tion (and annihilation) conditions and on the external circuit connections; no wholly stationary results were found beyond limiting. Increasing the random-to-drift velocity ratio at the input destroys the repetitive nature of the oscillation and reduces the amplitude of the fluctuations; further study is needed to see if the fluctuations were correlated with the random input and to see how much increase in stability is gained by increasing the random content of the input.

The start oscillation conditions, from perturbation analyses, indicate a weak start with no oscillation. However, the energy behavior, calculated from total quantities, indicates a violent start, as does occur. The large signal behavior of W, W_E, W_K and their time averages needs to be developed further, in particular, to be generalized to other models to get the start- and stop-oscillation conditions.

The analysis of stability in one-dimensional (infinitely broad) electron diodes is now made fairly complete. The two-dimensional (finite diameter stream) diode is shown to behave in a similar manner, but this study is not as exhaustive. The results are useful in themselves with applications to diode and drift-tube stability and to noise smoothing in electron guns and to oscillations in thermionic converters as given in Ref. 1. The results obtained are clues of what to compute and what to look for in more complex configurations.

The experimental observations by ourselves and others are only in partial agreement with these calculations. There is need for extending the analysis to include more effects as well as for improving the understanding of the experiments in order to obtain closer agreement.

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Effect of Hydrostatic Pressure on the Emission from Gallium Arsenide Lasers

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The pressure shift of both the coherent and the incoherent emission of GaAs junction lasers has been measured at about 200°K. The peak of the spontaneous emission shifts by $+1.09\times10^{-5}$ eV/atm, which is in agreement with the pressure coefficient of the band gap in GaAs determined by experiments based on the change of resistance under pressure. The shift of the coherent modes is much smaller, namely, $+2.96\times10^{-6}$ eV/atm. The effect of the compressibility on the latter shift is shown to be negligible. It is concluded from considerations of a simple model that the shift of the coherent radiation is primarily due to a change of the dielectric constant with pressure.

THE recent achievement of coherent light emission from forwardly biased GaAs junctions has provided a tool for more accurate measurements of certain basic parameters of semiconductors. This paper reports the results of hydrostatic pressure experiments on the coherent as well as the incoherent output of GaAs lasers at 200°K. Like the more familiar types of lasers the junction device consists of two basic ingredients: a region in k space with inverted population where spontaneous and stimulated emission can occur and a region in physical space forming an optical resonator to sustain prolonged oscillations. The first is determined by the band structure of the material, whereas the second depends on the physical dimensions and the dielectric constant of the medium. Pressure affects these properties differently, and therefore we discuss each of them in turn.

In a junction laser the population inversion is achieved by the injection of a large number of both types of carriers into the junction separating n- and p-type material, where electrons and holes can recombine and emit photons. The exact nature of the process is still subject to speculation. It may involve either conduction band-to-valence band transitions or transitions involving discrete impurity levels close to either of the band edges. One might hope to distinguish between some of the transitions by the difference in effect pressure might have on the energy states involved. The energy of the emitted radiation is smaller than the gap energy by about 0.04 eV. Therefore, only shallow impurity states could possibly be involved in the emission process. One can estimate the effect of pressure on such a state by adopting a hydrogenic model for the impurity. Assuming the change of the ionization energy to be due to the change of the effective mass and the dielectric constant, the estimated shift of the level with respect to the band edge is about 5% for the maximum pressure of 2000 atm employed in our experiments. The experi-