# STRUCTURE OF LEVELS AND ELECTROMAGNETIC TRANSITION RATES IN ODD-ODD NUCLEI CLOSE TO DOUBLY-MAGIC NEUTRON DEFICIENT $^{100}$Sn

V. I. Isakov[1]

*Petersburg Nuclear Physics Institute, National Research Center Kurchatov Institute, Gatchina 188300 Russia*

In our previous papers, we extensively studied odd-odd nuclei adjacent to doubly magical stable nuclide $^{208}$Pb, as well as to also doubly magical neutron excess $^{132}$Sn. To date, some experimental information has emerged also about the properties of such nuclei in the vicinity of an extremely neutron deficient and also doubly magical $^{100}$Sn. In our calculations of odd-odd nuclei close to $^{100}$Sn, we applied random phase approximation and multi-particle shell model, both based on the phenomenological nuclear potential [1] and effective two-body interaction [2], which parameters were defined by us before. The subject of our interest were $^{98}_{49}\mathrm{In}_{49}$, $^{100}_{49}\mathrm{In}_{51}$, $^{98}_{47}\mathrm{Ag}_{51}$ and $^{94}_{45}\mathrm{Rh}_{49}$. In these nuclei we determined energy spectra and $E2, M1$ transition rates. Effective transition operators were also defined by us before [3], and they successfully described $E2$ and $M1$ transitions in nuclei close to $^{208}$Pb and $^{132}$Sn. In particular, the values of proton and neutron effective charges were $e_p = 1.6|e|$ and $e_n = 0.9|e|$. In our case, the value of $e_p \approx 1.6|e|$ was also obtained by us by using the experimental $T_{1/2}$ values of the $8^+_1 \to 6^+_1$ and $6^+_1 \to 4^+_1$ transitions in $^{98}_{48}\mathrm{Cd}_{50}$ [4], as well as our RPA calculation for these cases. However, the energy of an analogous $6^+_1 \to 4^+_1$ transition and its half-life in $^{102}_{50}\mathrm{Sn}_{52}$ are known with great uncertainty [4, 5] and thus the value of neutron effective charge in nuclei close to $^{100}$Sn is also very uncertain [5]: $e_n = 2.3(+0.6-0.2)|e|$. Such a large value of neutron effective charge is a subject of discussions. Here, we defined the values of $e_p$ and $e_n$ from the joint description of the $4^+_1 \to 6^+_1(gr.st.)$ and $2^+_1 \to 4^+_1(gr.st.)$ transitions in $^{98}$Ag and $^{94}$Rh. The result is $e_p \approx 1.6$ and $e_n \approx 2.8$. Mention that the obtained by us value of $e_n$ agrees with the experimental results [6, 7], considered together with theoretical calculations performed by us for the $6^+_1 \to 4^+_1$ transition in $^{102}$Sn [2].

$^{98}_{47}\mathrm{Ag}_{51}$: $B(E2; 6^+_1 \to 4^+_1)_{exp} = 80.3(3.5)$; $4.70(e_n = 0.9)$; $49.8(e_n = 2.3)$; $77.5(e_n = 2.8)$
$^{94}_{45}\mathrm{Rh}_{49}$: $B(E2; 4^+_1 \to 2^+_1)_{exp} = 105.8(10.0)$; $13.4(e_n = 0.9)$; $75.8(e_n = 2.3)$; $110.5(e_n = 2.8)$

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[1] E-mail visakov@thd.pnpi.spb.ru

**Table 1. Energy levels and electromagnetic moments of $^{100}_{49}\mathrm{In}_{51}$. Experimental energies are marked by the asterisks. Energy of the $5_1^+$ state (x) is not known in the experiment, but it follows that this state is a low-lying isomer.**

| Level | Energy | Quadr. moment $Q_2$ | | | Magn. moment |
|---|---|---|---|---|---|
| | | $e_p = 1.6$ $e_n = 0.9$ | $e_p = 1.6$ $e_n = 2.3$ | $e_p = 1.6$ $e_n = 2.8$ | |
| $1_1^+$ | $2.697\,(x + 2.720)$* | 3.96 | 1.57 | 0.715 | 3.48 |
| $2_1^+$ | $0.674\,(x + 0.672)$* | 12.5 | 9.77 | 8.78 | 5.64 |
| $2_2^+$ | $1.494\,(x + 1.423)$* | 6.03 | 12.2 | 14.5 | 3.67 |
| $3_1^+$ | $0.247\,(x + 0.236)$* | 19.8 | 31.1 | 35.2 | 5.30 |
| $3_2^+$ | 1.174 | 10.4 | 24.8 | 30.0 | 3.81 |
| $4_1^+$ | $0.100\,(x + 0.095)$* | 23.3 | 38.2 | 43.6 | 4.87 |
| $4_2^+$ | 1.019 | 11.4 | 23.6 | 27.9 | 4.39 |
| $5_1^+$ | $0.094\ (x)$* | 23.3 | 32.7 | 36.0 | 4.97 |
| $5_2^+$ | 0.937 | 11.7 | 17.5 | 19.6 | 5.02 |
| $6_1^+$ | gr. st. (gr. st.)* | 19.9 | 15.5 | 13.9 | 5.00 |
| $6_2^+$ | 0.941 | 13.5 | 12.9 | 12.7 | 5.74 |
| $7_1^+$ | 0.284 | 17.4 | –1.62 | –8.43 | 5.32 |
| $7_2^+$ | 0.872 | 12.4 | –1.52 | –6.49 | 6.43 |
| $8_1^+$ | 1.354 | 14.5 | –9.51 | –18.1 | 7.22 |

**Table 2. Energy levels and electromagnetic moments of levels in ${}^{98}_{47}\mathrm{Ag}_{51}$. Experimental energies are marked by the asterisks.**

| Level | Energy | Quadr. moment $Q_2$ | | | Magn. moment |
|---|---|---|---|---|---|
| | | $e_p = 1.6$ $e_n = 0.9$ | $e_p = 1.6$ $e_n = 2.3$ | $e_p = 1.6$ $e_n = 2.8$ | |
| $1_1^+$ | 2.183 (2.165)* | 1.178 | −0.949 | −1.708 | 3.46 |
| $2_1^+$ | 0.531 (0.515)* | 3.720 | −1.808 | −3.782 | 5.90 |
| $2_2^+$ | 1304 | 5.633 | 13.88 | 16.83 | 3.41 |
| $3_1^+$ | 0.192 (0.168)* | 12.01 | 21.68 | 25.13 | 5.16 |
| $3_2^+$ | 1.253 (1.066 ?)* | 7.060 | 17.44 | 21.15 | 3.80 |
| $4_1^+$ | 0.085 (0.107)* | 13.82 | 25.50 | 29.67 | 4.92 |
| $4_2^+$ | 1.092 | 7.104 | 15.67 | 18.73 | 4.37 |
| $5_1^+$ | 0.087 | 12.03 | 18.28 | 20.51 | 4.92 |
| $5_2^+$ | 1.105 | 6.279 | 10.37 | 11.83 | 5.02 |
| $6_1^+$ | gr.st. (gr.st.)* | 7.737 | 3.315 | 1.736 | 5.06 |
| $6_2^+$ | 1.029 | 4.796 | 2.278 | 1.378 | 5.72 |
| $7_1^+$ | 0.201 (0.220)* | 1.449 | −17.90 | −24.81 | 5.29 |
| $7_2^+$ | 1.063 | 2.755 | −8.261 | −12.19 | 6.46 |
| $8_1^+$ | 1.167 (1.154)* | 0.212 | −21.06 | −28.66 | 7.21 |