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MOMENTS OF INERTIA AND COLLECTIVE GYROMAGNETIC RATIOS OF SOME OF THE DOUBLY EVEN NUCLEI IN THE RARE-EARTH REGION

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The moments of inertia and the gyromagnetic ratios of the ground states of some doubly even nuclei in the rare-earth region have been calculated using the cranking model formula. In the calculations the deformed shell-model asymptotic basis eigenfunctions with the inclusion of pair correlations have been used. Comparison with some of the available experimental data shows in general good agreement.

I. INTRODUCTION

We consider the single-particle Hamiltonian given by Lamm [1] and also treated by Boisson and Piepenbring [2] as our starting point

$$\hat{H}_t = \hat{H}_0(\varepsilon) + Cl_t . s + D(l_t^2 - \langle l_t^2 \rangle_{shell})$$

$$\hat{H}_0(\varepsilon) = -\frac{\hbar^2}{2m}\Delta + \frac{1}{2}m[W_\perp^2(x^2+y^2) + W_z^2 z^2], \tag{1}$$

where the subscript t stands for "transformed" or "stretched". Then the deformation parameter ε is introduced which is defined by the following relations:

$$W_\perp = W_0(\varepsilon)(1 + 1/3\varepsilon)$$

$$W_z = W_0(\varepsilon)(1 - 2/3\varepsilon). \tag{2}$$

The condition of the conservation of the volume of the nucleus leads to

$$W_\perp^2 W_z = \mathring{W}_0^3 = \text{const.}$$

$$W_0(\varepsilon) = \mathring{W}_0(1 - 1/3\varepsilon^2 - 1/27\varepsilon^3)^{-1/3}. \tag{3}$$

We perfer to use the asymptotic basis of eigenvectors $|NN_z\Lambda\Sigma\rangle$ since the expressions of the matrix elements become simpler. With this choice of the basis

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we write the single-particle eigenfunctions corresponding to $\hat{H}_t$ given by equation (1) as follows:

$$|\Omega\rangle = \sum_{N_z\Lambda\Sigma} b^{\Omega}_{N_z\Lambda\Sigma}|NN_z\Lambda\Sigma\rangle. \tag{4}$$

In the single-particle state defined as $|\Omega\rangle$, Ω denotes the component of the total spin of the single-particle on the intrinsic z-axis (symmetry axis) as well as all other quantum numbers necessary for the specification of the state. On the other hand $|\Omega\rangle$ has been normalized to unity. Furthermore, in order to be invariant under time reversal the system has to satisfy the condition

$$\hat{T}|\Omega\rangle = |-\Omega\rangle, \tag{5}$$

where $\hat{T}$ is the time-reversal operator. Then one ends up with the time reversed state given by the following relation

$$|-\Omega\rangle = (-1)^{N+\Omega+\frac{1}{2}} \sum_{N_z\Lambda\Sigma} b^{\Omega}_{N_z\Lambda\Sigma}|NN_z - \Lambda - \Sigma\rangle. \tag{6}$$

The single-particle energies und the coefficients $b^{\Omega}_{N_z\Lambda\Sigma}$ given in equations (4) and (6) can be determined by the diagonalization of the hamiltonian $\hat{H}_t$ in the basis $|NN_z\Lambda\Sigma\rangle$.

The aim of this paper is to evaluate the gyromagnetic ratios and moments of inertia of the ground states of some doubly even nuclei in the rare-earth region using the cranking model formula.

II. THE HAMILTONIAN OF THE NUCLEUS

In the second-quantization formalism the Hamiltonian of the nucleus is given by the relation

$$\hat{H} = \sum_{\nu>0} \varepsilon_\nu \hat{N}_\nu - G\sum_{\nu,\nu'} a^+_{\nu'} a^+_{-\nu'} a_{-\nu} a_\nu, \tag{7}$$

where

$$\hat{N}_\nu = (a^+_\nu a_\nu + a^+_{-\nu} a_{-\nu}) \tag{8}$$

is defined to be the number operator such that

$$\hat{N} = \sum_\nu \hat{N}_\nu \tag{9}$$

is the total number operator. The other parameters entering into the Hamiltonian are the single-particle energies ε_ν, the pairing energy G, the creation and annihilation operators a^+ and a, respectively.

The wave function which will be given in the following section is not an eigenfunction of the total number operator $\hat{N}$. In other words the number of particles is not conserved. On the other hand, the Hamiltonian $\hat{H}'$ is introduced

$$H' = \hat{H} - \lambda \hat{N}, \tag{10}$$

which ensures the condition that the number of particles is conserved on the average. λ is a Lagrange multiplier which is also called the chemical potential.

The Bogolyubov—Valatin transformation [3] to quasi-particles is given to be

$$\alpha_\nu = u_\nu a_\nu - v_\nu a^+_{-\nu} \tag{11a}$$

$$\alpha_{-\nu} = u_\nu a_{-\nu} + v_\nu a^+_\nu, \tag{11b}$$

where u_ν and v_ν are real, free parameters such that $u_\nu = 0$, $v_\nu = 1$ represents the occupied orbits, where as $u_\nu = 1$, $v_\nu = 0$ represents the unoccupied orbits. Thus the normalization condition requires

$$u_\nu^2 + v_\nu^2 = 1. \tag{12}$$

By making use of this transformation the Hamiltonian $\hat{H}'$ takes the form

$$\hat{H}' = U' + \hat{H}'_{11} + \hat{H}'_{20} + \hat{H}'_{22} + \hat{H}'_{31} + \hat{H}'_{40}, \tag{13}$$

where U' is a constant and the other terms may be expressed symbolically as $\hat{H}_{ij}$, i and j, representing the numbers of the quasiparticle creation and annihilation operators, respectively. For example, $\hat{H}_{31}$ contains the terms $\alpha^+\alpha^+\alpha^+\alpha$ and $\alpha\alpha\alpha\alpha^+$, etc. The explicit formulas of these operators and detailed descriptions of them are given by Belyaev [4] and Eisenberg and Greiner [5].

III. THE WAVE FUNCTION OF THE NUCLEUS

We consider the following wave function in order to minimize $\hat{H}'$:

$$\Psi_0 = \prod_\nu (u_\nu + v_\nu a^+_\nu a^+_{-\nu})|0\rangle. \tag{14}$$

As it has been mentioned above, Ψ_0 is not an eigenfunction of the total number operator $\hat{N}$ given by equation (9), i. e. N is not conserved. Then the Hamiltonian $\hat{H}'$ is defined, which causes the condition that the average number of particles is conserved.

When the Bogolyubov—Valatin transformation is performed, one can show that

$$\alpha_\nu|\Psi_0\rangle = 0, \tag{15}$$

which implies that the ground state Ψ_0 of an even-even nucleus is the quasi-particles vacuum state.

The variational calculations for the solution of the ground state of the Hamiltonian $\hat{H}'$ of equation (10), by the minimization of the expectation value of $\hat{H}'$ with the eigenfunctions $|\Psi_0\rangle$ provide the following relations:

$$U_\nu^2 = 1/2[1 + (\varepsilon_\nu - \lambda)/E_\nu] \tag{16a}$$

$$V_\nu^2 = 1/2[1 - (\varepsilon_\nu - \lambda)/E_\nu].$$

Where the definitions

$$E_\nu = \sqrt{(\varepsilon_\nu - \lambda)^2 + \Delta^2} \tag{17}$$

$$\Delta = G\sum_\nu U_\nu V_\nu \tag{18}$$

have been used. In these equations E_ν is called the quasi-particle energy and Δ the gap parameter.

IV. MOMENT OF INERTIA AND COLLECTIVE GYROMAGNETIC RATIO

In order to obtain the expression for the moment of inertia in the quasiparticle formalism one first considers the well-known Inglis formula for the moment of inertia:

$$I = 2\hbar^2 \sum_{m \neq 0} |\langle m|\hat{j}_x|0\rangle|^2/(\varepsilon_m - \varepsilon_0). \tag{19}$$

It is also borne in mind that the ground state of an even-even nucleus is the BCS ground state $|\Psi_0\rangle$ given in equation (14). The angular momentum operator $\hat{j}_x$ of equation (19) is a one-particle operator and thus it can be easily transformed to quasi-particle creation and annihilation operators using the inverse transformations of the equations (11a) and (11b). If the transformation is performed and the matrix elements $\langle m|\hat{j}_x|\Psi_0\rangle$ are computed, one can finally obtain the following expression

$$I = 2\hbar^2 \sum_{\nu,\nu'} |\langle \nu|\hat{j}_x|\nu'\rangle|^2 (u_\nu v_\nu - v_\nu u_\nu)^2/(E_\nu + E_\nu), \tag{20}$$

where u_ν, v_ν and E_ν have already been defined. The explicit forms of the matrix elements of $\hat{j}_x$ in the asymptotic basis are given in ref. [2].

The moment of inertia which is a measure of the mass transport of the collective rotational flow is an important quantity. Another quantity which is as important as the moment of inertia is the gyromagnetic ratio g_R. It measures the magnetic properties of the collective flow.

In the cranking model g_R is defined as the ratio between the average magnetic moment and the average angular momentum. The following expression is obtained when the collective gyromagnetic ratio is written by the inclusion of the pair-correlation interaction

$$g_R = I_p/I + (g_s^p - 1)W_p/I + g_s^n W_n/I, \qquad (21)$$

where

$$(1/2\hbar^2)W_i = \sum_{v,v'} \langle v'|l_x|v\rangle\langle v|S_x|v'\rangle(u_v v_{v'} - v_v u_{v'})^2/(E_v + E_{v'}). \qquad (22)$$

In the last two terms of equation (21) g_s^p and g_s^n represent the spin gyromagnetic ratios of proton and neutron, respectively.

V. NUMERICAL CALCULATIONS

In the numerical calculations the parameters of the intrinsic Hamiltonian have been chosen such that for the Hamiltonian of equation (1) new parameters μ and χ are introduced in the terms of C and D:

$$\mu = \frac{2D}{C} \qquad \chi = -C/2\hbar\mathring{\omega}_0, \qquad (23)$$

where

$$\hbar\mathring{\omega}_0 = 41 \,.\, A^{-\frac{1}{3}}\,\text{MeV}. \qquad (24)$$

The following μ and χ values are chosen for protons and neutrons, respectively:

$$\mu_p = 0.60 \qquad \chi_p = 0.0637$$
$$\mu_n = 0.42 \qquad \chi_n = 0.0637. \qquad (25)$$

The gap parameters Δ appearing in equations (17) and (18) are chosen in accordance with the work of Prior et al. [6]. First by means of Δ_p and Δ_n, then by p_p and p_n given by them, two sets of calculations are carried out. Later, taking $\Delta_p = 12A^{-\frac{1}{2}}$ and $\Delta_n = 11.2A^{-\frac{1}{2}}$, which are the best average values extracted from the experimental curves, a third set of calculations has been carried out. The values of these parameters for different nuclei together with the calculated I and g_R values for each set of calculations are shown in tables 1—3.

All the calculations have been done by taking the values 0.20, 0.25, 0.30 for the deformation parameter ε defined by equations (2) and (3). In our calculations we have taken into account all states of the $N = 4, 5, 6$ shells for protons and neutrons (64 levels for each).

Table 1a

Moment of inertia and collective gyromagnetic ratio of some of the doubly even nuclei for the gap parameters Δ_p and Δ_n

${}_Z X_N^A$	ε	Δ_p(keV)	Δ_n(keV)	G_p XA	G_n XA	$\frac{2}{\hbar^2}J_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J\exp$ (MeV)$^{-1}$	$F = \frac{J}{J\exp}$	$\frac{2}{\hbar^2}W_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}W_n$ (MeV)$^{-1}$	g_R
${}_{62}Sm_{90}^{152}$	0.20	1167	1129	21.98	18.30	10.899	25.316	47.3	0.531	−0.606	−0.629	0.401
	0.25			23.07	18.32	14.144	36.318		0.768	−0.858	−1.011	0.388
	0.30			23.95	18.65	16.935	47.412		1.002	−0.986	−1.418	0.376
${}_{62}Sm_{92}^{154}$	0.20	1061	1068	21.44	18.01	12.614	30.478	73.2	0.416	−0.804	−0.824	0.396
	0.25			22.60	18.30	16.074	40.963		0.560	−0.987	−1.176	0.392
	0.30			23.52	18.64	18.877	50.769		0.696	−1.109	−1.511	0.385
${}_{64}Gd_{90}^{154}$	0.20	1108	1089	21.57	18.25	12.205	27.408	48.8	0.562	−0.795	−0.660	0.404
	0.25			22.60	18.27	15.113	38.421		0.787	−0.956	−1.066	0.385
	0.30			23.30	18.61	17.630	49.542		1.015	−1.090	−1.492	0.370
${}_{64}Gd_{92}^{156}$	0.20	1013	1032	21.13	17.97	13.903	32.695	66.7	0.490	−0.912	−0.865	0.399
	0.25			22.20	18.27	16.911	42.965		0.644	−1.081	−1.233	0.388
	0.30			22.92	18.61	19.458	52.640		0.789	−1.218	−1.577	0.378
${}_{64}Gd_{94}^{158}$	0.20	962	953	20.97	17.62	14.943	38.051	75.0	0.507	−0.984	−1.099	0.385
	0.25			22.07	18.18	18.000	47.219		0.630	−1.157	−1.411	0.383
	0.30			22.80	18.46	20.550	55.892		0.745	−1.294	−1.711	0.379
${}_{64}Gd_{96}^{160}$	0.20	930	830	20.94	17.07	15.645	45.505	79.7	0.571	−1.032	−1.408	0.358
	0.25			22.05	17.89	18.731	54.127		0.679	−1.208	−1.728	0.366
	0.30			22.00	10.16	21.282	61.712		0.774	−1.345	−1.995	0.369

Table 1a continued

$_ZX_N^A$	ε	Δ_p(keV)	Δ_n(keV)	G_p XA	G_nXA	$\frac{2}{\hbar^2}J_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J\exp$ (MeV)$^{-1}$	$F=\frac{J}{J\exp}$	$\frac{2}{\hbar^2}W_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}W_n$ (MeV)$^{-1}$	g_R
$_{66}Dy_{94}^{160}$	0.20	937	913	20.93	17.54	15.653	40.217	68.5	0.587	−1.034	−1.169	0.383
	0.25			21.96	18.10	18.400	49.181		0.718	−1.164	−1.490	0.382
	0.30			22.42	18.38	20.235	57.203		0.835	−1.262	−1.797	0.373
$_{66}Dy_{96}^{162}$	0.20	891	803	20.82	17.06	16.774	47.962	74.0	0.648	−1.112	−1.474	0.361
	0.25			21.88	17.89	19.501	56.227		0.760	−1.242	−1.800	0.368
	0.30			22.34	18.15	21.225	62.989		0.851	−1.336	−2.072	0.366
$_{66}Dy_{98}^{164}$	0.20	858	637	20.79	16.25	17.648	61.539	80.8	0.762	−1.173	−1.977	0.322
	0.25			21.87	17.37	20.349	68.780		0.851	−1.302	−2.273	0.335
	0.30			22.33	17.68	21.901	71.384		0.883	−1.392	−2.326	0.343
$_{66}Dy_{100}^{166}$	0.20	828	680	20.77	16.54	18.501	56.867			−1.233	−1.418	0.321
	0.25			21.87	17.64	21.168	63.719			−1.361	−1.449	0.321
	0.30			22.34	10.26	22.705	67.264			−1.447	−1.464	0.322
$_{68}Er_{96}^{164}$	0.20	865	787	20.52	17.09	16.036	48.198	66.7	0.723	−1.062	−1.523	0.353
	0.25			21.39	17.93	18.672	56.373		0.845	−1.090	−1.853	0.368
	0.30			21.68	18.19	20.504	63.250		0.948	−1.139	−2.128	0.370
$_{68}Er_{98}^{166}$	0.20	827	622	20.43	16.30	16.917	62.077	74.1	0.838	−1.128	−2.040	0.315
	0.25			21.33	17.44	19.504	69.098		0.932	−1.145	−2.337	0.336
	0.30			21.62	17.75	21.238	71.606		0.966	−1.191	−2.383	0.348

Table 1a continued

$_ZX_N^A$	ε	Δ_p(keV)	Δ_h(keV)	G_p XA	G_h XA	$\frac{2}{\hbar^2}J_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J\exp$ (MeV)$^{-1}$	$F=\frac{J}{J\exp}$	$\frac{2}{\hbar^2}W_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}W_n$ (MeV)$^{-1}$	g_R
$_{68}Er_{100}^{168}$	0.20	800	685	20.42	16.73	17.581	55.609	75.0	0.741	−1.177	−1.402	0.316
	0.25			21.34	17.83	20.127	62.416		0.832	−1.187	−1.438	0.323
	0.30			21.63	18.46	21.786	66.168		0.882	−1.229	−1.454	0.328
$_{68}Er_{102}^{170}$	0.20	778	724	20.43	17.15	188.146	52.989	75.6	0.701	−1.219	−0.967	0.307
	0.25			21.37	18.29	20.656	60.711		0.803	−1.222	−0.883	0.304
	0.30			21.67	19.07	22.251	66.182		0.875	−1.262	−0.904	0.301
$_{70}Yb_{98}^{168}$	0.20	849	645	20.45	16.60	14.881	58.008			−0.928	−1.936	0.311
	0.25			20.94	17.73	18.209	66.031			−0.906	−2.235	0.342
	0.30			20.93	18.06	21.650	70.654			−0.880	−2.297	0.374
$_{70}Yb_{100}^{170}$	0.20	817	690	20.38	16.92	15.572	53.264	66.36	0.803	−0.980	−1.388	0.308
	0.25			20.89	18.03	18.923	60.950		0.918	−0.945	−1.426	0.329
	0.30			20.89	18.66	22.353	66.555		1.003	−0.910	−1.445	0.356

Table 1b

Moment of inertia and collective gyromagnetic ratio of some of the soubly even nuclei for the gap parameters Δ_p and Δ_n.

$_ZX^A_N$	ε	Δ_p(keV)	Δ_n(keV)	G_p XA	G_n XA	$\frac{2}{\hbar^2}J_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J$exp (MeV)$^{-1}$	$F=\frac{J}{J\text{exp}}$	$\frac{2}{\hbar^2}W_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}W_n$ (MeV)$^{-1}$	g_R
$_{70}Yb^{172}_{102}$	0.20	787	702	20.32	17.13	16.265	52.331	71.07	0.736	−1.032	−1.006	0.294
	0.25			20.85	18.29	19.631	60.887		0.857	−0.983	−0.913	0.306
	0.30			20.84	19.11	23.040	68.083		0.958	−0.938	−0.931	0.328
$_{70}Yb^{174}_{104}$	0.20	763	685	20.30	17.36	16.850	54.162	73.74	0.734	−1.076	−0.754	0.273
	0.25			20.84	18.55	20.226	62.121		0.842	−1.015	−0.667	0.292
	0.30			20.84	19.95	23.614	68.942		0.934	−0.962	−0.664	0.315
$_{70}Yb^{176}_{106}$	0.20	744	675	20.31	17.73	17.335	53.350	68.41	0.780	−1.112	−0.399	0.258
	0.25			20.87	18.69	20.717	59.310		0.867	−1.042	−0.447	0.298
	0.30			20.87	18.53	24.086	68.529		1.002	−0.981	−0.430	0.310
$_{72}Hf^{174}_{102}$	0.20	852	705	20.96	17.31	13.027	48.903			−0.657	−0.999	0.283
	0.25			20.90	18.47	16.397	57.496			−0.663	−0.908	0.293
	0.30			20.39	19.29	22.972	67.905			−0.554	−0.927	0.353
$_{72}Hf^{176}_{104}$	0.20	832	709	20.99	17.69	13.390	49.209	67.5	0.729	−0.680	−0.712	0.264
	0.25			20.93	18.87	16.765	57.304		0.849	−0.681	−0.637	0.281
	0.30			20.40	19.27	23.465	67.709		1.003	−0.562	−0.639	0.345
$_{72}Hf^{178}_{106}$	0.20	812	709	21.01	18.12	13.771	47.938	64.1	0.748	−0.703	−0.363	0.249
	0.25			20.96	19.07	17.147	54.273		0.847	−0.699	−0.416	0.286
	0.30			20.40	18.96	23.975	67.063		1.046	−0.569	−0.405	0.342

Table 1b continued

$_ZX^A_N$	ε	Δ_p(keV)	Δ_n(keV)	G_p XA	G_n XA	$\frac{2}{\hbar^2}J_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J$exp (MeV)$^{-1}$	$F=\frac{J}{J\text{exp}}$	$\frac{2}{\hbar^2}W_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}W_n$ (MeV)$^{-1}$	g_R
$_{72}Hf^{180}_{108}$	0.20	795	746	21.05	18.60	14.108	44.670	64.1	0.697	−0.724	−0.123	0.252
	0.25			21.00	19.30	17.484	51.912		0.810	−0.716	−0.311	0.296
	0.30			20.43	19.22	24.423	69.330		1.082	−0.576	−0.186	0.324
$_{74}W^{180}_{106}$	0.20	826	719	21.52	18.34	11.234	44.870			−0.392	−0.353	0.240
	0.25			20.72	19.30	14.578	51.298			−0.433	−0.408	0.276
	0.30			19.77	19.20	25.739	68.469			−0.241	−0.398	0.382
$_{74}W^{182}_{108}$	0.20	800	765	21.51	18.88	11.590	41.313	60.0	0.689	−0.408	−0.117	0.246
	0.25			20.69	19.57	14.916	48.643		0.811	−0.447	−0.300	0.288
	0.30			19.70	19.52	26.554	70.591		1.177	−0.236	−0.185	0.371
$_{74}W^{184}_{110}$	0.20	783	787	21.56	18.95	11.834	38.181	54.1	0.706	−0.419	−0.126	0.272
	0.25			20.73	19.11	15.149	48.057		0.888	−0.457	−0.386	0.302
	0.30			17.70	19.72	27.112	75.877		1.403	−0.233	−0.178	0.352
$_{74}W^{186}_{112}$	0.20	764	751	21.60	18.50	12.116	35.603	49.0	0.727	−0.432	−0.265	0.313
	0.25			20.75	18.18	15.414	49.631		1.013	−0.469	−0.543	0.309
	0.30			19.68	19.02	27.757	80.857		1.650	−0.228	−0.433	0.351
$_{76}Os^{186}_{108}$	0.20	815	722	21.91	18.75	10.226	41.860			−0.251	−0.129	0.229
	0.25			20.52	19.47	14.571	49.983			−0.248	−0.324	0.294
	0.30			19.42	19.36	28.948	75.096			−0.056	−0.190	0.392

Table 1b continued

$_Z X_N^A$	ε	Δ_p(keV)	Δ_n(keV)	G_p XA	G_n XA	$\frac{2}{\hbar^2} J_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2} J$ (MeV)$^{-1}$	$\frac{2}{\hbar^2} J\exp$ (MeV)$^{-1}$	$F = \frac{J}{J\exp}$	$\frac{2}{\hbar^2} W_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2} W_n$ (MeV)$^{-1}$	g_R
	0.20			21.90	18.83	10.650	38.508		0.900	−0.268	−0.134	0.258
$_{76}Os_{110}^{186}$	0.25	780	748	20.42	19.96	15.007	49.467	42.8	1.156	−0.259	−0.414	0.311
	0.30			19.24	19.62	30.344	81.686		1.909	−0.040	−0.174	0.377
	0.20			21.87	18.58	11.129	34.894		0.931	−0.288	−0.268	0.310
$_{76}Os_{112}^{188}$	0.25	743	742	20.30	18.25	15.481	50.095	37.5	1.336	−0.271	−0.550	0.326
	0.30			19.03	19.10	31.944	85.671		2.285	−0.021	−0.437	0.391
	0.20			21.92	17.92	11.418	33.230		1.086	−0.300	−0.528	0.363
$_{76}Os_{114}^{190}$	0.25	722	668	20.30	17.20	15.766	54.818	30.61	1.791	−0.279	−0.779	0.319
	0.30			18.98	17.85	32.912	90.914		2.970	−0.010	−0.857	0.398
	0.20			22.03	17.11	11.577	34.548			−0.306	−0.955	0.400
$_{76}Os_{116}^{192}$	0.25	711	537	20.38	15.79	15.929	65.661			−0.283	−1.123	0.288
	0.30			19.02	16.13	33.436	101.522			−0.004	−1.369	0.381

Table 2a

Moment of inertia and collective gyromagnetic ratio of some of the doubly even nuclei for the gap parameters $\Delta_p = P_p$ and $\Delta_n = P_n$

$_Z X_N^A$	ε	Δ_p(keV)	Δ_n(keV)	G_p XA	G_n XA	$\frac{2}{\hbar^2} J_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2} J$ (MeV)$^{-1}$	$\frac{2}{\hbar^2} J\exp$ (MeV)$^{-1}$	$F = \frac{J}{J\exp}$	$\frac{2}{\hbar^2} W_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2} W_n$ (MeV)$^{-1}$	g_R
	0.20			21.51	18.19	11.959	26.757		0.566	−0.759	−0.644	0.409
$_{62}Sm_{90}^{152}$	0.25	1100	1110	22.63	18.21	15.338	38.060	47.3	0.805	−0.938	−1.038	0.394
	0.30			23.54	18.54	18.136	49.297		1.042	−1.063	−1.454	0.382
	0.20			21.73	17.59	11.930	31.698		0.433	−0.757	−0.908	0.376
$_{62}Sm_{92}^{154}$	0.25	1100	1000	22.86	17.89	15.315	42.560	73.2	0.581	−0.936	−1.292	0.375
	0.30			23.77	18.23	18.125	52.559		0.718	−1.061	−1.642	0.372
	0.20			20.97	18.38	13.791	28.555		0.585	−0.905	−0.643	0.424
$_{64}Gd_{90}^{154}$	0.25	1020	1110	22.03	18.40	16.785	39.464	48.8	0.809	−1.073	−1.035	0.401
	0.30			22.74	18.73	19.321	50.441		1.034	−1.209	−1.451	0.383
	0.20			21.18	17.77	13.764	33.487		0.502	−0.903	−0.906	0.391
$_{64}Gd_{92}^{156}$	0.25	1020	1000	22.25	18.07	16.767	43.970	66.7	0.659	−1.071	−1.290	0.382
	0.30			22.97	18.42	19.314	53.727		0.806	−1.208	−1.640	0.373
	0.20			21.39	17.60	13.738	36.954		0.493	−0.901	−1.104	0.374
$_{64}Gd_{94}^{158}$	0.25	1020	950	22.47	18.16	16.749	46.084	75.0	0.614	−1.070	−1.417	0.375
	0.30			23.19	18.44	19.308	54.769		0.730	−1.206	−1.717	0.371
	0.20			21.61	17.77	13.712	38.765		0.486	−0.899	−1.166	0.362
$_{64}Gd_{96}^{160}$	0.25	1020	940	22.68	18.56	16.732	47.276	79.7	0.593	−1.068	−1.462	0.369
	0.30			23.41	18.85	19.301	54.872		0.688	−1.205	−1.709	0.370

Table 2a continued

${}_ZX_N^A$	ε	Δ_p(keV)	Δ_n(keV)	G_p XA	G_n XA	$\frac{2}{\hbar^2}J_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J\exp$ (MeV)$^{-1}$	$F=\frac{J}{J\exp}$	$\frac{2}{\hbar^2}W_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}W_n$ (MeV)$^{-1}$	g_R
${}_{66}Dy_{94}^{160}$	0.20	960	905	21.09	17.48	15.120	40.003	68.5	0.584	−0.996	−1.184	0.377
	0.25			22.10	18.05	17.878	48.992		0.715	−1.126	−1.507	0.377
	0.30			22.57	18.33	19.767	57.075		0.833	−1.227	−1.815	0.369
${}_{66}Dy_{96}^{162}$	0.20	960	940	21.29	17.94	15.093	40.099	74.0	0.542	−0.994	−1.163	0.374
	0.25			22.31	18.73	17.863	48.379		0.654	−1.125	−1.460	0.378
	0.30			22.78	19.03	19.770	55.330		0.748	−1.226	−1.707	0.374
${}_{66}Dy_{98}^{164}$	0.20	960	900	21.49	17.93	15.066	42.650	80.8	0.528	−0.992	−1.173	0.352
	0.25			22.52	18.91	17.849	50.770		0.628	−1.123	−1.422	0.357
	0.30			22.99	19.29	19.772	56.111		0.694	−1.225	−1.553	0.358
${}_{66}Dy_{100}^{166}$	0.20	960	800	21.69	17.40	15.039	46.642			−0.990	−1.136	0.318
	0.25			22.73	18.46	17.834	54.243			−1.121	−1.203	0.319
	0.30			23.20	19.05	19.773	59.153			−1.224	−1.247	0.320
${}_{68}Er_{96}^{164}$	0.20	900	940	20.78	18.12	15.266	40.226	66.7	0.603	−1.005	−1.161	0.375
	0.25			21.63	18.91	17.946	48.433		0.726	−1.041	−1.457	0.387
	0.30			21.91	19.21	19.872	55.422		0.831	−1.094	−1.705	0.386
${}_{68}Er_{98}^{166}$	0.20	900	900	20.97	18.09	15.250	42.784	74.1	0.574	−1.003	−1.170	0.354
	0.25			21.83	19.08	17.945	50.836		0.682	−1.041	−1.419	0.366
	0.30			22.11	19.47	19.888	56.228		0.755	−1.094	−1.551	0.370

Table 2a continued

${}_ZX_N^A$	ε	Δ_p(keV)	Δ_n(keV)	G_p XA	G_n XA	$\frac{2}{\hbar^2}J_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J\exp$ (MeV)$^{-1}$	$F=\frac{J}{J\exp}$	$\frac{2}{\hbar^2}W_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}W_n$ (MeV)$^{-1}$	g_R
${}_{68}Er_{100}^{168}$	0.20	900	800	21.17	17.56	15.234	46.804	75.0	0.624	−1.002	−1.134	0.320
	0.25			22.02	18.63	17.944	54.349		0.725	−1.040	−1.202	0.327
	0.30			22.31	19.22	19.903	59.311		0.791	−1.094	−1.247	0.331
${}_{68}Er_{102}^{170}$	0.20	900	700	21.36	16.96	15.218	51.418	75.6	0.680	−1.000	−1.011	0.282
	0.25			22.22	18.11	17.942	59.299		0.784	−1.039	−0.916	0.281
	0.30			22.51	18.93	19.918	65.021		0.860	−1.094	−0.933	0.284
${}_{70}Yb_{98}^{168}$	0.20	830	900	20.30	18.26	15.293	42.779			−0.959	−1.168	0.359
	.25			20.80	19.26	18.628	51.489			−0.929	−1.416	0.384
	0.30			20.79	19.65	22.054	58.394			−0.897	−1.549	0.409
${}_{70}Yb_{100}^{170}$	0.20	830	800	20.49	17.72	15.281	46.820	66.36	0.706	−0.958	−1.132	0.325
	0.25			20.99	18.79	18.628	55.029		0.829	−0.929	−1.201	0.345
	0.30			20.98	19.39	22.070	61.506		0.927	−0.898	−1.246	0.369

Table 2b

Moment of inertia and collective gyromagnetic ratio of some of the doubly even nuclei for the gap parameters $\Delta_p = P_p$ and $\Delta_n = P_n$

$_ZX_N^A$	ε	Δ_p(keV)	Δ_n(keV)	G_p XA	G_n XA	$\frac{2}{\hbar^2}J_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J\exp$ (MeV)$^{-1}$	$F = \frac{J}{J\exp}$	$\frac{2}{\hbar^2}W_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}W_n$ (MeV)$^{-1}$	g_R
	0.20			20.68	17.11	15.269	51.452		0.724	−0.956	−1.010	0.287
$_{70}Yb^{172}_{102}$	0.25	830	700	21.18	18.27	18.628	59.995	71.07	0.844	−0.928	−0.916	0.298
	0.30			21.17	19.09	22.087	67.230		0.946	−0.898	−0.933	0.320
	0.20			20.86	17.36	15.257	52.568		0.713	−0.954	−0.754	0.262
$_{70}Yb^{174}_{104}$	0.25	830	685	21.37	18.55	18.627	60.523	73.74	0.821	−0.928	−0.667	0.280
$_{70}Yb^{174}_{104}$	0.25	830	685	21.37	18.55	18.627	60.523	73.74	0.821	−0.928	−0.667	0.280
	0.30			21.36	18.95	22.102	67.431		0.914	−0.899	−0.664	0.304
	0.20			21.05	18.17	15.245	47.852		0.699	−0.952	−0.337	0.254
$_{70}Yb^{176}_{106}$	0.25	830	740	21.55	19.11	18.627	54.425	68.41	0.796	−0.927	−0.393	0.292
	0.30			21.55	19.04	22.118	63.906		0.934	−0.899	−0.384	0.305
	0.20			20.38	17.27	14.451	50.617			−0.748	−1.008	0.294
$_{72}Hf^{174}_{102}$	0.25	780	700	20.35	18.43	17.759	59.136			−0.731	−0.915	0.303
	0.30			19.76	19.26	24.767	69.949			−0.577	−0.934	0.367
	0.20			20.56	17.51	14.443	51.732		0.766	−0.747	−0.752	0.269
$_{72}Hf^{176}_{104}$	0.25	780	685	20.52	18.71	17.768	59.671	67.5	0.884	−0.731	−0.666	0.284
	0.30			19.94	19.11	24.783	70.160		1.039	−0.578	−0.664	0.352

Table 2b continued

$_ZX_N^A$	ε	Δ_p(keV)	Δ_n(keV)	G_p XA	G_n XA	$\frac{2}{\hbar^2}J_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J\exp$ (MeV)$^{-1}$	$F = \frac{J}{J\exp}$	$\frac{2}{\hbar^2}W_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}W_n$ (MeV)$^{-1}$	g_R
	0.20			20.74	18.33	14.434	47.027		0.734	−0.746	−0.336	0.262
$_{72}Hf^{178}_{106}$	0.25	780	740	20.70	19.27	17.775	53.594	64.1	0.836	−0.731	−0.392	0.297
	0.30			20.12	19.20	24.799	66.634		1.040	−0.580	−0.384	0.354
	0.20			20.92	18.04	14.425	49.094		0.766	−0.744	−0.155	0.236
$_{72}Hf^{180}_{108}$	0.25	780	660	20.88	18.78	17.783	55.686	64.1	0.869	−0.731	−0.365	0.284
	0.30			20.29	18.55	24.815	74.047		1.155	−0.581	−0.197	0.309
	0.20			21.55	18.48	11.181	43.760			−0.389	−0.335	0.244
$_{74}W^{180}_{106}$	0.25	830	740	20.75	19.43	14.529	50.367			−0.431	−0.391	0.279
	0.30			19.81	19.37	25.617	67.498			−0.242	−0.384	0.385
	0.20			21.73	18.19	11.182	45.853		0.764	−0.389	−0.154	0.218
	0.25	830	660	20.93	18.93	14.545	52.485	60.0	0.875	−0.431	−0.365	0.266
	0.30			19.98	18.70	25.619	74.904		1.248	−0.244	−0.198	0.337
	0.20			21.91	19.22	11.182	36.151		0.668	−0.388	−0.119	0.273
$_{74}W^{184}_{110}$	0.25	830	825	21.11	19.41	14.562	46.049	51.1	0.851	−0.430	−0.361	0.303
	0.30			20.16	19.98	25.621	72.047		1.332	−0.246	−0.183	0.350
	0.20			22.09	19.06	11.183	32.691		0.688	−0.388	−0.243	0.316
$_{74}W^{186}_{112}$	0.25	830	820	21.28	18.82	14.577	46.007	49.0	0.939	−0.430	−0.488	0.314
	0.30			20.33	19.58	25.622	74.238		1.561	−0.247	−0.407	0.351

Table 2b continued

$_ZX_N^A$	ε	Δ_p(keV)	Δ_n(keV)	G_p XA	G_n XA	$\frac{2}{\hbar^2}J_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J\exp$ (MeV)$^{-1}$	$F=\frac{J}{J\exp}$	$\frac{2}{\hbar^2}W_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}W_n$ (MeV)$^{-1}$	g_R
$_{76}Os_{108}^{184}$	0.20	960	660	22.72	18.34	8.730	43.404			−0.196	−0.154	0.194
	0.25			21.59	19.08	12.959	50.933			−0.213	−0.365	0.263
	0.30			20.76	18.86	24.098	73.435			−0.110	−0.198	0.332
$_{76}Os_{110}^{186}$	0.20	960	825	22.91	19.38	8.730	33.684	42.80	0.787	−0.196	−0.119	0.246
	0.25			21.77	19.57	12.969	44.462		1.039	−0.213	−0.360	0.301
	0.30			20.95	20.14	24.084	70.501		1.647	−0.111	−0.183	0.344
$_{76}Os_{112}^{188}$	0.20	960	820	23.09	19.22	8.730	30.236	37.5	0.806	−0.195	−0.243	0.290
	0.25			21.95	18.98	12.979	44.410		1.184	−0.213	−0.487	0.312
	0.30			21.13	19.75	24.071	72.680		1.938	−0.112	−0.408	0.346
$_{76}Os_{114}^{190}$	0.20	960	910	23.27	20.00	8.730	25.434	30.61	0.831	−0.195	−0.392	0.367
	0.25			22.13	19.56	12.989	41.229		1.347	−0.213	−0.557	0.343
	0.30			21.31	20.17	24.058	67.258		2.197	−0.114	−0.624	0.385
$_{76}Os_{116}^{192}$	0.20	960	950	23.46	20.58	8.730	23.747			−0.195	−0.554	0.419
	0.25			23.31	19.99	12.999	40.198			−0.213	−0.667	0.363
	0.30			21.49	20.49	24.045	64.975			−0.115	−0.794	0.409

Table 3a

Moment of inertia and collective gyromagnetic ratio of some of the doubly even nuclei for the gap parameters $\Delta_p = 12\sqrt{A}$ and $\Delta_n = 11.2/\sqrt{A}$.

$_ZX_N^A$	ε	Δ_p(keV)	Δ_n(keV)	G_p XA	G_n XA	$\frac{2}{\hbar^2}J_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J\exp$ (MeV)$^{-1}$	$F=\frac{J}{J\exp}$	$\frac{2}{\hbar^2}W_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}W_n$ (MeV)$^{-1}$	g_R
$_{62}Sm_{90}^{152}$	0.20	973	908	20.57	16.95	14.401	34.401	47.3	0.727	−0.929	−0.836	0.388
	0.25			21.76	16.95	18.000	48.031		1.015	−1.115	−1.391	0.379
	0.30			22.73	17.38	20.721	60.748		1.284	−1.226	−1.925	0.370
$_{62}Sm_{94}^{154}$	0.20	967	903	20.73	16.97	14.511	37.585	73.2	0.513	−0.936	−1.051	0.379
	0.25			21.94	17.28	18.129	49.390		0.675	−1.123	−1.490	0.378
	0.30			22.91	17.64	20.859	59.431		0.812	−1.234	−1.855	0.375
$_{64}Gd_{90}^{154}$	0.20	967	903	20.59	17.09	14.887	35.039	48.8	0.718	−0.980	−0.842	0.389
	0.25			21.67	17.08	17.919	48.170		0.987	−1.152	−1.401	0.374
	0.30			22.40	17.52	20.447	60.731		1.244	−1.288	−1.939	0.361
$_{64}Gd_{92}^{156}$	0.20	961	897	20.76	17.10	14.996	38.244	66.7	0.573	−0.987	−1.059	0.380
	0.25			21.84	17.42	18.044	49.529		0.743	−1.161	−1.501	0.373
	0.30			22.58	17.78	20.582	59.409		0.891	−1.397	−1.867	0.367
$_{64}Gd_{94}^{158}$	0.20	955	891	20.92	17.22	15.105	40.606	75.0	0.541	−0.995	−1.214	0.374
	0.25			22.02	17.79	18.167	49.904		0.665	−1.169	−1.539	0.375
	0.30			22.76	18.06	20.715	58.629		0.782	−1.306	−1.847	0.372
$_{64}Gd_{96}^{160}$	020	949	885	21.08	17.43	15.214	42.505	79.7	0.533	−1.002	−1.278	0.365
	0.25			22.19	18.23	18.289	51.119		0.641	−1.177	−1.588	0.371
	0.30			22.93	18.51	20.848	58.722		0.737	−1.315	−1.845	0.373

Table 3a continued

$_ZX^A_N$	ε	Δ_p(keV)	Δ_h(keV)	G_p XA	G_h XA	$\frac{2}{\hbar^2}J_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J\exp$ (MeV)$^{-1}$	$F=\frac{J}{J\exp}$	$\frac{2}{\hbar^2}W_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}W_n$ (MeV)$^{-1}$	g_R
	0.20			21.01	17.35	15.379	41.064		0.599	−1.014	−1.223	0.375
$_{66}Dy^{160}_{94}$	0.25	949	885	22.03	17.93	18.132	50.084	68.5	0.731	−1.144	−1.549	0.376
	0.30			22.50	18.20	19.996	58.151		0.849	−1.244	−1.859	0.368
	0.20			21.17	17.56	15.488	42.973		0.581	−1.022	−1.288	0.366
$_{66}Dy^{162}_{96}$	0.25	943	880	22.20	18.37	18.252	51.299	74	0.693	−1.152	−1.599	0.372
	0.30			22.67	18.66	20.119	58.232		0.787	−1.252	−1.857	0.369
	0.20			21.33	17.77	15.597	44.336		0.549	−1.029	−1.229	0.351
$_{66}Dy^{164}_{98}$	0.25	937	875	22.37	18.76	18.372	52.461	80.8	0.649	−1.160	−1.484	0.357
	0.30			22.84	19.14	20.241	57.623		0.713	−1.260	−1.612	0.358
	0.20			21.49	17.86	15.705	44.111			−1.037	−1.006	0.336
$_{66}Dy^{166}_{100}$	0.25	931	869	22.54	18.90	18.490	51.838			−1.168	−1.084	0.333
	0.30			23.02	19.47	20.363	57.053			−1.268	−1.139	0.331
	0.20			21.04	17.70	14.501	42.178		0.632	−0.948	−1.297	0.358
$_{68}Er^{164}_{96}$	0.25	937	875	21.87	18.51	17.216	50.478	66.7	0.757	−0.993	−1.610	0.373
	0.30			22.15	18.80	19.227	57.577		0.863	−1.049	−1.870	0.375
	0.20			21.20	17.90	15.598	43.536		0.588	−0.955	−1.237	0.343
$_{68}Er^{166}_{98}$	0.25	931	869	22.03	18.90	17.322	51.632	74.1	0.697	−0.999	−1.494	0.357
	0.30			22.31	19.29	19.337	56.944		0.768	−1.056	−1.623	0.364

Table 3a continued

$_ZX^A_N$	ε	Δ_p(keV)	Δ_h(keV)	G_p XA	G_h XA	$\frac{2}{\hbar^2}J_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J\exp$ (MeV)$^{-1}$	$F=\frac{J}{J\exp}$	$\frac{2}{\hbar^2}W_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}W_n$ (MeV)$^{-1}$	g_R
	0.20			21.35	17.99	14.694	43.288		0.577	−0.962	−1.013	0.327
$_{68}Er^{168}_{100}$	0.25	926	864	22.20	19.04	17.427	50.982	75.0	0.680	−1.006	−1.091	0.333
	0.30			22.48	19.62	19.447	56.349		0.751	−1.062	−1.146	0.336
	0.20			21.51	18.13	14.789	43.139		0.571	−0.968	−0.759	0.307
$_{68}Er^{170}_{102}$	0.25	920	859	22.36	19.20	17.532	51.152	75.6	0.677	−1.012	−0.725	0.306
	0.30			22.65	19.88	19.556	57.513		0.761	−1.069	−0.760	0.305
	0.20			21.04	18.03	13.369	42.506			−0.815	−1.246	0.339
$_{70}Yb^{168}_{98}$	0.25	926	864	21.49	19.04	16.642	51.173			−0.820	−1.504	0.364
	0.30			21.49	19.43	20.107	57.938			−0.814	−1.634	0.390
	0.20			21.19	18.12	13.459	42.238		0.636	−0.821	−1.020	0.322
$_{70}Yb^{170}_{100}$	0.25	920	859	21.65	19.18	16.743	50.502	66.36	0.761	−0.825	−1.098	0.340
	0.30			21.65	19.76	20.221	57.334		0.864	−0.819	−1.153	0.364

Table 3b

Moment of inertia and collective gyromagnetic ratio of some of the doubly even nuclei for the gap parameters $\Delta_p = 12\sqrt{A}$ and $\Delta_n = 11.2/\sqrt{A}$.

$_ZX_N^A$	ε	Δ_p(keV)	Δ_n(keV)	G_p XA	G_n XA	$\frac{2}{\hbar^2}J_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J\exp$ (MeV)$^{-1}$	$F=\frac{J}{J\exp}$	$\frac{2}{\hbar^2}W_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}W_n$ (MeV)$^{-1}$	g_R
	0.20			21.35	18.26	13.541	42.072		0.592	−0.826	−0.765	0.301
$_{70}Yb_{102}^{172}$	0.25	915	854	21.81	19.34	16.843	50.665	71.07	0.713	−0.830	−0.730	0.312
	0.30			21.80	20.02	20.335	58.509		0.823	−0.824	−0.764	0.333
	0.20			21.50	18.53	13.627	42.335		0.574	−0.832	−0.528	0.279
$_{70}Yb_{104}^{174}$	0.25	910	848	21.96	19.60	16.943	50.605	73.74	0.686	−0.835	−0.500	0.297
	0.30			21.96	20.01	20.448	58.645		0.795	−0.828	−0.518	0.318
	0.20			21.65	18.85	13.712	41.68		0.609	−0.837	−0.267	0.261
$_{70}Yb_{106}^{176}$	0.25	905	844	22.12	19.76	17.042	48.843	68.41	0.714	−0.840	−0.325	0.296
	0.30			22.12	19.80	20.561	58.411		0.854	−0.833	−0.325	0.308
	0.20			21.40	18.39	12.039	40.749			−0.596	−0.770	0.301
$_{72}Hf_{102}^{174}$	0.25	910	849	21.33	19.48	15.410	49.433			−0.615	−0.734	0.311
	0.30			20.87	20.17	21.651	60.039			−0.534	−0.769	0.369
	0.20			21.55	18.66	12.113	41.001		0.607	−0.600	−0.532	0.278
$_{72}Hf_{104}^{176}$	0.25	905	844	21.48	19.74	15.497	49.357	67.5	0.731	−0.619	−0.503	0.295
	0.30			21.02	20.15	21.772	60.178		0.892	−0.539	−0.521	0.354
	0.20			21.70	18.98	12.186	40.327		0.629	−0.604	−0.269	0.259
$_{72}Hf_{106}^{178}$	0.25	899	839	21.63	19.90	15.512	48.825	64.1	0.762	−0.618	−0.305	0.280
	0.30			21.16	19.94	21.892	59.943		0.935	−0.539	−0.327	0.345

Table 3b continued

$_ZX_N^A$	ε	Δ_p(keV)	Δ_n(keV)	G_p XA	G_n XA	$\frac{2}{\hbar^2}J_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}J\exp$ (MeV)$^{-1}$	$F=\frac{J}{J\exp}$	$\frac{2}{\hbar^2}W_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2}W_n$ (MeV)$^{-1}$	g_R
	0.20			21.85	19.17	12.259	39.180		0.611	−0.607	−0.104	0.252
$_{72}Hf_{108}^{180}$	0.25	894	835	21.78	19.83	15.670	46.879	64.1	0.731	−0.626	−0.267	0.295
	0.30			21.31	19.87	22.011	62.887		0.981	−0.542	−0.177	0.321
	0.20			21.99	19.11	10.376	38.686			−0.353	−0.271	0.253
$_{74}W_{106}^{180}$	0.25	894	835	21.24	20.04	13.771	45.924			−0.398	−0.330	0.288
	0.30			20.40	20.07	23.775	62.024			−0.255	−0.329	0.385
	0.20			22.14	19.30	10.434	37.512		0.625	−0.355	−0.105	0.245
$_{74}W_{108}^{182}$	0.25	889	830	21.39	19.97	13.841	45.217	60.0	0.754	−0.400	−0.269	0.288
	0.30			20.54	20.00	23.907	64.999		1.083	−0.256	−0.178	0.360
	0.20			22.29	19.23	10.492	35.436		0.655	−0.357	−0.119	0.263
$_{74}W_{110}^{184}$	0.25	885	826	21.53	19.41	13.910	45.373	54.1	0.839	−0.402	−0.360	0.296
	0.30			20.67	19.98	24.039	70.424		1.302	−0.256	−0.183	0.335
	0.20			22.44	19.07	10.549	32.024		0.654	−0.359	−0.243	0.307
$_{74}W_{112}^{186}$	0.25	880	821	21.67	18.83	13.979	45.362	49.0	0.926	−0.405	−0.487	0.308
	0.30			20.81	19.60	24.170	72.710		1.484	−0.257	−0.407	0.338
	0.20			22.30	19.43	9.462	36.697			−0.222	−0.105	0.241
$_{76}Os_{108}^{184}$	0.25	885	826	21.03	20.11	13.773	45.317			−0.230	−0.271	0.304
	0.30			20.08	21.14	26.442	67.750			−0.085	−0.179	0.395

Table 3b continued

$_Z X_N^A$	ε	Δ_p(keV)	Δ_n(keV)	G_p XA	G_n XA	$\frac{2}{\hbar^2} J_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2} J$ (MeV)$^{-1}$	$\frac{2}{\hbar^2} J\exp$ (MeV)$^{-1}$	$F = \frac{J}{J\exp}$	$\frac{2}{\hbar^2} W_p$ (MeV)$^{-1}$	$\frac{2}{\hbar^2} W_n$ (MeV)$^{-1}$	g_R
	0.20			22.45	19.36	9.512	34.599		0.808	−0.223	−0.119	0.259
$_{76}Os_{110}^{186}$	0.25	880	821	21.18	19.54	13.841	45.472	42.80	1.062	−0.231	−0.363	0.312
	0.30			20.21	20.11	26.591	73.233		1.711	−0.085	−0.183	0.367
	0.20			22.60	19.19	9.563	31.154		0.831	−0.225	−0.244	0.304
$_{76}Os_{112}^{188}$	0.25	875	817	21.31	18.95	13.908	45.459	37.5	1.212	−0.232	−0.489	0.324
	0.30			20.34	19.72	26.739	75.543		2.014	−0.085	−0.409	0.370
	0.20			22.75	19.21	9.613	28.155		0.920	−0.226	−0.440	0.364
$_{76}Os_{114}^{190}$	0.25	871	813	21.45	18.67	13.975	45.918	30.61	1.500	−0.233	−0.634	0.334
	0.30			20.47	19.30	26.886	75.427		2.464	−0.084	−0.706	0.384
	0.20			22.91	19.51	9.663	26.964			−0.227	−0.668	0.414
$_{76}Os_{116}^{192}$	0.25	866	808	21.59	18.69	14.041	46.678			−0.234	−0.793	0.343
	0.30			20.60	19.17	27.033	75.406			−0.084	−0.947	0.401

In the tables given above the nuclei are shown in the first column and the values of the deformation parameter are given in the second. The third and the fourth columns are the gap parameters for protons and neutrons, respectively. The following two columns present the pairing energy times the mass number for the same nucleons, whereas the seventh is the column representing the contribution of the protons to the moment of inertia of the nucleus, which is given in equation (21). In column eight the calculated total momenta of inertia of the nuclei are listed, the neighbouring column represents the experimental values taken from refs. [7—9] The tenth column shows the ratio of the calculated to the experimental moment of inertia. The next two columns are the W_i values of the formula (21) for protons and neutrons, respectively. In the last column calculated gyromagnetic ratios are given.

The comparison between experiment and theory shows a very good agreement for Sm^{152}, Gd^{154}, Er^{164}, Er^{166}, all Yb and Hf isotopes, W^{186} and Os isotopes. In the case of the Dy, Gd and W isotopes the theoretical values do not differ much from the experimental ones and the agreement is rather good.

VI. CONCLUSIONS

The theoretical results obtained according to three alternative procedures described in the preceding section are consistent with each other and in general show good agreement with the experimental data.

The choice of an alternative basis, namely an asymptotic basis in the calculations improves somewhat the accuracy of the theoretical predictions.

One can see the dependence of the moment of inertia and the gyromagnetic ratio on the deformation parameter by taking into account three different values of ε in the calculations. Considering the change of ε in different intervals for different nuclei and performing the same calculation, it seems possible to find the exact experimental results given for each nucleus. Thus this procedure reveals a theoretical prediction for the deformation degree of the nuclei.

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МОМЕНТЫ ИНЕРЦИИ И ГИРОМАГНИТНЫЕ ОТНОШЕНИЯ НЕКОТОРЫХ ЧЕТНО-ЧЕТНЫХ ЯДЕР ИЗ РЕДКОЗЕМЕЛЬНОЙ ОБЛАСТИ.

С применением кранкинг-модели вычислены моменты инерции и гиромагнитные отношения некоторых четно-четных ядер из редкоземельной области. В расчетах применены, за исключением парных корреляций, асимпточеские собственные функции модели деформированных оболочек. Сравнение с экспериментальными данными показывает хорошое согласие.