EMISSION OF A SHORT SINGLE PULSE BY AN INJECTION SEMICONDUCTOR LASER

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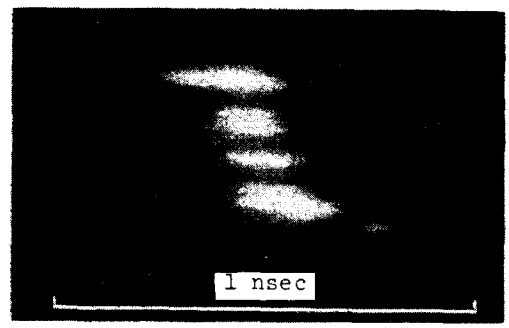
Submitted 3 October 1966
ZhETF Pis'ma 5, No. 3, 77-78, 1 February 1967

Self-modulation of the emission from an injection gallium-arsenide laser was previously observed in the form of a sequence of spikes of amplitude P_{sp}, separated by intervals in which the emission intensity P_i was vanishingly small, i.e., $P_i/P_{sp} \ll 1$. At the same time, modes were observed in which the spike duration $T_{sp} = \theta_{sp}\tau$ was much shorter than the duration of the interval $T_i = \theta_i\tau$ (τ = spontaneous-recombination time). This is in qualitative agreement with the estimates presented in [1] for θ_{sp} and θ_i, leading in the case of $P_i/P_{sp} \ll 1$ to a ratio $T_{sp}/T_i = \theta_{sp}/\theta_i \approx [\ln(P_{sp}/P_i)]^{-1} \ll 1$.

This inequality shows that it is possible to observe a very short single light pulse emitted from a semiconductor laser, with duration on the order of T_{sp}, following excitation by an injection-current pulse of much longer duration $\Delta t \lesssim T_i$.

This was attempted under the experimental conditions of [1] using a GaAs diode with diffusion pn junction and a resonator produced by cleavage. An injection-current pulse of duration $\Delta t \approx 2$ nsec was produced with a ferrite surge line.

The figure shows a time scan of the glowing active layer, produced at a slight excess over the generation threshold by cooling with liquid nitrogen, using the procedure of [1]. The picture was obtained with an electron-optical converter on a 35 mm screen at a sweep time of 2 nsec and a resolution not worse than 0.02 nsec. Several individual glowing spaces can be seen, separated in time from one another. The duration of the light pulse of each individual region is about 2×10^{-10} sec. Thus, the shortening of the emission duration relative to the injection duration, was about $10(T_{sp}/\Delta t) \simeq 0.1$. Even shorter pulses can be obtained by varying the parameters and duration of the pulses.



[1] V. D. Kurnosov, V. I. Magalyas, A. A. Pleshkov, L. A. Rivlin, V. G. Trukhan, and V. V. Tsvetkov, JETP Letters 4, 449 (1966), transl. p. 303.