scintillation crystal. This phenomenon is due to the mechanism of occurrence of scintillations [17] and was verified by us experimentally.

An intense beam of 23.8-keV γ quanta from a Sn^{119} source entered a scintillation counter consisting of a NaI(Tl) crystal and an FEU-35A photomultiplier. The signals from the photomultiplier output were analyzed with the aid of a 256-channel pulse-height analyzer of the AI-256 type. An additional peak, due to random coincidences of the γ quanta within the limits of the resolving time of the scintillation counter, appeared in the spectrum of the γ radiation from the source.

The intensity of the γ-quantum beam decreased to a value at which the number of random coincidences in the counter becomes negligibly small. With this, an additional peak in the spectrum of the γ radiation of the counter was not registered, thus indicating the absence from the beam of γ quanta entering the counter simultaneously.

Thus, the effect of correlation in the beam of γ quanta from the Sn^{119} source, observed in [12], should be regarded as in error.

[1] Kvantovaya optika i kvantovaya radiofizika (Quantum Optics and Quantum Radiophysics) [Translation Collection, O. V. Bogdanovich and O. N. Krokhin, eds.], Mir, 1966, p. 93.

[2] E. Wolf and L. Mandel, Revs. Modern Phys. 37, 231 (1965).

[3] R. H. Brown and R. Q. Twiss, Nature 177, 27 (1956).

[4] U. Fano, Amer. J. Phys. 29, 539 (1961).

[5] Yu. P. Dontsov and A. I. Baz', Zh. Eksp. Teor. Fiz. 52, 3 (1967) [Sov. Phys.-JETP 25, 1 (1967)].

[6] M. I. Podgoretskii and O. A. Khrustalev, Usp. Fiz. Nauk 81, 217 (1963) [Sov. Phys.-Usp. 6, 682 (1964)].

[7] D. A. Varshalovich, Izv. AN SSSR Ser. fiz. 28, 275 and 396 (1964); Yad. Fiz. 3, 643 (1966) [Sov. J. Nucl. Phys. 3, 470 (1966)].

[8] W. L. Bond, M. A. Dugray, and P. M. Rentzepis, Appl. Phys. Lett. 10, 216 (1967).

[9] M. A. Dugray and P. M. Rentzepis, ibid. 10, 350 (1967).

[10] R. H. Dicke, Phys. Rev. 93, 9 (1954).

[11] L. Janossy and Zs. Naray, Acta Phys. Acad. Sci. Hung. 7, 403 (1957).

[12] A. V. Kolpakov and R. N. Kuz'min, ZhETF Pis. Red. 7, 61 (1968) [JETP Lett. 7, 46 (1968)]

[13] V. Vali and W. Vali, Proc. IEEE 51, 223 (1963).

[14] R. H. Brown and R. Q. Twiss, Proc. Roy. Soc. (London) A242, 300 (1957) and A243, 291 (1957).

[15] E. M. Purcell, Nature 178, 1449 (1956).

[16] V. G. Baryshevskii and M. I. Podgoretskii, Zh. Eksp. Teor. Fiz. 55, 312 (1968) [Sov. Phys.-JETP 28 (1969)].

[17] V. O. Vyazemskii et al., Stsintillyatsionnyi metod v radiometrii (Scintillation Method in Radiometry), Gosatomizdat, 1961.

DIFFRACTION OF RESONANT γ RADIATION IN BRAGG SCATTERING BY NUCLEI AND ELECTRONS IN PERFECT SINGLE CRYSTALS OF TIN

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In [1] we investigated experimentally the diffraction of resonant γ radiation by nuclei and electrons in the case of Bragg reflection from mosaic crystals of tin containing 80% of the isotope Sn^{119}. For crystals with thicknesses 2 - 16 μ, we obtained the dependence of the intensity of the scattered radiation on the relative velocity of the source and scatterer (scattering spectra) in three orders of reflection at temperatures 293°K and 110 - 120°K.

These experiments clearly revealed an interference between the resonant and Rayleigh scattering and a diffraction of the radiation resonantly scattered by the nuclei.

The character of the scattering spectra of the resonant γ radiation at the Bragg angle, and particularly the interference pattern, depend on the structure of the crystal. The Bragg reflection of the resonant γ radiation from thick ideal crystals should be strongly influenced by dynamic effects. Therefore a study of the scattering of the Mossbauer radiation in such crystals is of particular interest. If the ratio of the coherent part of the amplitude of scattering from the nucleus at resonance (f^r_{nuc}) to the coherent part of the amplitude of scattering from electrons (f_e) is large, a peak should appear in the spectrum of the scattering at the Bragg angle (even in first order of reflection). If $f^r_{nuc}/f_e < 1$, then the scattering spectrum of a crystal of perfect structure should reveal a much lower resonant absorption than the corresponding spectrum of a mosaic crystal. This decrease of the absorption, together with the appearance of the peak in the spectrum when $f^r_{nuc}/f_e > 1$, is connected to a considerable degree with the dynamic effect of suppression of the inelastic channel of the nuclear reaction [2,3].

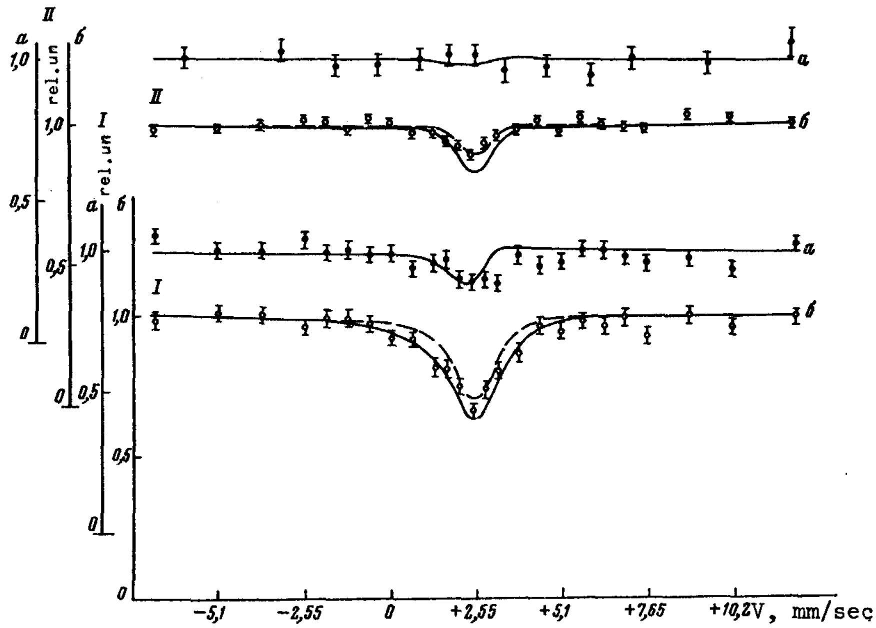
We investigated in the present paper the diffraction of resonant γ radiation at Bragg reflection from perfect single crystals of tin of natural isotopic composition ($f^r_{nuc}/f_e < 1$).

The experimental setup is identical with that described in [1]. We used a two-crystal spectrometer based on a modernized type GUR-4 goniometer and a Mossbauer spectrometer with constant velocity. The source of resonant γ radiation (23.8 keV) was a layer of $Sn^{119m}O_2$. In the measurements at a temperature 110°K, we used a nitrogen cryostat. The radiation scattered by the single crystal of tin was registered by a scintillation counter with single-channel pulse-height analyzer. The intrinsic background of the counter was 0.5 count/min.

The tin crystals were grown in optically polished molds on oriented primers [4] and then subjected to a prolonged annealing at 224°C. The perfection of the crystal structure obtained in this manner was demonstrated by the results of experiments on the Bragg reflection of the x-radiation. The experimental relative intensities of MoK_β x-rays scattered in different orders of reflection are close to those calculated for an ideal crystal [1]. We observed the Borrmann effect [5] in these crystals.

The figure shows the experimental intensity of the γ radiation of Sn^{119m}, reflected by a perfect single crystal of tin at the Bragg angle, against the relative velocity of the source and scatterer. The crystal thickness was 400 μ. The same figure shows for comparison the Mossbauer spectra of γ radiation reflected at the Bragg angle from a mosaic crystal 15 μ thick. The resonant absorption in a crystal with perfect structure at a temperature 110°K is much lower than in a mosaic crystal, and at room temperature there is practically no resonant absorption in the perfect crystal. The small asymmetry of the curves in the dip is connected with the interference of the resonant and Rayleigh scattering.

The experimentally observed sharp dependence of the resonant absorption on the structure of the crystal is a manifestation of the difference in the character of the scattering of the resonant radiation in ideal and mosaic crystals. The agreement between the experi-



Intensity of γ radiation of Sn^{119m} scattered at the Bragg angle vs. the relative velocity of the source and scterer. Reflection planes (020), I - temperature 100°K, II - 293°K. a) Perfect single crystal of tin, 400 μ thick; solid curve - calculation based on the dynamic theory [3]. b) Mosaic single crystal of tin, 15 μ thick; solid curve - calculation for the crystal of an ideal-mosaic structure; dashed curve - calculation with allowance for the secondary extinction (mosaic of crystal - 3').

mental scattering spectrum and the calculation based on the dynamic theory confirms that the Bragg reflection from a thick ideal crystal is determined by the dynamic character of the scattering, and is indirect evidence of the existence of the effect of suppression of the inelastic channel of the nuclear reaction.

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[1] V. K. Voitovetskii, I. L. Korsunskii, A. I. Novikov, and Yu. F. Pazhin, Phys. Lett. 27A, 244 (1968); Zh. Eksp. Teor. Fiz. 54, 1361 (1968) [Sov. Phys.-JETP 27 (1968)].
[2] A. M. Afanas'ev and Yu. M. Kagan, Zh. Eksp. Teor. Fiz. 48, 327 (1965) [Sov. Phys.-JETP 21, 215 (1965)].
[3] Yu. M. Kagan, A. M. Afanas'ev, and I. P. Perstnev, ibid. 54, 1530 (1968) [27 (1968)].
[4] Yu. V. Sharvin and V. F. Gantmakher, PTE No. 6, 165 (1963).
[5] V. K. Voitovetskii, I. L. Korsunskii, A. I. Novikov, and Yu. F. Pazhin, Phys. Lett. 27A, 207 (1968); ZhETF Pis. Red. 7, 330 (1968) [JETP Lett. 7, 258 (1968)].