the table. The wavelength standards were the Ca X lines measured by Edlen [8]. The identification of the previously unknown Ca XIII and Ca XIV lines was by extrapolating along the isoelectronic series OI and NI. The two lines λ = 148.84 Å and λ = 148.11 Å were identified with a certain indeterminacy, since their extrapolated values are close to each other and lie within the limits of the error arising in the extrapolation process. The wavelength measurement accuracy is ±0.05 Å.

A very rough estimate of the plasma electron temperature can be obtained by using the values of the ionization potentials of the observed ions. Taking into account the foregoing measured values of Ne, we can show that the so-called coronal approximation [9] is applicable in the distribution of the atoms over the degrees of ionization, if it is assumed that the electrons have a Maxwellian energy distribution:

$$\frac{n_{i+1}}{n_i} \approx \frac{7{,}4\cdot 10^8 \exp E\left(\frac{\chi_i}{T_e}\right)}{T_e^2 \left(\frac{\chi_i}{T_e}\right)^3},$$

where T_e and χ_i are in eV.

Assuming $\chi_i = 728.8$ eV for Ca XIII, we obtain $T_e \sim 130$ eV for $n_{\text{Ca XIV}}/n_{\text{Ca XIII}} \approx 1$.

In conclusion, the authors are deeply grateful to O. N. Krokhin and I. L. Beigman for a discussion of the results.

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GENERATION OF ULTRASHORT LIGHT PULSES WITH A GaAs SEMICONDUCTOR LASER

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In the course of an investigation of the dependence of the time characteristics of a GaAs semiconductor laser on the injection current through the p-n junction, it was established that at a certain excitation level the diode emits spikes, with the period and duration of the light flashes having an irregular character during the entire current pulse, whose duration is ≈0.5 msec. A similar irregular spike mode was observed also in [1].

By connecting two semiconductor lasers to a common resonator [2,3], ultrashort light pulses were generated with a spike repetition frequency on the order of several GHz and a pulse duration of a fraction of a nanosecond. In this case the frequency and duration of the light spikes was practically constant during the entire current pulse (of 10 msec duration) applied to both parts of the diode, and the depth of modulation of the light radiation was close to 100%.

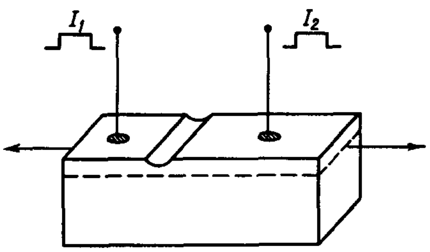

Fig. 1

In our experiments, both parts of the laser were excited by independent current generators. The current-pulse amplitude could be varied smoothly from 0 to 60 A, and the pulse duration could be regulated from 0.1 to 10 msec. The diodes operated at liquid-nitrogen temperature. The semiconductor laser emission was registered by a type FER-1 photoelectronic recorder with a time resolution 3×10^{-11} sec [4,5]. The spike radiation mode was observed only when the semiconductor laser was not uniformly excited over the area of the p-n junction, for which purpose the density J_1 of the current injected in one part of the diode (part 1, see Fig. 1) was several times larger than the density J_2 in the second part of the diode (part 2). If the amplitude of current I_2 is maintained constant while current I_1 is varied smoothly, then the period and the duration of the observed light spikes change when I_1 is increased (Fig. 2).

The dependence of the repetition frequency f and of the duration τ of the light pulse on the current I_1 at a fixed amplitude of the current I_2 is plotted in Fig. 3. It follows from the figure that the repetition frequency and the duration of the spikes depend strongly on the amplitude of the current I_1 when this current is close to its threshold value I_{1thr}, and that the dependence becomes weak when I_1 exceeds I_{1thr} by a factor 1.5 - 2. It must be noted that at another value of I_2, larger than 8 A, a mode could be obtained with spike duration on the order of 10^{-10} sec and a repetition frequency of several GHz. The strong dependence of the light-pulse parameters on the current I_2 apparently indicates that part 2 plays the role of a nonlinear absorber.

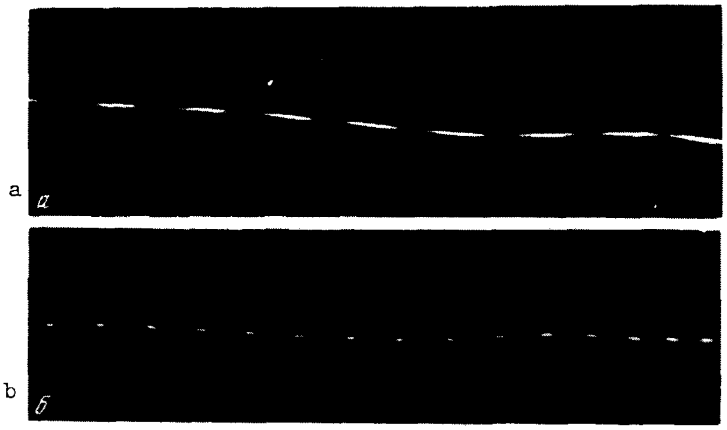

Fig. 2. Oscillograms of light pulses at different values of the current I_1 and at I_2 = 8 A.

The multivibrator operating mode of the semiconductor laser indicates that such a double laser diode can be used to generate ultrashort light pulses with a repetition frequency of several GHz. The noted strong dependence of the spike repetition frequency on the current can be used for frequency modulation.

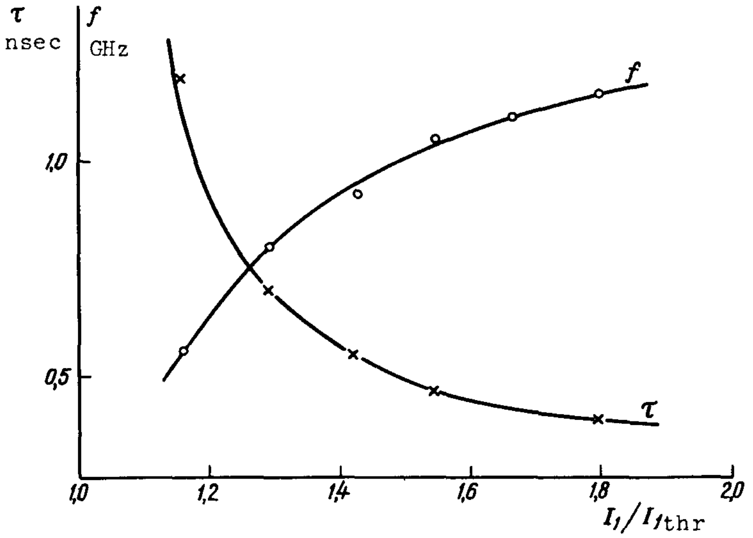

Fig. 3. Repetition period and duration of light pulses vs. current I_1 at I_2 = 8 A.

A more detailed investigation of the operating characteristics of semiconductor lasers in the mode wherein ultrashort light pulses are generated, and a theoretical interpretation of the observed phenomenon, will be published later.

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