

COINCIDENCE STUDY OF LOW-LYING STATES IN ^{108}Ag FOLLOWING
 $^{107}\text{Ag} (n, \gamma)$ REACTION

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Abstract: Time differential coincidence measurements have been made in order to investigate the population of 215.38 keV ($T_{1/2} = 48$ ns) isomeric level in ^{108}Ag , following the $^{107}\text{Ag} (n, \gamma)$ ^{108}Ag reaction. In total about 800 gamma transitions have been observed in the energy interval from 100 keV to 7300 keV. From these measurements new levels at 364.24 keV, 439.12 keV, 611.26 keV, 959.85 keV and 1161.23 keV have been proposed. The neutron separation energy in ^{108}Ag was determined to be 7269.1 ± 0.7 keV.

1. Introduction

The theoretical and experimental study of the low-lying states in ^{108}Ag is of considerable interest since the spectra of neighbouring even-even Pd and Cd isotopes show vibrational-like character. Ground-state quasirotational bands are rather regular in Pd and exhibit irregularities in Cd isotopes. Odd-even Ag isotopes show characteristic excitational pattern for the core-cluster coupling description with characteristic decoupled bands. The three-proton holes in ^{108}Ag are distributed in $g_{9/2}$, $p_{1/2}$, $p_{3/2}$ and $f_{5/2}$ shell-model states giving rise to $1/2^-$ ground and $7/2^+$ first excited states in ^{107}Ag . Energy

separation between these two states is 93.13 keV. Close to $7/2^+$ state one finds $9/2^+$ second excited state in ^{107}Ag . The $1/2^-$ state is predominantly of $(g_{9/2}^{-2}) 0p_{1/2}^{-1}$ character with large admixtures of one-phonon states. The $7/2^+$ and $9/2^+$ states are of $(g_{9/2}^{-3}) 7/2, 9/2$ character with strong admixtures of one-phonon states ¹⁾. Eleven neutrons in ^{108}Ag outside the closed shell at 50 neutrons, are distributed in $g_{7/2}, d_{5/2}, h_{11/2}, s_{1/2}, d_{3/2}$ shell-model states, giving rise to $5/2$ ground state in $^{109}_{48}\text{Cd}$ with characteristic band structures based in addition on $1/2, 3/2$ and $7/2$ states ²⁾. From these known level sequences in ^{107}Ag and ^{109}Cd we might derive possible configurations for some low-lying states in ^{108}Ag . The ground state of ^{108}Ag is expected to be of the type $(\tilde{j} 7/2^+, \gamma 5/2^+) 1^+$ followed by the rest of particle multiplet states $2^+, 3^+, 4^+, 5^+, 6^+$. The lowest negative parity states are of the form $(\tilde{j} 1/2^-, \gamma 5/2^+) 2^-, 3^-$. The isomeric state has probably the basic configuration $(\tilde{j} 7/2^+, \gamma 7/2^+) 0^+, 1^+, 2^+, 3^+, 4^+, 5^+, 6^+, 7^+$. For higher excited states one expects, beside proton-neutron (particle) multiplets, also particle-phonon multiplets and the band structure similar to the neighbouring even-even nuclei. As indicated, we expect in ^{108}Ag rather high level density even at the lowest excitation, due to absence of pairing.

The ^{108}Ag compound nucleus state formed after thermal neutron capture has 0^- or 1^- assignment. Therefore the predominant $E(1), M(1)$ or $E(2)$ primary transitions are populating levels with low spins as $0^+, 1^+, 2^+$ and $0^-, 1^-, 2^-, 3^-$. In the $^{107}\text{Ag} (d,p)^{108}\text{Ag}$ reaction only negative parity states are populated since the ^{107}Ag ground state has assignment $1/2^-$ and the transferred neutrons have positive ℓ values ($\ell = 0, 2, 4$) ⁷⁾. In this way the (n, γ) studies combined with other methods, (d,p) reactions, and comparison of the results with results

of neighbouring nuclei, makes it possible to construct a consistent level diagram.

Till now there is no theoretical calculation for ^{108}Ag and previous experimental results ³⁾ were not sufficient to give informations about the level diagram of ^{108}Ag . This nucleus obtained from $^{107}\text{Ag} (n, \gamma)$ reaction was investigated by Bolotin and Namenson ⁴⁾. They used a Ge(Li) detector as a system for single and pairspectrometer modes, and found 33 primary transitions in ^{108}Ag . These authors compared their data with the $^{107}\text{Ag} (d, p)$ results. Deexcitation of the 127-year isomer at 109.8 keV in ^{108}Ag has been investigated by Kistner and Sunyar ⁵⁾. They found by coincidence studies and internal conversion coefficients measurements, that the 30.4 keV M4 isomeric transitions is followed by 79 keV E1 transition, to the ground state 1^+ of ^{108}Ag . They also proposed the spin and parity assignments for the 79.4 keV (2^-) and 109.8 keV (6^+) levels.

Bondarenko, Prokofjev, Rosantcev and Estulin measured the conversion coefficients and γ - γ coincidences, for a few low-energy transitions, by a scintillation spectrometer ⁶⁾. Brient, Riley, Seitz and Sen ⁷⁾ investigated the (d, p) stripping reaction. The half-life of the 215.98 keV level in ^{108}Ag state involving the 215.38 keV ground state transition was determined by Rozantcev and Estulin ⁸⁾ as (48 ± 3) ns and by S.C. Gujrathi et al. ⁹⁾ as (54 ± 8) ns. The most detailed level and transition diagram of the low-lying states of ^{108}Ag so far is based on the high-resolution diffractometer low-energy (n, γ) data. ¹⁰⁾

The purpose of the present work was to obtain additional information about γ -transitions, which can be used in the interpretation of the level and transition diagram of ^{108}Ag . This information can be

obtained by using time-differential coincidence spectrometry technique ¹¹⁾ in order to investigate the population of the 215.38 keV ($T_{1/2} = 48$ ns) isomeric level in ^{108}Ag , following thermal neutron capture of ^{107}Ag . In such experiment, the intensity of each line in coincidence and single mode respectively, determines a new parameter P, associated with the feeding of isomeric state. The parameter P gives the percentage of intensity of transition which populates the isomeric state in the "advanced" coincidence mode and has the value from 100 to 0%.

2. Experimental procedure

Target of metallic silver of 100 mg enriched to 98.54% in ^{107}Ag ($\sigma_{\text{th}} = 35$ b) was exposed to a filtered thermal neutron beam emerging from the horizontal channel of reactor RA of the Boris Kidrich Institute. The thermal neutron flux at the target had a value of $4.2 \times 10^7 \text{ n cm}^{-2} \text{ s}^{-1}$. Singles gamma spectra in the energy intervals of 0.1 - 1.4 MeV and 1.4 - 7.5 MeV were measured with a Ge(Li) detector of 16 cm^3 and a resolution of 2.5 keV at 1332 keV gamma-ray. The coincidence spectra in the "advanced" mode (referring to the decay of the 215.38 keV, $T_{1/2} = 48$ ns - isomeric level of ^{108}Ag) were measured with the same Ge(Li) detector, gated in a fast-slow mode by the NaI(Tl) detector, accepting the 215.38 keV delayed transition. The NaI detector was placed in an approached geometry to insure a good accumulation rate of the coincidence events. The coincidence prompt resolution was $2\tau \approx 10$ ns in the whole energy interval of interest. In order to suppress the prompt-events, the first ~ 50 ns of the delay-coincidence curve had to be rejected, so the "gating interval" was set from about 50 to 250 ns of the delayed coincidences. As a result the "advanced" part of spectrum was enhanced

by a factor of about hundred. The electronic apparatus consisted of a fast-slow coincidence system including a time to amplitude convertor. A 4096 channel pulse height analyser served to collect the data. The data were evaluated using a semiautomatic program ¹³⁾ on Control Data 3600 Computer.

The gamma ray energies in the low-energy part of the spectrum were determined by using the precise energy values of several strong ^{108}Ag lines obtained from crystal diffractometer data ¹⁰⁾. In the medium and high-energy region the spectra were calibrated applying the mixed target method using the gamma-ray energies from the $^{32}\text{S}(n,\gamma)^{33}\text{S}$ reaction ¹²⁾. The efficiency curves for the Ge(Li) detector have been obtained using several isotopes and (n,γ) reactions with precisely known intensity ratios of the cascading gamma-rays. Sources of $^{180\text{m}}\text{Hf}$, ^{22}Na , ^{24}Na , ^{46}Sc and ^{60}Co were used to obtain the total energy peak efficiency curve ¹⁴⁾ and the $^{53}\text{Cr}(n,\gamma)$, $^{48}\text{Ti}(n,\gamma)$ and $^{32}\text{S}(n,\gamma)$ reactions to determine the double-escape peak efficiency ¹⁵⁾.

3. Results and discussion

The γ -ray energies, relative intensities and parameter P-values of the primary transitions in ^{108}Ag , following the $^{107}\text{Ag} (n, \gamma) ^{108}\text{Ag}$ reaction, are listed in Table 1, together with the data of Bolotin and Namenson⁴⁾. In Table 2 are listed the γ -ray energies, relative intensities and parameter P-values for low-energy gamma spectra up to 1000 keV. The intensity value of 327.32 keV line is used for normalization in Table 1 and 2. This transition is known to feed directly the isomeric level of 215.38 keV. Tables 1 and 2 present only gamma-rays placed into the preliminary level and transition diagram of ^{108}Ag given in Fig 2 (also in Ref. 16).

In Fig. 1 a part of the low-energy gamma spectra is given, including the line 148.86 keV with P-value about 100.

In Fig. 2 is shown the preliminary transition and level diagram of ^{108}Ag , following the $^{107}\text{Ag} (n, \gamma) ^{108}\text{Ag}$ reaction, till excitation energy of about 1200 keV. This diagram was constructed using precise data from the γ -diffractometer measurements of the $^{107}\text{Ag} (n, \gamma) ^{108}\text{Ag}$ reaction⁽¹⁰⁾ and our high and low-energy singles and coincidence data,

The interpretation of our coincidence results is rather simple for those γ -rays with P-values nearly 100. Such transitions are probably populating directly the 215.38 keV isomeric level, and therefore their position in the ^{108}Ag level diagram is unambiguously determined. Gamma transitions with $P \sim 100$ also indicate the positions of corresponding starting levels.

The high-energy primary γ -transitions combined with the separation energy of the last neutron in ^{108}Ag independently indicate positions of energy levels in ^{108}Ag and may confirm the data obtained

from the coincidence data. The separation energy of the last neutron in ^{108}Ag was calculated using the energy of the intensive primary ground state transition and several ground state γ -ray cascades. The separation energy, corrected for recoil, has a value of (7269.1 ± 0.7) keV.

In Table 3 are given the most significant γ -rays and levels in ^{108}Ag involved in feeding of the 215.38 keV isomeric level. In the first column are listed the feeding energy levels, in the second the stop-over transitions and in the third column corresponding P-values are given. In the last column the starting levels are given, involved in the feeding of the levels, presented in the first column. In Table 3 are also presented the main feeding modes for seven levels of excitation energies higher than 215.38 keV. The new data are indicated by asterisk. We also found that all starting levels are populated with high energy primary γ -transitions.

The P-values of the corresponding stop-over transitions feeding the same level are grouped in column 3, Table 3. It is evident that for higher level excitations this parameter tends to be smaller. This is in accordance with a fact that toward higher excitation energies the number of level decay modes is increasing.

A most detailed level and transition diagram of ^{108}Ag up to excitation energies of 606 keV was given by Breitig et al.¹⁰⁾ They measured with γ -diffractometer the low-energy γ -rays following the $^{107}\text{Ag}(n,\gamma)^{108}\text{Ag}$ reaction and constructed the ^{108}Ag level and transition diagram applying the Ritz combination principle.

Comparing our level and transition diagram (Fig. 2) with diagram of Breitig et al.¹⁰⁾ and with the results given in Refs. 3, 4, 6, 7, 9

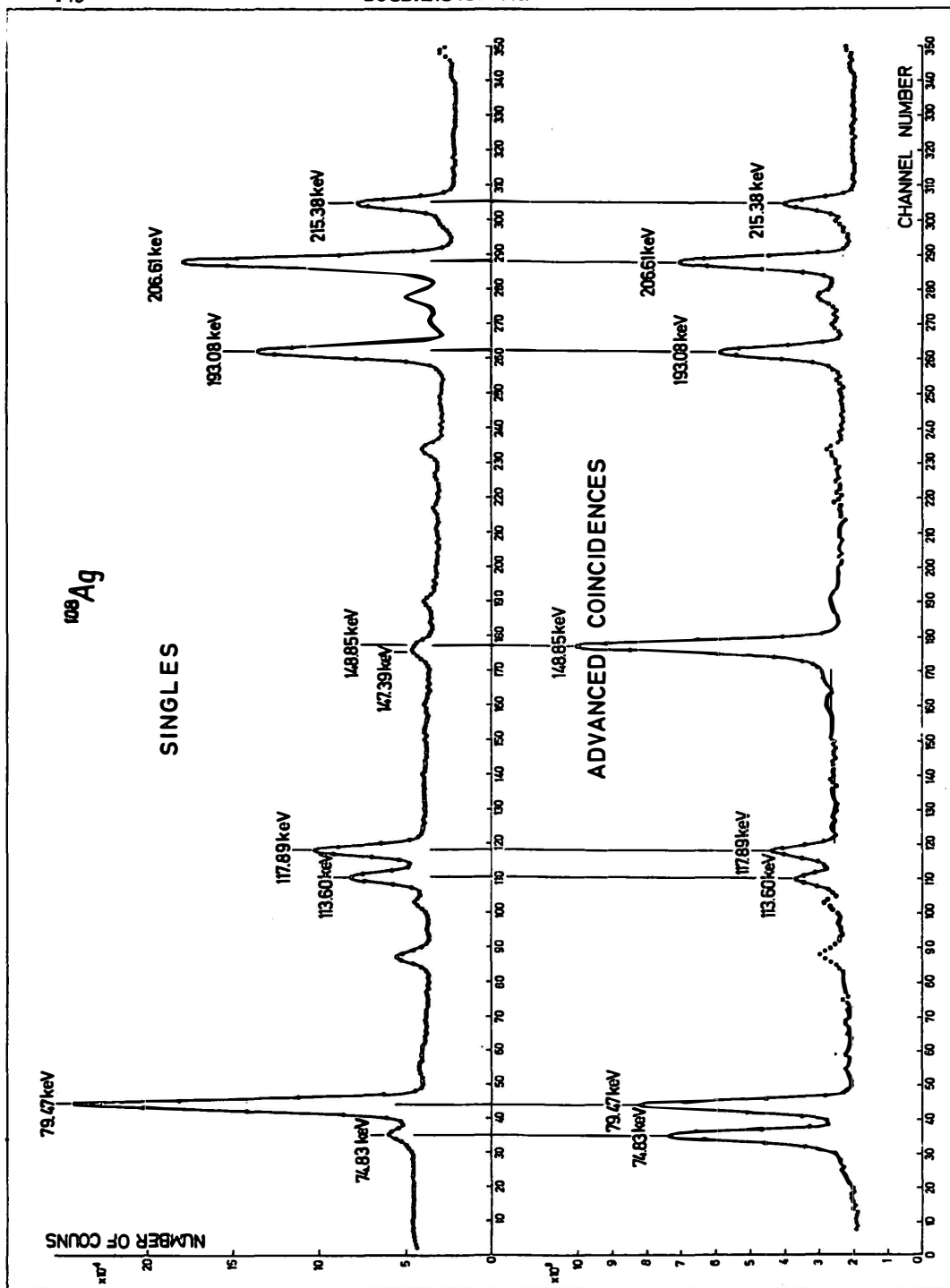


Fig. 2. Preliminary decay scheme of ^{108}Ag . Coincidence relations are indicated with dots.

T A B L E 1.
 Primary gamma rays observed from the $^{107}\text{Ag} (n, \gamma) ^{108}\text{Ag}$ reaction

Bolotin and Namenson ⁽⁴⁾			This work	
E_{γ} (keV)	I_{γ} rel	E_{γ} (keV)	I_{γ} rel	P (%)
7267 ± 1	70 ± 11	7268.9 ± 0.4	73.7 ± 14.0	2 ± 3
7188 ± 2	1.1 ± 0.6	7189.6 ± 1.2	0.82 ± 0.5	1 ± 2
7076 ± 1	71	7075.3 ± 0.8	71.1 ± 11.5	2 ± 2
7062 ± 1	27 ± 4	7062.0 ± 0.7	28 ± 6	1 ± 2
6982 ± 2	2.1 ± 0.4			
6974 ± 1	32.7 ± 5.0	6974.3 ± 0.4	32.7 ± 8.5	3 ± 2
		6939.7 ± 1.3	0.9 ± 0.5	25 ± 17
6934 ± 2	0.85 ± 0.14	6933.9 ± 0.6		
6929 ± 1	1.6 ± 0.3	6930.1 ± 0.8	2.2 ± 0.8	1 ± 2
		6904.6 ± 1.6	1.2 ± 0.4	33 ± 14
		6889.8 ± 0.8	15.1 ± 4.5	4 ± 3
		6860.6 ± 0.7	3.4 ± 1.2	6 ± 8
		6829.9 ± 1.9	0.66 ± 0.24	61 ± 27
6816 ± 1	2.1 ± 0.3	6817.4 ± 0.9	1.3 ± 0.7	28 ± 17
6807 ± 2	2.3 ± 0.7	6808.3 ± 1.2	1.6 ± 0.8	8 ± 6
6802 ± 2	2.6 ± 0.6	6803.6 ± 0.8	4.3 ± 1.0	1 ± 2
6759 ± 1	3.1 ± 0.5	6760.2 ± 0.7	4.0 ± 1.6	3 ± 2
		6726.2 ± 0.8	1.8 ± 0.7	25 ± 15
6720 ± 3	0.78 ± 0.28	6721.8 ± 0.6	1.4 ± 0.8	14 ± 10
6704 ± 1	22.7 ± 3.5	6705.1 ± 0.8	24.9 ± 5.5	2 ± 2
6689 ± 2	2.1 ± 0.4	6689.9 ± 0.7	1.6 ± 0.6	1 ± 2
6681 ± 2	1.8 ± 0.4	6661.6 ± 1.0	3.2 ± 1.2	31 ± 19
		6657.2 ± 0.7	1.9 ± 0.6	12 ± 7
		6612.5 ± 0.7	0.9 ± 0.2	32 ± 14
6568 ± 3	1.3 ± 0.6	6568.0 ± 1.2	2.8 ± 1.2	16 ± 10
6561 ± 1	7.1 ± 1.1	6561.0 ± 0.6	5.14 ± 1.4	2 ± 2
		6506.5 ± 0.7	1.1 ± 0.5	2 ± 3
6388 ± 2	3.9 ± 0.7	6388.2 ± 0.7	3.0 ± 1.2	30 ± 18
6370 ± 3	1.3 ± 0.3	6370.3 ± 0.3	2.2 ± 0.8	11 ± 7

Table 1 (continuation)

Bolotin and Namenson ⁽⁴⁾			This work	
E_{γ} (keV)	I_{γ} rel	E_{μ} (keV)	I_{γ} rel	P (%)
		6309.4 ± 0.6	1.9 ± 0.8	21 ± 12
6292 ± 3	1.8 ± 0.4	6291.7 ± 0.5	1.6 ± 1.2	11 ± 7
6265 ± 1	19.2 ± 2.8	6266.2 ± 0.6	24.0 ± 8.5	1 ± 2
6255 ± 1	9.2 ± 1.4	6256.2 ± 0.7	9.5 ± 2.5	12 ± 8
6220 ± 1	14.9 ± 2.8	6221.5 ± 0.7	4.5 ± 1.5	20 ± 12
		6216.9 ± 1.2	9.4 ± 2.6	12 ± 7
6162 ± 1	13.5 ± 2.1	6163.4 ± 0.6	9.8 ± 3.2	28 ± 12
6156 ± 1	40.5 ± 6.4	6156.7 ± 0.7	42.1 ± 10.0	8 ± 5
6131 ± 2	2.3 ± 0.5	6133.3 ± 0.5	1.3 ± 0.3	30 ± 15
		6129.1 ± 2.1	2.5 ± 1.7	15 ± 10
6110 ± 2	2.1 ± 0.4	6110.4 ± 1.2	2.0 ± 1.2	16 ± 10
		6107.1 ± 0.8	1.7 ± 0.7	16 ± 8

T A B L E 2
Gamma rays observed from the $^{107}\text{Ag}(n,\gamma)^{108}\text{Ag}$ reaction

E_γ (keV)	I_γ rel	P(%)	E_γ (keV)	I_γ rel	P(%)
101.22 ± 0.35	4.77 ± 1.01	1 ± 2	206.24 ± 0.30	116.60 ± 11.5	2 ± 1
113.26 ± 0.14	7.50 ± 0.97	2 ± 2	*207.78 ± 1.02	0.03 ± 0.02	> 10
113.71 ± 0.25	7.38 ± 1.55	2 ± 2	212.97 ± 0.58	2.90 ± 0.75	3 ± 2
117.81 ± 0.28	20.26 ± 6.52	2 ± 2	215.17 ± 0.63	46.24 ± 5.44	2 ± 1
129.03 ± 0.07	1.32 ± 0.32	3 ± 2	222.95 ± 0.45	0.32 ± 0.06	5 ± 3
130.86 ± 1.21	0.42 ± 0.26	6 ± 6	223.68 ± 0.35	0.07 ± 0.03	92 ± 50
134.46 ± 0.19	0.36 ± 0.10	6 ± 4	225.16 ± 0.58	0.32 ± 0.16	3 ± 3
135.98 ± 0.32	0.98 ± 0.28	8 ± 6	226.28 ± 0.75	0.26 ± 0.08	4 ± 4
139.85 ± 1.13	0.64 ± 0.18	8 ± 5	227.08 ± 0.45	1.00 ± 0.35	3 ± 2
148.57 ± 0.24	4.86 ± 0.68	96 ± 20	231.48 ± 0.47	0.22 ± 0.08	15 ± 10
149.54 ± 0.42	0.30 ± 0.11	8 ± 5	238.59 ± 0.26	9.95 ± 1.05	2 ± 3
155.48 ± 0.14	2.85 ± 0.47	2 ± 2	247.88 ± 0.10	2.02 ± 0.31	4 ± 3
169.89 ± 0.14	1.83 ± 0.35	2 ± 2	248.83 ± 0.09	1.41 ± 0.25	2 ± 1
172.05 ± 0.85	0.19 ± 0.06	8 ± 5	254.07 ± 0.42	0.60 ± 0.15	22 ± 8
185.48 ± 0.62	0.21 ± 0.08	16 ± 10	254.92 ± 0.28	1.30 ± 0.15	3 ± 2
186.12 ± 0.51	0.84 ± 0.15	7 ± 5	259.03 ± 0.09	43.14 ± 6.12	2 ± 1
192.87 ± 0.04	75.11 ± 9.25	2 ± 2	*259.74 ± 0.20	0.38 ± 0.22	> 10
199.95 ± 0.25	0.32 ± 0.15	< 10	*267.85 ± 1.00	0.05 ± 0.03	> 10
201.19 ± 0.12	17.25 ± 1.92	2 ± 2	268.95 ± 0.43	4.88 ± 0.75	2 ± 1
203.35 ± 0.11	4.00 ± 0.75	3 ± 4	272.64 ± 0.26	0.84 ± 0.11	2 ± 2

Table 2 (continuation 1)

E_{γ} (keV)	$I_{\gamma,rel}$	P(%)	E_{γ} (keV)	$I_{\gamma,rel}$	P(%)
273.82 ± 0.69	0.18 ± 0.06	50 ± 32	386.12 ± 0.97	1.37 ± 0.60	5 ± 4
275.28 ± 0.54	0.45 ± 0.09	8 ± 5	395.32 ± 0.53	0.35 ± 0.05	22 ± 8
277.15 ± 0.75	0.11 ± 0.03	32 ± 20	395.95 ± 0.57	1.81 ± 0.25	100 ± 27
278.30 ± 0.43	1.68 ± 0.43	6 ± 4	399.03 ± 0.45	2.32 ± 0.35	7 ± 5
291.97 ± 0.45	0.06 ± 0.02	66 ± 36	407.86 ± 0.35	0.91 ± 0.10	< 10
294.44 ± 0.04	52.05 ± 3.25	2 ± 1	413.63 ± 0.62	0.30 ± 0.05	< 10
299.81 ± 0.31	31.86 ± 4.31	2 ± 1	423.28 ± 0.35	1.27 ± 0.14	< 10
301.95 ± 0.59	0.80 ± 0.22	5 ± 4	429.07 ± 0.56	5.78 ± 0.67	5 ± 3
311.37 ± 0.62	0.93 ± 0.27	5 ± 4	441.32 ± 0.42	1.42 ± 0.44	15 ± 10
314.60 ± 0.58	0.37 ± 0.08	8 ± 6	452.93 ± 0.32	0.25 ± 0.04	8 ± 8
317.28 ± 0.41	4.94 ± 0.31	4 ± 2	463.76 ± 0.26	2.68 ± 0.31	< 10
324.01 ± 0.45	1.10 ± 0.27	3 ± 2	464.95 ± 0.65	6.47 ± 0.58	< 10
327.32 ± 0.10	1.00	100	471.85 ± 0.46	1.58 ± 0.23	< 10
328.96 ± 0.14	17.87 ± 0.93	2 ± 1	483.26 ± 0.87	0.69 ± 0.30	36 ± 22
339.46 ± 0.45	0.22 ± 0.12	< 10	494.49 ± 0.64	1.45 ± 0.35	16 ± 12
348.03 ± 0.28	0.78 ± 0.23	48 ± 27	499.42 ± 0.81	2.36 ± 0.75	5 ± 3
355.52 ± 0.31	0.11 ± 0.05	27 ± 15	502.31 ± 0.35	0.40 ± 0.20	18 ± 12
359.77 ± 0.47	0.14 ± 0.08	7 ± 8	516.93 ± 0.31	0.28 ± 0.08	8 ± 11
369.95 ± 0.41	1.91 ± 0.21	3 ± 2	520.98 ± 0.55	0.76 ± 0.31	12 ± 8
378.98 ± 0.79	0.80 ± 0.25	< 10	523.68 ± 0.65	1.12 ± 0.47	17 ± 14
380.43 ± 0.52	2.27 ± 0.43	4 ± 3	527.50 ± 0.15	7.53 ± 0.82	2 ± 2
385.97 ± 0.47	1.35 ± 0.55	9 ± 6	532.65 ± 0.17	1.02 ± 0.48	10 ± 6

Table 2 (continuation 2)

E_{β} (keV)	I_{β}^{rel}	P (%)	E_{β} (keV)	I_{β}^{rel}	P (%)
536.95 ± 0.14	4.06 ± 0.85	4 ± 3	720.96 ± 2.14	0.50 ± 0.20	38 ± 20
562.95 ± 0.22	4.72 ± 0.63	6 ± 3	744.34 ± 0.55	0.96 ± 0.38	102 ± 35
585.37 ± 0.16	1.10 ± 0.25	7 ± 5	747.50 ± 0.71	0.57 ± 0.30	14 ± 10
603.80 ± 0.17	1.10 ± 0.15	2 ± 2	766.51 ± 0.72	0.40 ± 0.11	7 ± 5
608.04 ± 0.70	0.43 ± 0.10	41 ± 25	795.42 ± 0.21	4.27 ± 0.97	7 ± 5
628.25 ± 0.35	0.28 ± 0.11	10	832.05 ± 0.31	0.26 ± 0.12	92 ± 52
648.91 ± 0.68	0.11 ± 0.07	39 ± 25	844.91 ± 0.17	1.85 ± 0.55	9 ± 7
656.05 ± 0.44	1.03 ± 0.32	3 ± 2	896.75 ± 0.37	0.58 ± 0.32	83 ± 47
664.78 ± 1.49	0.81 ± 0.25	92 ± 48	920.43 ± 0.73	1.42 ± 0.50	96 ± 50
675.46 ± 0.45	0.42 ± 0.28	10	933.17 ± 1.16	1.00 ± 0.42	10 ± 7
682.55 ± 0.35	0.53 ± 0.37	9 ± 6	943.22 ± 0.37	0.30 ± 0.15	96 ± 54
694.98 ± 0.42	0.92 ± 0.32	2 ± 2	945.85 ± 1.08	0.34 ± 0.12	100 ± 54
707.74 ± 0.56	0.58 ± 0.24	5 ± 4	1002.69 ± 0.31	1.35 ± 0.75	3 ± 3
			1051.03 ± 0.99	2.65 ± 0.75	8 ± 6

*From coincidence data only.

T A B L E 3.

 $^{107}\text{Ag}(n, \gamma)^{108}\text{Ag}$ Summary of coincidence results

Feeding level (keV)	E (keV)	P(%)	Starting level (keV)
215.38	148.86 [*]	96 \pm 20	364.24 [*]
	223.73 [*]	92 \pm 50	439.12 [*]
	327.46	100	542.84
	396.28 [*]	100 \pm 27	611.66 [*]
	665.29 [*]	92 \pm 46	880.67
	744.49 [*]	102 \pm 33	959.85 [*]
	832.05 [*]	92 \pm 52	1047.50
	896.75 [*]	83 \pm 47	1112.12
	920.24 [*]	96 \pm 50	1135.40
	943.22 [*]	96 \pm 54	1158.60
945.45 [*]	100 \pm 54	1161.23 [*]	
364.24 [*]	292.10 [*]	66 \pm 36	656.34 [*]
	348.42 [*]	48 \pm 27	712.66 [*]
	648.26 [*]	39 \pm 25	1012.50
	747.97 [*]	14 \pm 10	1112.12
439.12 [*]	441.58 [*]	15 \pm 10	880.61
	520.71 [*]	12 \pm 8	959.85 [*]
	608.34 [*]	41 \pm 25	1047.50
	722.05 [*]	38 \pm 20	1161.23 [*]
542.84	355.60 [*]	27 \pm 15	898.44
611.66 [*]	268.99 [*]	> 10	880.67
	494.11 [*]	16 \pm 12	1105.78
656.34	395.30 [*]	22 \pm 8	1051.63 [*]
	502.24 [*]	18 \pm 12	1158.60
880.61	231.44 [*]	15 \pm 10	1112.12
	254.73 [*]	22 \pm 8	1135.40
898.44	207.34 [*]	> 10	1105.78

the following conclusion can be drawn: The level at 45.46 keV (Refs. 3, 9) was not confirmed. The 215.38 keV isomeric level was proved by 11 coincidence transitions comparing to 4 transitions found by energy combinations (Ref, 10). The evidence was not given for the level at 287.47 keV (Refs. 6, 9). The level at 364.24 keV was proposed on basis of the 148.86 keV depopulating transition with P-value about 100 to 215.38 keV isomeric level. This level was populated by 6904.6 keV primary transition and 292.10 keV, 342.42 keV, 648.26 keV and 747.97 keV low-energy transitions with P-values of about 50. We propose also a level at 439.12 keV, populated by 6829.9 keV primary transition and 4 transitions found in coincidences and depopulated to the 215.38 keV isomeric level by 223.73 keV transition. In the same way we have identified levels in ^{108}Ag at 611.66 keV, 959.85 keV and 1161.23 keV energies with corresponding transitions of 396.28 keV, 744.49 keV and 945.45 keV populating the 215.38 keV level. The 452.94 keV level was indicated with 6317.4 keV primary transition and 524.12 keV and 259.71 keV transitions found in coincidences. The 452.94 keV level decays to the ground state by 452.98 keV transition. No transitions depopulating the levels at 329.18 keV and 452.94 keV to the 215.38 keV isomeric level have been found in spite of higher P-value in the γ -ray high-energy spectra.

Our coincidence results have confirmed also the existence of the 542.84 keV, 880.67 keV, 1047.50 keV, 1112.12 keV, 1135.40 keV and 1158.60 keV levels, populated by 327.46 keV, 665.29 keV, 832.05 keV, 896.75 keV, 920.24 keV and 943.22 keV, respectively. All other levels presented in Fig. 2 are confirmed or proposed on the basis of our primary γ -ray and coincidence data.

We have also attempted to assign spins for low-lying states in ^{108}Ag . The 1^+ spin and parity assignment for the ground state of ^{108}Ag is known. The spin assignment for the 79.14 keV level is 2^- , as the level is populated in (d,p) reaction and (n, γ^-) reaction and it decays to the ground state by E1 gamma transition. In ^{107}Ag (d,p) ^{108}Ag reaction the transferred neutron into the 79.14 keV level, has the $d_{5/2}$ main configuration ⁷⁾. The ground state is probably the 1^+ state of the particle multiplet $(\tilde{J}_i 7/2^+, \gamma 5/2^+) 1^+, 2^+, 3^+, 4^+, 5^+, 6^+$. The 79.14 keV level is the 2^- state of the doublet $(\tilde{J}_i 1/2^-, \gamma 5/2^+) 2^-, 3^-$. The states at 379.24 keV and 465.64 keV populated also in (d,p) reactions with the neutron transferred into $s_{1/2}$ orbit are probably the states of the doublet $(\tilde{J}_i 1/2^-, \gamma 1/2) 0^-, 1^-$.

The spin-parity assignment of the 215.38 keV ($T_{1/2} = 48$ ns) isomeric level is probably 3^+ . In our primary gamma-ray spectra (singles and coincidences) the transition feeding this level has not been found. There is no evidence for its population from the (d,p) reaction. The 215.38 keV level decays possibly by an E2 gamma transition to the ground level ⁶⁾, and it is probably the 3^+ state of the configuration $(\tilde{J}_i 7/2^+, \gamma 7/2^+) 0^+, 1^+, 2^+, 3^+, 4^+, 5^+, 6^+, 7^+$.

The spin-parity assignment of the 329.18 keV, 364.24 keV and 439.12 keV levels is proposed as 1^- , 2^- , since we observed a weak primary transitions, probably M1, of 6939.7 keV, 6904.6 keV and 6829.9 keV, respectively.

On the same basis, together with results from the (d,p) reaction, for the most levels the spin-parity assignment is proposed to be 1^- , 2^- . Exceptionally, for the level 1112.12 keV the spin-parity assignment is

2^+ , as it is probably populated by a strong E1 primary transition.

It is evident that for unique spin assignment of the ^{108}Ag levels additional γ - γ coincidence, electron-conversion data will be needed.

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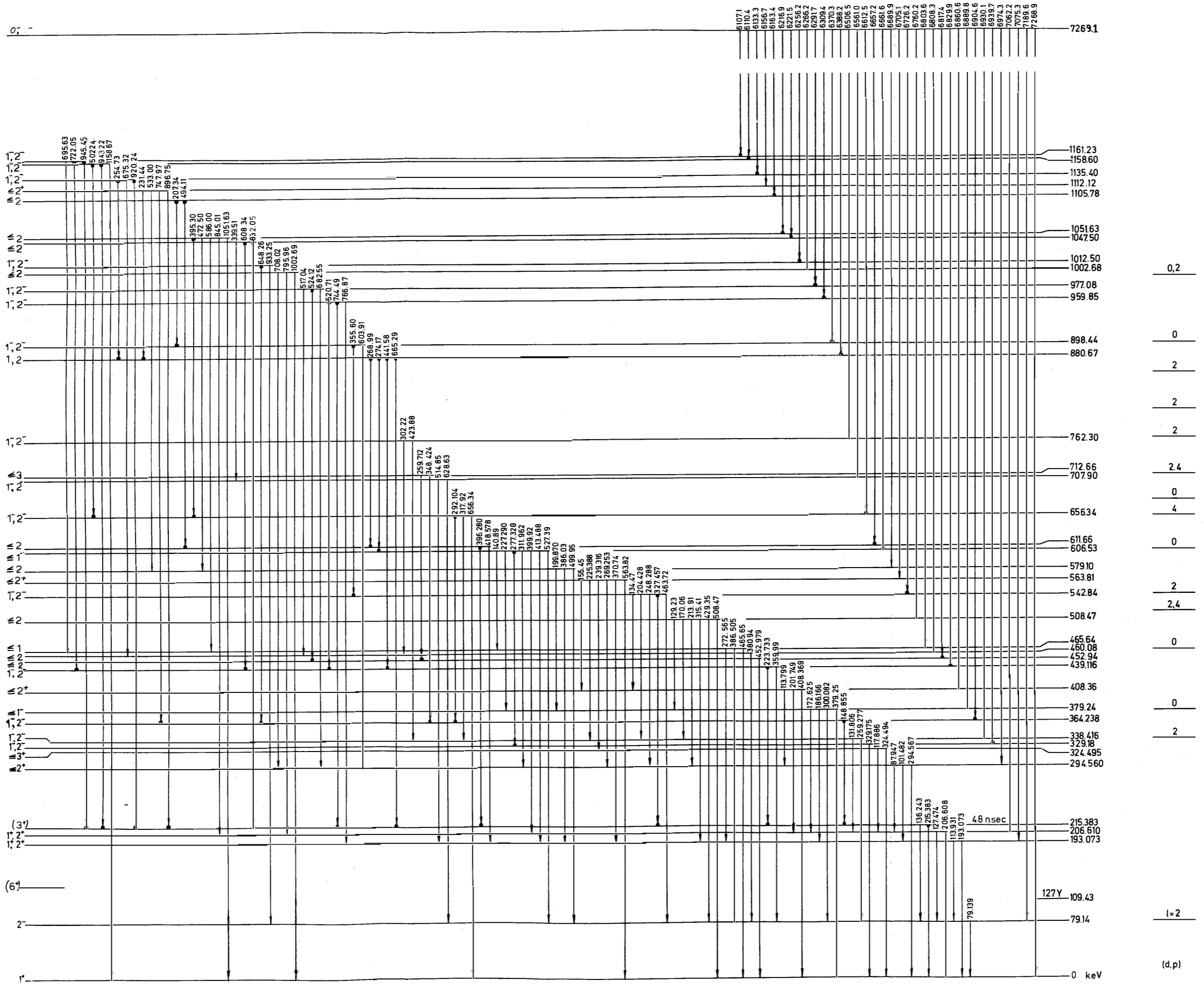
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KOINCIDENTNA MERENJA NISKO-LEŽEĆIH STANJA U JEZGRU ^{108}Ag NASTALOM
U ^{107}Ag (n, γ) REAKCIJI

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Sadržaj

Pomoću vremenski zakasnelih koincidentnih merenja sa Ge(Li) i NaI(Tl) detektorima izučavano je popunjavanje izomernog stanja od 215.38 keV ($T_{1/2} = 48$ n sec) u ^{108}Ag . U intervalu energija od 100 keV do 7300 keV nadjeno je oko 600 γ -prelaza, od kojih oko 200 u koincidencijama. Predloženi su novi nivoi u šemi raspada ^{108}Ag na energijama od 364.24 keV, 439.12 keV, 611.26 keV, 959.85 keV i 1163.23 keV. Odredjena je vrednost ekscitacione energije proizvedenog jezgra ^{108}Ag od 7269.1 ± 0.7 keV.



¹⁰⁸
₄₇Ag

Fig. 1. Part of low-energy singles and coincidence spectra following ¹⁰⁷Ag (n, γ) ¹⁰⁸Ag, reaction showing strong coincidence intensity for the 148.885 keV line.