of a strong dependence of f_2^1 on the angle between the direction of propagation of the γ quanta and the displacement of the atoms under the influence of the acoustic oscillations can find wide use in research on physical phenomena in crystal physics.

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EXCITATION OF ULTRASONIC WAVES BY PASSAGE OF FAST ELECTRONS THROUGH A METAL

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Askar'yan has predicted [1] the emission of ultrasonic waves when charged particles pass through a liquid, and noted that such radiation should take place in solids and in compressed gases, but its intensity there would be much less than in liquids.

Kaganov et al. [2] indicated that interaction between electrons and the lattice, for electrons having a velocity larger than the velocity of propagation of sound in the medium, leads to "Cerenkov" radiation of phonons.

Beron and Hofstadter [3] observed experimentally mechanical oscillations arising in ceramic piezoelectric pickups through which relativistic electrons with E_0 = 1 GeV pass.

Using the electron accelerator of the Physico-technical Institute of the Ukrainian Academy of Sciences, with E_0 = 300 MeV, experiments were undertaken aimed at observing ultrasonic oscillations in solids excited by passing electrons. The beam of electrons was normally incident on the center of a plate made of the investigated material and measuring $50 \times 10 \times h$ cm^3, where the thickness h was varied during the experiment. At one end of the plate there was fastened a detector of ultrasonic oscillations, made of a plate of rochelle salt and operating at 65 kHz. The plate together with the detector and preamplifier was placed in acoustic and electric screens. The signal from the cascade emitter repeater of the preamplifier was fed through a coaxial cable to a matched attenuator and a terminal tuned amplifier. The signal amplitude was registered on the screen of an oscilloscope IO-4, the delayed sweep of which was triggered by a synchropulse from the accelerator. The bandwidth of the entire detecting system was Δf = 4 kHz. The sensitivity of the detection system made it possible to measure displacement $\Delta\lambda \approx 10^{-12}$ cm at a twofold distance of the signal amplitude from the noise level of the preamplifier.

In the experiments we registered the amplitude U of the electric signal from the ultrasound detector, and the value of the average amplifier current. The sound force was calculated from the formula

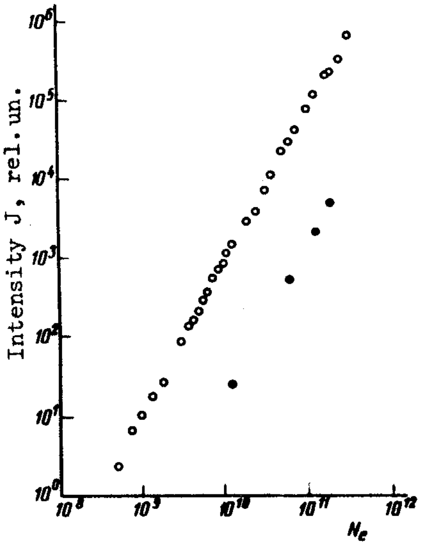
$$J = \frac{U^2}{R_s S}, \tag{1}$$

where $R_S = 1.88 \times 10^1\ \Omega$ is the "acoustic" resistance of the detector and of the plate of the investigated material, and S is the area of the ultrasound detector.

The figure shows the dependence of the ultrasound force in duraluminum plates of thickness h = 1 cm and h = 0.2 cm on the total number of the electrons passing in the current pulse of the accelerator (duration $\tau = 1.75$ μsec at the level 0.1). The amplitude of the signal was directly proportional to the number of particles in the pulse, and therefore the force of the sound (or the energy of the ultrasound) was proportional to the square of the number of particles (see formula (1)) in the pulse, i.e., $J \sim N_e^2$.

Experiments carried out with different thicknesses of the same material (duraluminum) have shown that the amplitude of the signal is approximately proportional to the thickness of the material h. The amplitude of the signal U was the same in experiments with electrons having energies 80 and 225 MeV. When the current density was decreased by a factor of 20 (by changing the beam diameter), no noticeable change of the signal amplitude U was observed at the same number of electrons in the pulse.

In our experiments we have satisfied the condition h << t (where t is the unit radiation length), and therefore the main process leading to the transfer of energy of the beam electron to the metal is probably the ionization loss.



Dependence of the intensity of ultrasonic oscillations (J) produced when electrons pass through a plate of duraluminum, on the total number of the electrons (N_e). Light circles - experimental data for a plate with thickness h = 1 cm; dark circles - 0.2 cm.

Thus, the amplitude of the excited ultrasonic waves in the metal depends on the number of particles in the pulse and on the thickness of the sample, but does not depend on the particle energy and on the current density. The fraction of the energy transferred by the ultrasonic wave in our conditions ranges from $\sim 3.7 \times 10^{-15}$ at $N_e = 5 \times 10^8$ particles to $\sim 1.6 \times 10^{-12}$ at $N_e = 2.5 \times 10^{11}$ particles; this differs from the data given by Beron and Hofstadter [3], who obtained for this value 2×10^{-10}.

The obtained data can be used to estimate the level of the signal excited by μ showers in Weber's experiments [4]. To this end we extrapolate the data of the figure to the region of a small number of muons, noting that the ionization losses of the muons are half as large as those of the electrons

$$J \approx 8.1 \cdot 10^{-31} N_\mu^2 (h)^2 . \qquad (2)$$

Weber's most sensitive gravitational detector [4], which has a threshold sensitivity $J \simeq 10^{-21}$ W/cm^2, can be triggered by the core part of a cosmic shower produced by a primary cosmic particle with energy $E_0 \gtrsim 5 \times 10^{14}$ eV, the intensity of which is $\sim 5 \times 10^{-2}$ m^{-2}hr^{-1}sr^{-1} [5]. Isolated Weber detectors should register signals from cosmic-ray showers. However, taking into account the resolving time of the detectors ~0.3 sec [4] and assuming that the detectors register only randomly entering showers, we arrive at the conclusion that the random coincidences of the pulses from two Weber's detectors of muons, from extensive air showers with $E_0 > 5 \times 10^{14}$ eV, have a frequency not higher than 10^{-3} year^{-1}.

Thus, it is quite probable that no cosmic-ray showers are detected in Weber's experiment.

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FEATURES OF SCATTERING OF LIGHT BY HYPERSONIC WAVES IN UNIAXIAL CRYSTALS

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The scattering of light by elastic waves in crystals is a subtle means of investigating the characteristics of propagation of elastic waves. In this connection, it is of interest to study the features of the scattering phenomenon itself. These features can appear in optically anisotropic crystals when the plane of polarization of the light is rotated during the course of the scattering. They are well known for scattering of light by thermal phonons (see [1] and the references therein). In scattering (diffraction) of light by coherent elastic waves with lower frequency and with strictly specified propagation direction and polarization, these features become manifest more distinctly and uniquely. Scattering of light by coherent elastic waves in uniaxial crystals was first considered in [2], where only one case was investigated, wherein the plane of scattering coincided with the xy plane (z is the optical axis). Using quartz crystals as an example, it was shown that if the scattering of light is accompanied by rotation of the plane of polarization, then the geometry of the scattering differs from the normal so-called Bragg geometry in that the angles of incidence and diffraction of the light are not equal, and collinear interaction is possible when the wave vectors of the elastic waves and of the incident and scattered radiation are parallel.

In the present paper we consider a more general case, when the plane of scattering makes an arbitrary angle with the optical axis. Then the optical anisotropy of the crystal leads to such interesting effects as the appearance, at a given frequency, of elastic waves of two possible angles of incidence, and accordingly two diffraction angles.

To study the singularities of the scattering of light in an optically anisotropic crystal, it is convenient to use the wave-vector surface [3], the radius vector of which defines the value of the wave vector of the light propagating in a given direction. For uniaxial crystals this is a two-cavity surface consisting of a sphere and an ellipsoid, which are tangent to each other at two points lying on the k_z axis ($\vec{k}$ is the wave vector). During the scattering process, there should be satisfied the law of momentum conservation $\vec{k}_2 = \vec{k}_1 + \vec{q}$, where 1 and 2 pertain to the incident and scattered light, respectively, and $\vec{q}$ is the wave vector of the elastic waves. Therefore, to determine the possible scattering geometry and its dependence of the frequency of the elastic