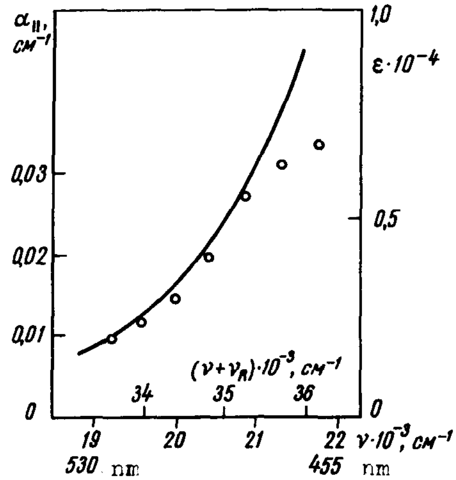
spectral region near 33 000 - 36 000 cm^{-1}. It has turned out that the edge of the two-photon absorption spectrum of nitrobenzene coincides closely with the edge of its single-photon absorption, with a shift by the value of the ruby-laser frequency (see the figure). The slight deviations on the short-wave side pertain to the region where single-photon absorption already took place and the measurement accuracy was much lower.

The spectrum shown in the figure pertains to the case $\vec{E}_1 \parallel \vec{E}_2$. When $\vec{E}_1 \perp \vec{E}_2$ the absorption was much lower, with $\alpha_{\parallel}/\alpha_{\perp} = 1.8 \pm 0.2$.

Thus, two-photon dichroism does not reach in nitrobenzene a value corresponding to the limiting anisotropy. A contribution is apparently made here by transitions with other directions of the dipole moment.



Two-photon absorption of nitrobenzene (points, left ordinate scale, lower scale of frequencies ν); single-photon spectrum (continuous curve, right scale, upper scale of frequencies $\nu+\nu_R$).

It should be noted that the two-photon absorption in nitrobenzene is itself quite large, in agreement with its observed large nonlinear polarizability [3]. Measurement of two-photon absorption in a number of other liquids is made very difficult by the light scattering caused by variations of the refractive index, due to nonlinear effects and to heating by the laser pulse [3].

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*It can be noted that this ratio of $\alpha_{\parallel}$ to $\alpha_{\perp}$ recalls the case of polarized luminescence of extremely anisotropic molecules in a liquid, when the oscillators responsible for the absorption and emission coincide in direction. In this case, the polarization ratio for the luminescence intensities is also equal to 3.

MEASUREMENT OF THE REACTION Nd(n, α) WITH RESONANT NEUTRONS

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Reactions of the (n, α) type with heavy nuclei and at low neutron energies have been the subject of relatively few investigations, namely work by Macfarlane [1], Cheifetz [2], and Andreev [3] at thermal neutron energy and the authors' work [4] on the Sm(n, α) reaction in the resonant region. This is caused by methodological difficulties brought about by the extremely small cross sections of the (n, α) reaction and the large gamma background.

We investigated the reaction (n, α) with a natural mixture of neodymium isotopes, and also with enriched Nd^{145} and Nd^{143}, using the IBR pulsed reactor of the Neutron Physics Laboratory of JINR and a multilayer xenon scintillation detector [5]. We measured simultaneously the (n, γ) reaction for each sample (for details see [6]).

Figures 1, 2, and 3 show experimental plots of the α-particle and γ-quantum counts against the resonance-neutron energy.

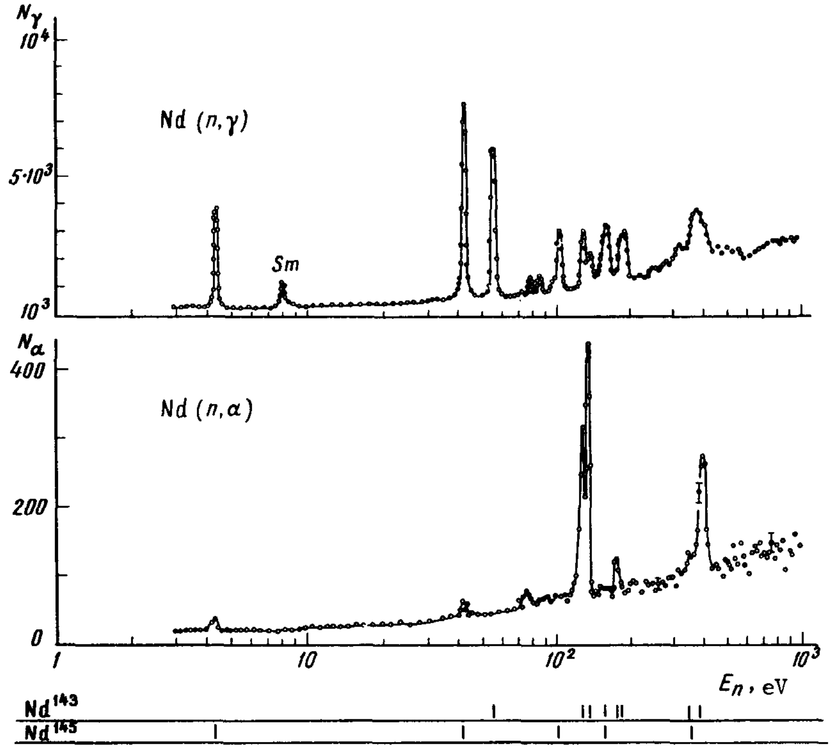

Fig.1. α and γ counts (lower and upper curves) vs. neutron energy in measurements with natural Nd isotope mixture. Points between resonances are averaged. The statistical accuracy below 5 eV is 4%. The resonances are identified by isotopes in accord with [7] and our data in the lower part of the figure.

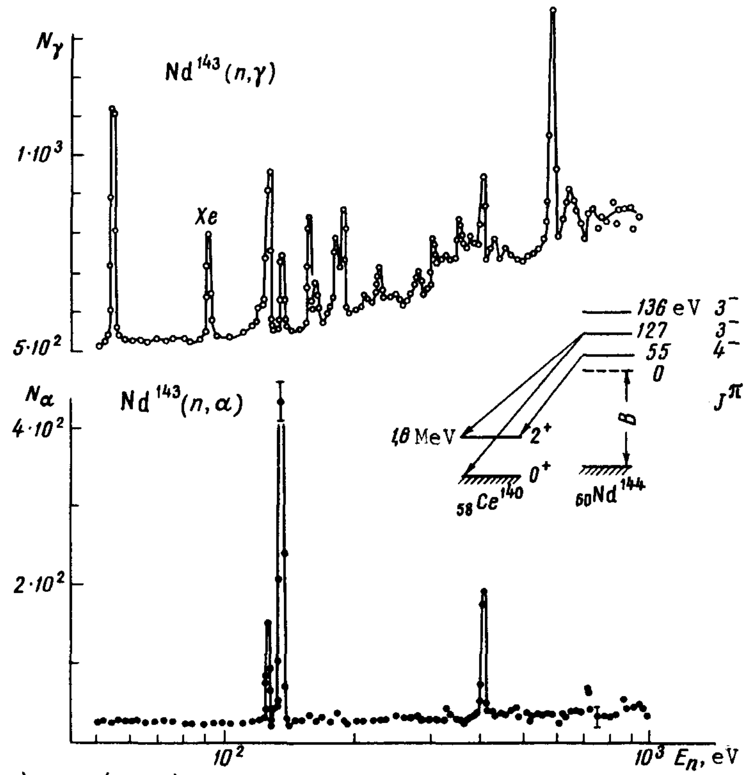

Fig.2. α and γ counts (lower and upper curves) vs. neutron energy in measurements with enriched Nd^{143}. The figure shows the α-decay scheme of the compound nucleus Nd^{144}.

The ratio of the areas of the (n, α) and (n, γ) resonance curves is proportional to the width ratio $\Gamma_\alpha/\Gamma_\gamma$. The proportionality coefficient was determined from the known ratio $\sigma_\alpha/\sigma_\gamma$ for Nd^{143} in the thermal region, taken from [2,3]. Figures 2 and 3 show also the decay schemes

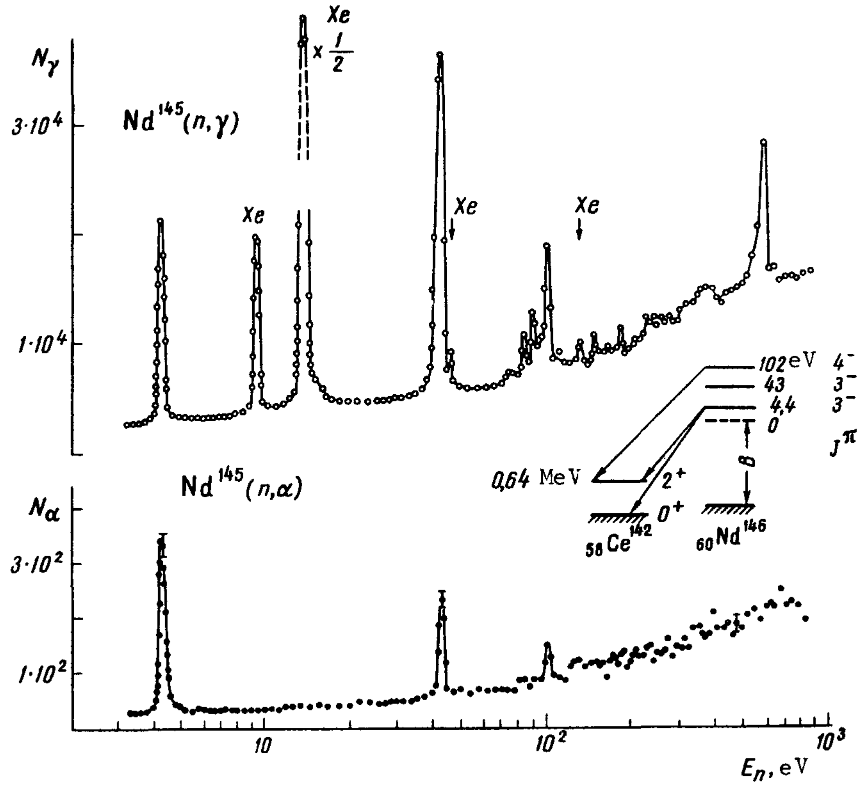

Fig. 3. α and γ counts (lower and upper curves) vs. neutron energy in measurements with enriched Nd^{145}. The figure shows the α-decay scheme of the compound nucleus Nd^{146}..

Values of α-widths and spins of odd Nd isotope resonances

E_0, eV	−6	4,37	43,1	55,5	102	103	127	136	157	180	187	410
Isotope	143	145	145	143	145	145	143	143	143	143	143	143
J^{π}	3−*	(3−)	3−**	(4−)	3−**	4−**	3−**	3−	(4−)	3−	(4−)	3−
$\Gamma_{\alpha}/\Gamma_{\gamma}\cdot 10^5$	5,3	3,0	0,82	~1	1.2		32	170	2	12	2	65
$\Gamma_{\alpha}\cdot 10^6$ eV	5,0	1,8	0.5	⩽ 1	0.7		31	160	⩽2	11	⩽2	61
$\Delta\Gamma_{\alpha}\cdot 10^6$eV ***	±0,05	±0.2	±0,15	±1	±0,3		±10	±50	±2	±5	±2	±30

* Spin value taken from [2].

** Identification by isotopes and spins taken from [7].

*** The errors given are those of our relative measurements. The errors due to normalization (∿ 30%) and to the possible deviation of Γ_{γ} from $\overline{\Gamma}_{\gamma}$ are not taken into account here.

of neutron-excited Nd^{144} and Nd^{146}. In the decay scheme of Nd^{144}, the first excited level of the product nucleus Ce^{140} is at 1.6 MeV above the ground state. Since the probability of the α-particle emission from the nucleus depends strongly on the α-particle energy, and the transition from the level with spin $J^{\pi} = 4^-$ to the ground state of Ce^{140} is parity-forbidden, we should observe a noticeable difference in the probabilities of α-particle emission from the excited states 4^- and 3^-. An estimate of the ratio of the probabilities of the transitions $3^- \to 0^+$ and $4^- \to 2^+$ yields a value of about two orders of magnitude.

The table lists the measured values of Γ_α for the isotopes Nd^{143} and Nd^{145}. To determine Γ_α from the $\Gamma_\alpha/\Gamma_\gamma$ ratio we used the values $\bar{\Gamma}_\gamma = 60\times10^{-3}$ eV (Nd^{145}) and $\Gamma_\gamma = 94\times10^{-3}$ eV (Nd^{143}). In the case of Nd^{143} we have four resonances with $\Gamma_\alpha \geq 10^{-5}$ eV and three with $\Gamma_\alpha < 2\times10^{-6}$ eV. Such a difference makes it apparently possible to draw conclusions regarding the spins of the Nd^{143} nucleus.

The method proposed here for determining the spin of the resonance from the value of the α-width is not always unique. Since the reaction $Nd^{143}(n, \alpha)$ has in practice one open channel, namely α-decay to the ground state, we can expect the distribution of the α-widths to satisfy the Porter-Thomas law with $\nu = 1$. Then the probability of observing a resonance with Γ_α some 100 times larger than $\bar{\Gamma}_\alpha$ is practically zero, i.e., the spin 3^- is reliably assigned to the strong resonances. At the same time, the probability of observing a resonance with $\Gamma_\alpha \sim 0.01\bar{\Gamma}_\alpha$ amounts to several per cent, we cannot ascribe a spin 4^- to the weak resonances with full assurance.

Returning to Fig. 1, we note that the origin of the peak in the α-particle count at $E_0 = 76$ eV is still not clear. We propose to obtain more precise data in later experiments.

From the values of Γ_α listed in the table and from those published by us earlier [1] we calculated the α-widths for the corresponding values of J^{π}. The same quantities were calculated by statistical theory:

$$\bar{\Gamma}_\alpha = \frac{D_{J\pi}}{2\pi} \sum_l T_l \, ,$$

where T_I is the penetrability of the Coulomb barrier for an α-particle with orbital angular momentum I, and $D_{J\pi}$ is the average spacing between levels with identical J^{π}.

For Nd^{143}, Nd^{145}, Sm^{147} ($J^{\pi} = 3^-$), and Sm^{149} ($J^{\pi} = 4^-$) the theory yields for $\bar{\Gamma}_\alpha\times10^7$ eV the following values: 350, 2.8, 61, and 0.83, whereas experiment yields respectively 530(5), 10(3), 19(5), and 0.74(3). (The numbers in the parentheses are those of the resonances over which the averaging was carried out.) Good agreement between theory and experiment can be noted for Nd^{143} and Sm^{149}, and somewhat poorer for Sm^{147} and Nd^{145}.

In conclusion, the authors are grateful to F. L. Shapiro for useful discussions, and I. Ribanskii for help with the measurements. They also thank V. S. Zolotarev and his co-workers for furnishing the separated neodymium isotopes.

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NEW METHOD OF OBTAINING HIGH-RESOLUTION HOLOGRAMS

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We describe in this preliminary communication a new method of obtaining high-resolution holograms.

It is known [1] that the use of a reference beam improves greatly the quality of the hologram and of the reproduced picture. The reconstruction, however, contains in this case a large amount of noise. The level of this noise is reduced usually by decreasing the vibration of the experimental setup during the recording of the hologram, by decreasing the exposure time, and by using fine-grain emulsions. The reference beam must have an undistorted wave front. The use of plates is recommended to allow a decrease in the emulsion thickness [1-5]. It is believed that the action of some of the foregoing factors can be eliminated by using diffuse illumination [1]. But even this does not yield high-grade reconstructions. The noise due to vibration affects strongly the reconstruction quality. The use of a beam-splitting mirror, ground glass, a mirror for the reference beam, and a lens system bring about differences in the physical conditions of the reference beam and the beam scattered by the object [1, 6]. Since a rigid optical system is unattainable, the least vibrations will cause great distortion and there can be no talk of identity of the reference beam and the beam incident on the object. It seems to us, however, that when diffuse illumination is used the noise is uniformly distributed over the entire area of the hologram and the resultant improvement in the hologram is illusory.

To reduce the noise due to vibrations of the experimental setup, we used a Fresnel biprism (FBP) to take the role of the beam-splitting plate. In such a setup, the physical conditions for the beam scattered by the object and the reference beam are strictly identical, and the vibrations of the FBP do not affect the image quality.

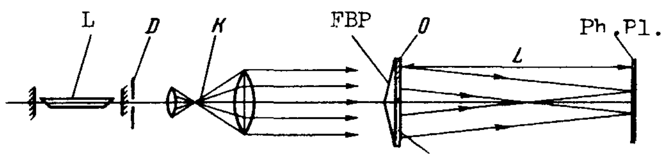

Fig. 1

The experimental setup is illustrated in Fig. 1. A collimated light beam from a laser struck the FBP, was split into two beams, one of which was incident on the object and the other served as the reference beam. The intensity ratio of the scattered and reference beams could be varied in arbitrary fashion by filters which were made integral with the FBP by optical contact. The interference pattern of the rays diffracted from the object yields, in conjunction with the field of the reference beam on the photographic plate, the hologram of the object. As a result, the photographic plate records only the changes experienced by the beam