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THE FRAGMENTATION OF SUBSHELLS IN TUNGSTEN ISOTOPES

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Introduction

The fragmentation (strength distribution) of single-particle states in atomic nuclei is intensively studied experimetally[1-3] and theoreticallly[4-8]. The experimental data have been reported [9-13] on the fragmentation of deep hole states in spherical and deformed isotopes of Nd, Pm, and Sm. Change of the strength function of subshells while passing from spherical to deformed nuclei has been studied within the quasiparticle-phonon nuclear model[14]. The fragmentation of some subshells in isotopes of Sm, Gd, Yb, and Lu has been calculated in ref.[15].

The experimental data on the fragmentation of single-particle states in deformed nuclei are very scarce. The fragmentation of low-spin states in the energy interval up to 2 MeV has been studied [16-20] in isotopes of Hf, Re, W and Os. The excitation cross sections of $K^{\pi} = 1/2^-$ and $3/2^-$ states in (d,p) and (α,t) reactions in ^{183}W turned out to be considerably less than in ^{179}Hf, ^{185}W and ^{187}W. An increase in the $1/2^-$ and $3/2^-$ state fragmentation in ^{183}W in comparison with other nuclei has been explained in refs.[16-19] by a sharp increase in ^{183}W of the hexadecapole deformation β_4. According to the data[21] for ^{183}W $\beta_4 = -0.075 \pm 0.010$, for $^{182,184,186}W$ $\beta_4 = -0.056 \pm 0.006$, i.e., does not differ greatly. It was shown in ref.[20] that the spectrum of ^{183}Re can be sufficiently well described with $\beta_4 = -0.06$.

In view of the afore-mentioned anomaly in the excitation of $K^{\pi} = 1/2^-$ and $3/2^-$ states it is interesting to calculate the fragmentation of the subshells $3p_{1/2}$ and $3p_{3/2}$ in tungsten isotopes within the quasiparticle-phonon nuclear model. In the present paper we investigate the fragmentation of subshells of the spherical basis caused by the quadrupole and hexadecapole deformation and quasiparticle-phonon interaction.

1. Basic formulae of the model

Within the quasiparticle-phonon nuclear model one calculates the fragmentation of one-quasiparticle, one-phonon and quasiparticle–phonon states and the nuclear state characteristics resulting from this fragmentation at low, intermediate and high excitation energies. The model Hamiltonian includes an average field as the Saxon-Woods potential, pairing interaction and separable multipole and spin-multipole isoscalar and isovector including charge exchange interactions. The general description of the model Hamiltonian for deformed nuclei is given in refs./22,23/. The model takes into account the secular equation solutions in the random phase approximation for one-phonon states and the model Hamiltonian is reduced to the form

$$H_M = \sum_{q\sigma} \varepsilon_q \alpha^+_{q\sigma} \alpha_{q\sigma} + H_v + H_{vq} \qquad (1)$$

in which the terms are separated, corresponding to free quasiparticles and phonons and to the interaction of quasiparticles with phonons H_{vq}. Here ε_q is the quasiparticle energy, $\alpha^+_{q\sigma}$ is the quasiparticle creation opertor; to describe the single-particle states $q\sigma$, $\sigma=\pm1$ we use the asymptotic quantum numbers $Nn_z\Lambda$ ($\uparrow$ for $K=\Lambda+\frac{1}{2}$, $\downarrow$ for $K=\Lambda-\frac{1}{2}$) and the quantum number of the K-projection of momentum onto the symmetry axis of a nucleus.

Since formulae for describing the fragmentation of one-quasiparticle states have been derived in ref./4/, we shall restrict ourselves only to those necessary for our treatment. The nonrotational state wave function of an odd-A nucleus is

$$\Psi_\nu(K^\pi) = \frac{1}{\sqrt{2}} \sum_\sigma \Big\{ \sum_{q_0} C_{q_0\nu}\, \alpha^+_{q_0\sigma} + \sum_{\lambda\mu i q'} D^{\lambda\mu i}_{q'}(K_\nu)\, \alpha^+_{q'\sigma} Q^+_{\lambda\mu i} \Big\} \Psi_0, \qquad (2)$$

where Ψ_0 is the ground state wave function of the relevant doubly even nucleus, ν is the state number, $Q^+_{\lambda\mu i}$ is the creation operator of a phonon with multipolarity λ and projection μ, i is the root number of the secular equation in the RPA. The wave function (2) satisfies the normalization condition.

A secular equation for finding energies η_ν of the states of deformed nuclei described by the wave function (2) has the form

$$\Theta(\eta_\nu) = \det \left\| (\varepsilon_{q'} - \eta_\nu)\delta_{qq'} - \sum_{g} \frac{\Gamma(qg)\,\Gamma(q'g)}{\varepsilon_{q''} + \omega_{\lambda\mu i} - \eta_\nu} \right\| = 0, \qquad (3)$$

where

$$\Gamma(qg) = \langle \Psi_0^* \alpha_{q\sigma} H_{vq} \alpha^+_{q''\sigma} Q^+_{\lambda\mu i} \Psi_0 \rangle, \quad g = q''\lambda\mu i .$$

The rank of the determinant (3) is equal to the number of one-quasiparticle terms in the wave function (2). To calculate the fragmentation of the one-quasiparticle state q_0 we introduce the function

$$\mathcal{F}_{q_0}(\eta) = \Theta(\eta) / \Theta_{q_0}(\eta) \qquad (4)$$

for which the following condition holds

$$C^{-2}_{q_0\nu} = - \left. \frac{\partial \mathcal{F}_{q_0}(\eta)}{\partial \eta} \right|_{\eta=\eta_\nu} . \qquad (5)$$

Here

$$\Theta_{q_0} = \det \left\| (\varepsilon_{\bar q'} - \eta_\nu)\delta_{\bar q \bar q'} - \sum_{g} \frac{\Gamma(\bar q g)\,\Gamma(\bar q' g)}{\varepsilon_{q''} + \omega_{\lambda\mu i} - \eta_\nu} \right\| \qquad (6)$$

$\bar q$ and $\bar q'$ run over all single-particle states with given K^π excluding q_0, the rank of determinant (6) is less by unity than that of determinant (3). The strength function describing the fragmentation of the one-quasiparticle state q_0 has the form

$$C^2_{q_0}(\eta) = \sum_\nu (C_{q_0\nu})^2 \rho(\eta_\nu - \eta) = \frac{1}{\pi} \mathrm{Im}\, \mathcal{F}^{-1}_{q_0}(\eta + i\Delta/2) = \frac{1}{\pi} \mathrm{Im} \frac{\Theta_{q_0}(\eta + i\Delta/2)}{\Theta(\eta + i\Delta/2)}, \qquad (7)$$

where

$$\rho(\eta_\nu - \eta) = \frac{1}{2\pi} \frac{\Delta}{(\eta_\nu - \eta)^2 + (\Delta/2)^2},$$

Δ is the energy interval of averaging.

We are interested in the fragmentation in a deformed nucleus of a certain subshell nlj of the spherical basis. As is known the single-particle wave function of the Saxon-Woods potential for a deformed nucleus is expressed through the single-particle wave functions φ_{nlj} of the spherically symmetric Saxon-Woods potential

$$\varphi_q = \sum_{nlj} a^{qK}_{nlj} \varphi_{nlj} \qquad (8)$$

with normalization $$\sum_{qK} (a^{qK}_{nlj})^2 = j + \tfrac{1}{2} .$$

The strength function describing the fragmentation of the subshell nlj entering into the one-quasiparticle state q_0 with $K=K_0$ is

$$S^{q_0K_0}_{nlj}(\eta) = \sum_\nu \left| a^{q_0K_0}_{nlj} C_{q_0\nu} \right|^2 \rho(\eta_\nu - \eta) = (a^{q_0K_0}_{nlj})^2 C^2_{q_0}(\eta) . \qquad (9)$$

To calculate the fragmentation of the subshell nlj one should sum over all one-quasiparticle states with given values of $K_0^{\pi_0}$ and then over all values of K_0, i.e.,

$$S_{nlj}^{K_0}(\eta) = \sum_{q_0} S_{nlj}^{q_0 K_0}(\eta), \tag{10}$$

$$S_{nlj}(\eta) = \sum_{q_0 K_0} S_{nlj}^{q_0 K_0}(\eta). \tag{11}$$

In calculating the spectroscopic strength functions which are compared with the current ones obtained from the experimental data, instead of $S_{nlj}^{q_0 K_0}(\eta)$ we use for the (d,p) reactions

$$\widetilde{S}_{nlj}^{q_0 K_0}(\eta) = \left(a_{nlj}^{q_0 K_0} u_{q_0}\right)^2 C_{q_0}^2(\eta) \tag{12}$$

and for the (d,t) reactions

$$\widetilde{\widetilde{S}}_{nlj}^{q_0 K_0}(\eta) = \left(a_{nlj}^{q_0 K_0} v_{q_0}\right)^2 C_{q_0}^2(\eta). \tag{13}$$

where u_q and v_q are the Bogolubov transformation coefficients. Then the strength functions (12) are substituted into formulae (10) and (11) and the relevant functions are denoted by $\widetilde{S}_{nlj}^{K_0}(\eta)$ and $\widetilde{S}_{nlj}(\eta)$. The parameters of the single-particle potential and the constants of residual effective interactions are the parameters of the quasiparticle-phonon nuclear model. The calculations have been made with the single-particle energies and wave functions of the Saxon-Woods potential with scheme A=181 whose parameters are presented in ref. /23/. The equilibrium deformation parameters are β_2 =0.24 and β_4 =-0.03. The pairing constants are determined from the difference of nuclear masses, they are given in ref. /23/. In calculating deformed nuclei we have used the multipole phonons with $\lambda \leqslant 7$, the multipole-multipole interaction constants are given in ref. /23/. The calculations have been performed with Δ =0.4 MeV.

2. The results of calculations and discussion

The subshells of the spherical basis nlj are (2j+1)-tuple degenerated. Due to a stable quadrupole deformation the spherical symmetry is changed by the axial one, and the angular momentum is not as correct quantum number any more as its projection K. Each subshell is splitted into twice degenarated levels. The nlj strength is distributed over many single-particle levels of the deformed basis with the values of K from 1/2 to j. The single-particle wave functions

are expessed as a superposition of states of the spherical basis, as one can see from formula (8).

Consider the fragmentation of the $3p_{1/2}$ and $3p_{3/2}$ subshells which show up in the (d,p) reactions on the tungsten isotopes. The strength fragmentation of these subshells due to a stable deformation is exemplified in fig. 1. Most part of the neutron subshell $3p_{3/2}$ strength is concentrated on single-particle states 501↓, 510↑ and 530↑. The $3p_{1/2}$ subshell strength is concentrated mainly on two levels 501↓ and 521↑. The largest contribution to the normalization of states 770↑ and 761↑ comes from the $1j_{15/2}$ subshell thus giving a very small contribution to the (d,p) cross section with excitation of low-spin states. In case of the subshells $3p_{1/2}$ and $3p_{3/2}$ as well as in cases calculated in refs. /14,15/, the fragmentation of subshells of the spherical basis due to a stable deformation turned out to be essential. The nlj strength is distributed over a number of single-particle states in the energy interval of 6÷10 MeV.

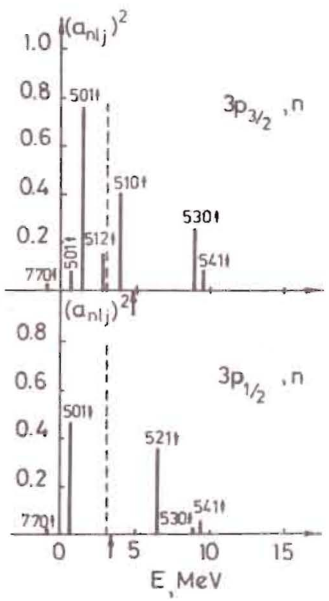

Fig. 1. Strength distribution of the $3p_{1/2}$ and $3p_{3/2}$ subshells over single-particle states in the Saxon-Woods potential with β_2 = =0.24 and β_4 =-0.03. The arrows denote the position of subshells in the spherical basis. The dashed lines denote the Fermi level corresponding to ^{183}W.

Now we consider the fragmentation due to the quasiparticle-phonon interaction and restrict ourselves to the coupling of a quasiparticle with quasiparticle ⊗ phonon states, that is easily seen in the wave function (2). In the model of independent quasiparticles the strength of the quasiparticle q_0 state of a deformed nucleus is concentrated on one level and the quasiparticle-phonon interaction leads to its fragmentation described by formula (7). The fragmentation of the nlj subshell of the spherical basis in a deformed nucleus is described by formulae (9)-(11) in which allowance is made for the fragmentation due to a stable quadrupole deformation and quasiparticle-phonon interaction.

We have calculated the strength functions $S_{nlj}(\eta)$ and spectroscopic factors $\tilde{S}_{nlj}(\eta)$ for the neutron $3p_{1/2}$ and $3p_{3/2}$ subshells in isotopes of $^{183,185,187}W$. The functions $\tilde{S}_{nlj}(\eta)$ practically coincide with the spectroscopic factors of the (d,p) reactions for states 501↓ and 501↑. The strength functions of the $3p_{1/2}$ subshell are shown in fig. 2. The 501↓ state contributes greatly to the total strength function $3p_{1/2}$. The location regions of the $3p_{1/2}$ strength in three nuclei are close to each other and amount to 6-7 MeV. Inside this region the strength distribution turns out to be different in different isotopes. Thus, in ^{183}W the strength function $3p_{1/2}$ is characterized by one large peak in the region of 2.4 MeV, which exhausts a large part of the subshell strength. In ^{185}W and ^{187}W one can easily see two principal peaks in the strength functions $3p_{1/2}$. If in ^{185}W and ^{187}W almost 30% of the subshell strength is in the excitation energy region less than 2 MeV, then in ^{183}W about 20% of the subshell strength is exhausted in the same energy region. The behaviour of the strength function $\tilde{S}_{3p_{1/2}}$ also differs in ^{183}W as compared with ^{185}W and ^{187}W since the main strength of 501↓ in ^{183}W is in the energy region higher than 2 MeV.

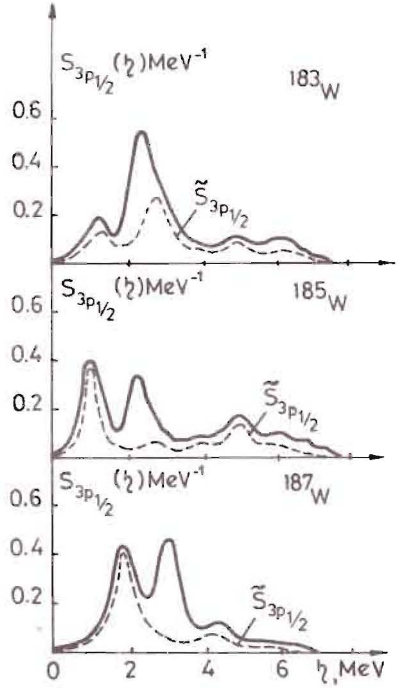

Fig. 2. Fragmentation of the neutron $3p_{1/2}$ subshell in $^{183,185,187}W$ and the spectroscopic strength functions $\tilde{S}_{3p_{1/2}}(\eta)$ (dashed curves) in these nuclei.

The strength functions $S_{3p_{3/2}}(\eta)$ $\tilde{S}_{3p_{3/2}}(\eta)$ calculated in $^{183,185,187}W$ are shown in fig. 3. The location regions of the $3p_{3/2}$ strength are somewhat larger than of the $3p_{1/2}$ strength and amount to 7-8 MeV. Inside the location region in ^{183}W the strength is distributed rather uniformly whereas in ^{185}W and ^{187}W there is a large concentration of strength at small excitation energies. Comparing these curves one can see that in ^{183}W less than half (~40%) of the $3p_{3/2}$ strength is exhausted in the energy region below 2 MeV, whereas in ^{185}W almost 50% and in ^{187}W up to 60% of the total subshell strength is in the same excitation region. As to the strength function of 501↑, which almost coincides with the strength function $\tilde{S}_{3p_{3/2}}(\eta)$, one can see from the figure that it gives a predominant contribution to the $3p_{1/2}$ strength and therefore its behaviour defines that of the subshell as a whole.

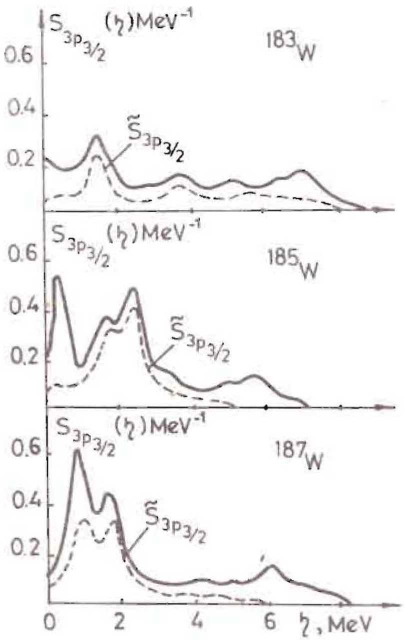

Fig. 3. Fragmentation of the neutron $3p_{3/2}$ subshell in $^{183,185,187}W$ and the spectroscopic strength functions $\tilde{S}_{3p_{3/2}}(\eta)$ (dashed curves) in these nuclei.

It is seen from figs. 2 and 3 that the spectroscopic strength functions $\tilde{S}_{nlj}$ for the $3p_{1/2}$ and $3p_{3/2}$ subshells are mainly defined by the fragmentation of particle states 501↓ and 501↑. In ^{183}W the single-particle energies of states 501↓ and 501↑ are by 2-3 MeV above the Fermi level. With increasing mass number in $^{185,187}W$ they approach the Fermi level. The regularities of the fragmentation of one-quasiparticle states in deformed nuclei have been studied in ref. /4/. It was shown that the fragmentation increases with increasing difference between the single-particle and Fermi level. This regularity is observed in the tungsten isotopes. The fragmentation of states 501↓ and 501↑ in ^{183}W appeared to be stronger than in $^{185,187}W$. Moreover, in the energy interval up to 2.3 MeV, in which the (d,p) cross sections have been measured /16/ the sum strength of these in ^{183}W was found to be less than in $^{185,187}W$.

In ref. /16/ the experimental cross section of the (d,p) reaction (E_d =12 MeV, θ =90) with excitation of $j^{\pi}=1/2^-$ and $3/2^-$ states are summed in the energy intervals (1.4÷2.3) MeV in ^{183}W, (1.1÷2.0) MeV in ^{185}W and (0.7÷1.8) MeV in ^{187}W. The sum cross sections are represented for two cases: a) $\sum_{j^\pi=1/2^-,3/2^-} \sigma(\geq 100\,\mu b/sr)$ for peaks with the cross sections higher than 100 $\mu b/sr$ and b) $\sum_{j^\pi=1/2^-,3/2^-} \sigma$ for all peaks with $l=1$ which is considered to be the upper limit. The cross sections have been calculated[16] using the single-particle wave functions of the Nilsson potential with $\beta_4=0$ without taking the fragmentation into account. The ratio of the sum experimental cross sections to the theoretical ones was obtained: 0.55 for ^{183}W, more than 0.65 for ^{185}W and 0.9 for ^{187}W. It was assumed that the discrepancy between theory and experiment can be removed by introducing a large hexadecapole deformation responsible for the fragmentation.

Using the spectroscopic factors $\widetilde{S}_{nlj}$ shown in figs. 2 and 3 we have calculated the sum cross sections of the (d,p) reaction

$$\sigma = \sum_{j^\pi=1/2^-,3/2^-} 3\,\widetilde{S}_{31j}\,\frac{\sigma^{DWUCK}_{l=1,j}}{2j+1} \qquad (14)$$

for excitation of $1/2^-$ and $3/2^-$ states (E_d =12 MeV, θ =90°) in $^{183,185,187}W$ in the same energy intervals over which the experimental data are summed. The cross sections have been calculated by the DWUCK program; the values of $\widetilde{S}_{31j}$ are taken in the interval 0.1 MeV. The experimental data for cases a) and b) and the results of our calculations for the ratios of the cross sections in different tungsten isotopes are given in the table. It is seen from the table that the results of calculations describe correctly the tendency of the cross sections to increase in excitation of $1/2^-$ and $3/2^-$ states in ^{183}W as compared to $^{185,187}W$. A good agreement is obtained in summing the experimental data in case a). Thus, the fragmentation of single-particle states due to the quasiparticle-phonon interaction is responsible for the experimentally observed anomaly in the cross sections of the (d,p) reaction with excitation of $1/2^-$ and $3/2^-$ states in the tungsten isotopes.

Table. Comparison of theoretical calculations with experiment

Ratio	Experiment a)	Experiment b)	Calculation
$\sigma(^{183}W)/\sigma(^{185}W)$	0.57	0.80	0.52
$\sigma(^{183}W)/\sigma(^{187}W)$	0.41	0.62	0.37

The analysis of relative difference of energies of states 541↓ and 532↓ in ^{183}Re has shown[20] that in calculations based on the Nilsson model for the proton system in the given region one should take a hexadecapole deformation in the interval from -0.02

to -0.06. In this paper the spectroscopic factors C^2U^2 for the 541↓ state were calculated with β_4=-0.045. We have calculated the spectroscopic factors $\widetilde{S}_j$ for excitation of the 541↓ state in ^{183}Re with β_4=-0.03. The results of our calculations are in agreement with the experimental data and results of calculations in ref.[20]; this testifies to that the calculations can be made with β_4=-0.03.

The calculations with large values of $|\beta_4|$ and taking into account their change in the W isotopes would probably lead to an additional improvement of the agreement between theory and experiment.

The results of our calculations and their comparison with experiment show that the quasiparticle-phonon nuclear model describes correctly the fragmentation of single-particle states with $j^\pi=1/2^-$ and $3/2^-$ in the tungsten isotopes.

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References

1. Crawley G.M., Proc.Int.Symp. on Highly Excited States in Nuclear Reactions, Osaka, 1980 (RCNP, Osaka University) p. 590.
2. Gales S., Nucl.Phys. 1981, A354, p. 193c.: Journ de Physique 1984, 45, Collogue C4, supp. N. 3, p. C4-39.
3. Mondey J., Nucl.Phys. 1983, A396, p. 39c.
4. Malov L.A., Soloviev V.G. Nucl.Phys., 1976, A270, 87.
Малов Л.А., Соловьев В.Г. ЯФ, 1977, 26, 729.
5. Doll P., Nucl.Phys. 1977, A292, p. 165.
Koeling T., Iachello F. Nucl.Phys. 1978, A295, p. 45.
6. Soloviev V.G., Stoyanov Ch., Vdovin A.I. Nucl.Phys. 1980. A342, p. 261.
7. Chan Zuy Khuong, Soloviev V.G., Voronov V.V. J.Phys.G: Nucl.Phys. 1981, 7, p. 151.
Soloviev V.G., Stoyanov Ch., Voronov V.V. Nucl.Phys. 1983, A399, p. 141.
8. Soloviev V.G. Journ. de Physique 1984, 45, Collogue C4, supp. N.3, p. C4-69.
9. Løvhøiden G., Lien J.R., El-Kazzaz S. et al. Nucl.Phys. 1980, A339, p. 477.
10. Doll P., Wagner G.J., Breuer H. et al. Phys.Lett. 1979, 82B, p. 357.

11. Lee J.S., Jordan W.J., Mafier J.V. et al. Nucl.Phys. 1981, A371, p. 111.
12. Rekstad J., Løvhøiden H., Lien J.R. et al., Nucl.Phys. 1980, A348, p. 93.
13. Gales S., Crawley G.M., Weber D., Zwiedlinski B. Nucl.Phys. 1983, A398, p. 19.
14. Нгуен Динь Винь и др. ОИЯИ, Р4-84-304, Дубна, 1984.
15. Нгуен Динь Винь. ОИЯИ, Р4-85-45, Дубна, 1985.
16. Casten R.F. et al. Nucl.Phys. 1974, A228, p. 493.
17. Casten R.F. et al. Nucl.Phys., 1977, A285, p. 235.
18. Warner D.D. et al. Nucl.Phys., 1979, A316, p. 13.
19. Casten R.F. et al. Nucl.Phys., 1980, A333, p. 237.
20. Brenner D.S. et al. Nucl.Phys., 1983, A408, p. 285.
21. Delaroche J.P. et al. Phys.Rev., 1981, C23, p. 136.
22. Соловьев В.Г. ЭЧАЯ, 1978, 9, с. 580.
Soloviev V.G., Nucleonica 1978, 23, p. 1149.
23. Малов Л.А., Соловьев В.Г. ЭЧАЯ, 1980, 11, с. 301.

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Нгуен Динь Винь, В.Г.Соловьев E4-85-439

Фрагментация подоболочек в изотопах вольфрама

В рамках квазичастично-фононной модели ядра рассчитана фрагментация подоболочек $3p_{1/2}$ и $3p_{3/2}$ в изотопах вольфрама, $^{183,185,187}W$ и в ^{183}Re для низкоспиновых состояний $1/2^-$ и $3/2^-$. Получено правильное описание обнаруженной экспериментально аномалии в сечениях реакции типа (d,p) и (α,t) для $1/2^-$ и $3/2^-$ состояний в изотопах вольфрама.

Работа выполнена в Лаборатории теоретической физики ОИЯИ.

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Nguyen Dinh Vinh, V.G.Solovies E4-85-439

The Fragmentation of Subshells in Tungsten Isotopes

The fragmentation of the $3p_{1/2}$ and $3p_{3/2}$ subshells in tungsten isotopes and the spectroscopic factors of the one-nucleon transfer reactions in $^{183,185,187}W$ and ^{183}Re for the low-spin $1/2^-$ and $3/2^-$ states is calculated within the quasiparticle-phonon nuclear model. The experimentally observed anomaly in the cross sections of the (d,p) and (α,t) reactions for $1/2^-$ and $3/2^-$ states in tungsten isotopes is described correctly.

The investigations has been performed at the Laboratory of Theoretical Physics, JINR.

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