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V–8 The g Factors of the Isomeric States in ^{174}Hf and ^{176}Hf

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High spin isomers of even deformed nuclei are mostly two quasi-particle states (two quasi-protons, two quasi-neutrons) with spin $J \simeq (l_1 \pm 1/2) + (l_2 \mp 1/2) = l_1 + l_2$. Because of the cancellation of the instrinsic spins s_1 and s_2, the g factor of the isomer is approximately expressed in terms of the orbital g factors, $g \simeq \alpha^2 g_l^p + (1 - \alpha^2) g_l^n$. Here the $\alpha^2/1 - \alpha^2$ is the two quasi proton to neutron mixing ratio.

We measured the g factors of the $I^\pi K = 6^+6$ and 8^-8 isomers[1] in ^{174}Hf and ^{176}Hf in order to study the proton to neutron mixing ratios[4] $\alpha^2/1 - \alpha^2$ and the orbital g factor. The high lying rotational levels (up to $I = 10 \sim 11$) based on the isomers were well populated by $(\alpha, 2n\gamma)$ reactions.[2] The α beam with $E = 20 \sim 28$ MeV was provided from the super FN tandem accelerator at Risø. The targets were enriched foils and the detector was a 40 cc Ge(Li). The values $(g_K - g_l)/Q_0$ were obtained from the cross over (E2) to cascade (M1 + E2) γ branching ratios[3] for the rotational levels in the isomer bands. After finishing our experiment, a similar work on the ^{176}Hf isomers appeared.[4] Their results of the branching ratios in ^{176}Hf agree with ours. We measured angular distributions in order to determine the signs of $(g_K - g_R)/Q_0$. The results are given in the Table I and in the Fig. 2. Here the Q_0 for the ground band[5] was used since the difference between the Q moments of the isomer and ground bands is estimated to be negligible. The g_R is evaluated as $g_R \simeq g_R(\text{ground}) + \Delta\mathcal{I}/\mathcal{I}\,(1 - g_R) - \Delta\mathcal{I}_n/\mathcal{I} \cdot (1 - \alpha^2)$, where $\mathcal{I}$ and $\mathcal{I} + \Delta\mathcal{I}$ are the moments of inertias for the ground and the isomer bands.

The proton components α^2 were obtained as shown in Table I, by comparing the experimental g_K with the calculated g_K for two quasi-protons and the two quasi neutrons. Here the g_K for the one quasi-particle is given by $g_l + (2K)^{-1} \cdot (g_s - g_l)\Sigma(a^2_{l\Omega-1/2} - a^2_{l\Omega+1/2})$. The Nilsson levels for the present isomers are $[7/2^+[404]_p 5/2^+[402]_p]_{6^+}$, $[5/2^-[512]_n 7/2^-[514]_n]_{6^+}$, $[7/2^+[404]_p 9/2^-[514]_p]_{8^-}$ and $[7/2^-[514]_n 9/2^+[624]_n]_{8^-}$. We note that the present g_K for the two quasi-particles are nearly equal to the values g_l, and are very

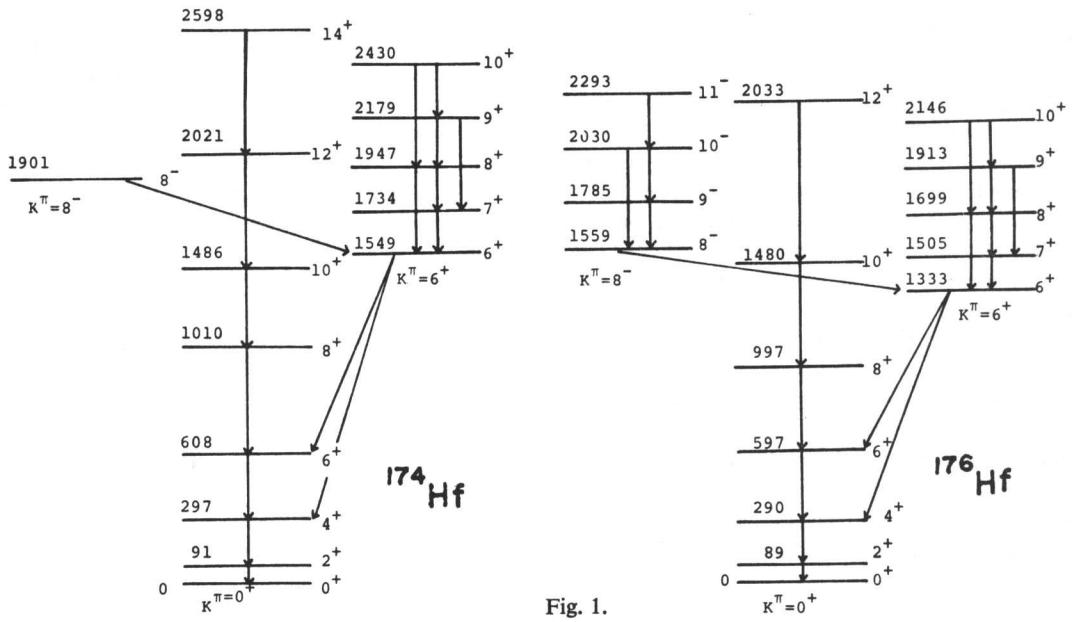

Fig. 1.

Table I.

	$I^{\pi}K$	$(g_K-g_R)/Q_0$	g_K	α^2
^{174}Hf	6^+6	0.105 ± 0.015	1.08 ± 0.10	0.97 ± 0.12
^{176}Hf	6^+6	0.041 ± 0.005	0.61 ± 0.03	0.61 ± 0.03
^{176}Hf	8^-8	0.073 ± 0.003	0.85 ± 0.05	0.82 ± 0.05

insensitive to the values g_s. The g factors[6] used for the calculation are $g_s = 0.6g_s$ (free), $g_l^p = 1.1$ and $g_l^n = -0.1$. The present values for α^2 are consistent with the expectations from the relative positions of the Fermi surfaces of the protons and the neutrons in the Nilsson level diagram, and with the particle experiments.[4] Alternatively it suggests the validity of the $g_l^p \simeq 1.1$ used in the calculation.

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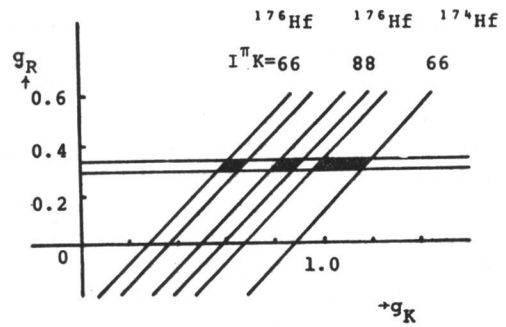

Fig. 2.

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