

\begin{align*}
\text{Fig. 1. Partial decay scheme of }^{172}\text{Yb}
\end{align*}

\begin{align*}
\text{citation energies } & 1172.3, 1262.9, 1375.7, \text{ and } 1510.0 \text{ keV [see Fig. 1 of Ref. 14].}
\end{align*}

\begin{align*}
\text{Since the } 3^+ \text{ state is interpreted as a two quasiparticle configuration}^{3,7} \text{ it is very interesting to study the structure and the properties of such a rotational band. We have therefore determined in a series of experiments the } g\text{-factor, the quadrupole moment}^{14,15} \text{ and the half life of the band head. Using these data and the well known multipole mixing parameters } \delta^2 \text{ of the rotational transitions}^8 \text{ as well as their half lives}^{16} \text{ we have tried to interpret the properties of this two quasiparticle rotational band within the theory of Bohr and Mottelson}^{17}. \text{ As a result we were able to calculate the factors } g_R \text{ and } g_K \text{ as well as the intrinsic quadrupole moments of the excited rotational states.}
\end{align*}