neutron fractions in the incident, transmitted, and scattered beams were determined by the cadmium-foil method [3].

Figures 1 and 2 show the measurement results, which indicate that all the transmission curves (T) have the dispersion form characteristic of crystals of intermediate thickness ($1 < \mu t < 10$). Such a character of the transmission curve is due to the interference between the two wave fields in the crystal ("incident" and "reflected") and constitutes direct experimental proof of the existence of suppression of the inelastic channels in resonant scattering of the neutrons. The measurements were repeated many times, and in all cases the value of the maximum on the T curves greatly exceeded the experimental error, and the fraction of the "higher-order" neutrons in the anomalously transmitted beam did not exceed 1 - 2% (using quartz filters). At $\lambda = 1.06$ Å (Fig. 2), the singularities on the T-curves become more sharply pronounced with increasing μt, but then the requirements concerning the measurement accuracy become more stringent, and the fraction of the "higher orders" in the scattered beam increases (from 10 to 20% without the quartz filters). At large $\mu t \approx 7.35$ ($\lambda = 0.81$ Å, $t = 0.96$ mm) the scattered beam, as seen from Fig. 1b, is due almost entirely to the "higher-order" neutrons, and observation of the anomalous transmission is difficult under these conditions.

The theoretical curves (dashed lines in Figs. 1 and 2) were obtained by convolution of the R-curve, the shape of which is governed by "instrumental" factors, with the T-curve calculated from the formulas of [2]. We used the characteristic temperature $\theta = 214°K$ [4] to calculate the Debye-Waller factor of the Cd atoms, and the Debye-Waller factor for the sulfur atoms was assumed equal to unity, since it exerts little influence on the form of the theoretical T-curve. Although the theoretical curves describes qualitatively the experimental data, there are nevertheless appreciable differences, due either to the insufficient perfection of the CdS crystal or to the influence of "many-wave" processes. The latter is not very probable, since a difference of the same type was observed also at $\lambda = 2.5$ Å, where no simultaneous reflection from other crystal planes took place.

The results show thus that in resonant scattering of particles (neutrons), just as in the case of waves (γ rays), the anomalous-transmission effect remains in force, i.e., the (n,γ) reaction is suppressed when a neutron interacts with a perfect crystal in the Bragg position.

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TWO-STEP SELECTIVE PHOTOIONIZATION OF RUBIDIUM ATOMS BY LASER RADIATION

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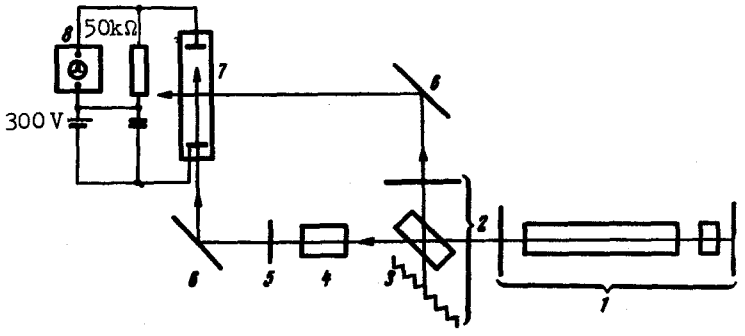
1. We report here the first experiment on selective two-step photoionization of atoms (Rb) by radiation from two lasers operating at different frequencies. In the two-step photoionization scheme, the radiation of the first laser transfers the atoms (in this experiment, Rb atoms) from the ground to the excited state. The atoms are simultaneously illuminated by light from the



Experimental setup: 1 - Q-switched ruby laser; 2 - dye laser, 3 - diffraction grating, 4 - KDP crystal, 5 - UV filter, 6 - rotating mirrors, 7 - cell with rubidium vapor, 8 - oscilloscope.

second laser, whose quantum energy is insufficient for photoionization of the atoms from the ground state, but sufficient for the photoionization of the atoms from the excited level. The results point to a high selectivity of the two-step photoionization processes.

2. The experimental setup is illustrated in the figure. A Q-switched ruby laser (1) pumps a dye laser (2) (DTTCI solution in ethyl alcohol). One of the dye-laser mirrors was a diffraction grating (600 lines/mm), which made it possible to tune the laser frequency in a wide range. For resonant excitation of the $5^2P_{1/2}$ states of rubidium, the laser was tuned to the wavelength λ_1 = 7947.6 Å. The width of the radiation spectrum of the employed laser was 1.3 - 3 Å, depending on the excess of the pump over threshold. The radiation energy was 1.5 - 2 MJ. The distance between the axial modes of the dye laser was somewhat larger than the Doppler width of the fine-structure component lines of the Rb atoms.

The ruby laser beam was then aimed on a KDP crystal to obtain the second harmonic (λ_2 = 3471 Å), and the ruby-laser radiation was cut off with an ultraviolet filter. The second-harmonic quantum energy (3.58 eV) was sufficient for photoionization of the excited Rb atoms, but insufficient for the photoionization of the atoms from the ground state (E_{ion} = 4.12 eV). The radiation energy of the second harmonic was 1 MJ. The second-harmonic and dye-laser beams were directed to the same region of the rubidium cell. Such a scheme ensured synchronization of the illumination of the Rb vapor by both pulses. The illuminated volume was $\sim$1 cm^3, and the distance between the electrodes in the cell was 10 cm.

The rubidium-cell temperature was maintained at 116 ± 2°C, corresponding to a vapor pressure of 10^{-3} Torr.

3. When the rubidium cell was illuminated with pulsed radiation at λ_2 = 3471 Å, the oscilloscope recorded a "dark photocurrent" equal to 1 μA, which remained unchanged when the cell was simultaneously illuminated by the dye laser, whose wavelength did not coincide with the absorption line of the Rb vapor. When the wavelength of the dye laser was tuned to the Rb absorption line, the photocurrent increased by a factor 15 - 20. The photocurrent was smaller by approximately one order of magnitude than the limiting theoretical value. This discrepancy can be attributed to the following: 1) the small delay of the dye-laser signal relative to the second-harmonic signal, owing to the short time of generation development in the dye laser; 2) the approximate value of the cross section for photoionization from the excited state; 3) saturation of only part of the Doppler-broadened line of the Rb atoms by the radiation of one axial mode of the dye laser.

4. A two-step scheme of photoionization of atoms by laser radiation makes possible selective ionization of different gas-mixture atoms whose ionization

energies are practically equal, and to measure accurately the cross sections for the photoionization of the atoms from the excited states. High selectivity can apparently be obtained also by two-step photodissociation of the molecules by laser radiation. Experiments in these directions are presently under way.

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SURFACE CONDUCTIVITY IN TIN IN A STRONG MAGNETIC FIELD

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1. It was shown in [1] that in a strong magnetic field $\vec{H}$ the static conductivity of a metal at the surface and in a region of the depth of the order of the Larmor radius r differs from the conductivity in the interior. The surface impedance with allowance for this fact was subsequently calculated in [2]. It was shown that if the conditions

$$r \ll \delta \ll \ell, \quad \mathbf{H} \parallel \mathbf{n} \tag{1}$$

are satisfied for pure metals, a skin effect of a new type should occur at frequencies $\omega < \nu$ (δ is the depth of penetration of the electromagnetic field, ν and ℓ are respectively the collision frequency and the mean free path of the conduction electrons, and n is the normal to the surface of the metal). An important feature of the impedance under these conditions is its sensitivity to the character of the scattering of the electrons from the surface. In specular reflection δ is larger than or equal to the depth of penetration of the electromagnetic field calculated from the value of the static conductivity for the normal skin effect (Fig. 1), and in diffuse reflection it is much smaller.

We report in the present paper the results of an investigation of the surface impedance of tin in a magnetic field; these results point to the existence of the skin effect predicted in [2]. We have also observed that in a strong magnetic field ($\omega_c > \nu$ where $\omega_c = eH/m^*c$ is the cyclotron frequency) there exists a region in which the depth of penetration δ decreases with increasing magnetic field. Such a behavior is connected with the distinctive role of diffuse scattering of conduction electrons from the surface of the metal when $\vec{H} \parallel \vec{n}$.

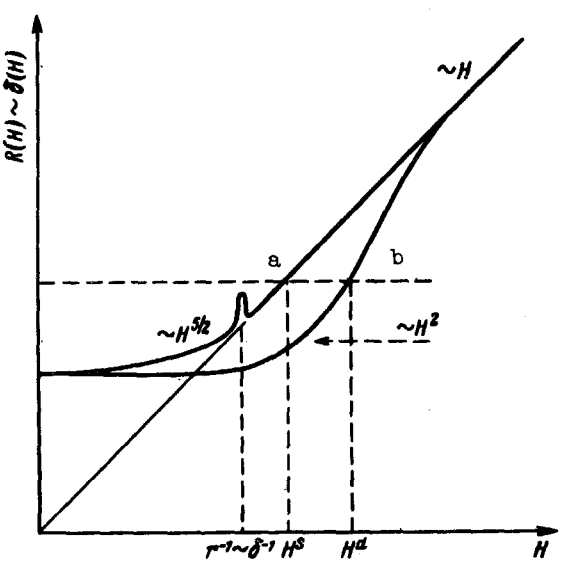

Fig. 1. Depth of penetration δ of the electromagnetic field in a metal at ω = const against the magnetic field, with $\vec{H} \parallel \vec{n}$, in accordance with (2); a - specular reflection of the electrons from the metal surface, b - diffuse reflection; H^d and H^S are the values of the magnetic field for diffuse and specular electron scattering, at which $\delta(H^d) = \delta(H^S)$.