case of ordinary reflection the difference would amount to two or three orders. Consequently, when the crystal is in a reflecting position, the neutron absorption is noticeably decreased $\mu_{eff} \approx 0.3\mu$). This effect is observed also in transmission curves, although here the measurements are made difficult by the incomplete absorption of the incident wave in a crystal of intermediate thickness. In addition, when resonance is approached, the background increases sharply, and the fraction of the monochromatic neutrons decreases in accord with the Maxwellian distribution in the reactor spectrum.

Single-crystal quartz filters were used to attenuate the fast-neutron background.

The anomalous-transmission effect could be observed most distinctly on the transmission curves at $\lambda = 2.49$ Å ($\mu t = 5.9$), which have a dispersion form due to the interference between the two wave fields ("transmitted" and "reflected"), a characteristic feature of a crystal of intermediate thickness. With decreasing μt at $\lambda = 1.64$ Å (see the plot of the cross section in Fig. 2), the "depth of the dip" increases, in accord with the theory, and the height of the transmission maximum decreases. At $\lambda = 0.88$ Å it was possible to observe only anomalous reflection of the neutrons, since the effect/background ratio is too small in this energy region on the transmission curve, owing to the weak effectiveness of the quartz filters at room temperature. It is interesting that the singularities on the T-curves for (0002) and (000$\bar{2}$) are practically of the same magnitude, whereas the intensities of the (0002) and (000$\bar{2}$) reflections differ strongly. This agrees with the formulas in [1, 2].

Our results confirm the conservation of coherence in resonant scattering, as manifest by the existence of anomalous transmission of neutrons near the resonance (effect of suppression of inelastic channels). To observe the effect directly in the resonance of Cd^{113} it is necessary to optimize the experiment to some degree. A quantitative comparison of the results with the theory will be reported separately.

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RADIATION OF Hg-He^3 GAS MIXTURE BOMBARDED BY A NEUTRON STREAM

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The idea of exciting a gas laser by nuclear-reaction products has already been advanced in the literature [1, 2]. Among the advantages of such a pumping method is, in particular, the possibility of exciting large volumes at high pressures of the working gas.

The authors have attempted to obtain lasing of an Hg-He^3 mixture bombarded by neutrons from a pulsed source with a thermal-neutron flux of about 5×10^{16} neut/cm^2sec.

The large cross section of the reaction $He^3(n, p) + 0.8$ meV ($\sim$5000 b for thermal neutrons) ensures a large per-unit energy input. The slowing down of the reaction products in the gas leads to formation of mainly unexcited ions. Charge exchange of the $He^+(1s)$ ions with the Hg atoms excites selectively the upper level of the 7p - 7s transition of the Hg^+ ion ($\lambda = 6150$ Å) [3, 4]. An analysis of the relaxation mechanism has shown that the optimal mixture is one with a small partial pressure of mercury (on the order of several per cent) and that the lasing power should increase with increasing total gas pressure (the corresponding calculations will be published). The experimental setup is illustrated in Fig. 1.

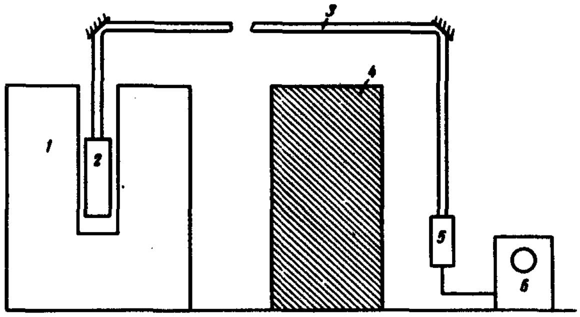

Fig. 1

Fig. 1. Experimental setup: 1- pulsed neutron source, 2 - resonator, 3 - light pipe, 4 - shield, 5 - radiation receiver, 6 - oscilloscope.

Fig. 2. 1 - signal from photomultiplier, 2 - signal from neutron pickup.

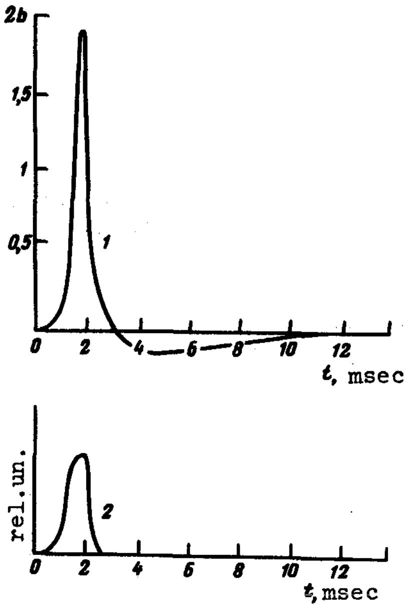

Fig. 2

The laser was constructed in the form of a metallic cylinder 600 mm long and of 40 mm diameter, heated to 150°C to produce the required saturated mercury vapor pressure. It was filled with an Hg-He^3 mixture with a total pressure ~350 mm Hg. The resonator output mirror was produced by dielectric coating on a glass substrate (R = 3 m, r = 98% for λ = 6328 Å, and the reflecting mirror was plane, with gold sputtered on a pyroceram substrate. The radiation receiver was an FEU-36 photomultiplier. To decrease the recorded background, the receiver was placed far from the pulsed neutron source, behind a shield. The stray background did not exceed 0.05 V.

Figure 2 shows an oscillogram of the signal from the photomultiplier when the working mixture is bombarded with neutrons. The signal amplitude (~2 V) corresponds to a radiation power ~10 mW (the calibration was with an OKG-13 He-Ne laser). This is much higher than the spontaneous-radiation power in the visible band, emitted from the resonator into the light pipe and estimated under the assumption that the entire energy of the nuclear-reaction products is converted into radiation.

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