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INTENSITY AND FREQUENCY NOISE IN SEMICONDUCTOR LASERS

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An overview of the physics governing frequency and intensity noise in semiconductor lasers will be discussed and the noise performance of state-of-the-art laser diodes will be reviewed.

Semiconductor lasers have now found their way into several large commercial markets. Brightness, diffraction limited spot size, power efficiency, reliability, and cost per component are the overriding concerns in most of these applications. A sole exception is their application to fiber optic telecommunication systems. Research and product-development activities in this area continue to set impressive device performance records concerning spectral purity, tunability, modulation speed, and relative intensity noise levels. As a result of this effort commercial semiconductor lasers are nearly ideal in terms of their physical properties. Their intensity noise spectra and short-term frequency stability are governed almost exclusively by quantum mechanical effects, and these, in turn, determine system performance levels. In this paper we will review the physics governing field fluctuations in semiconductor lasers, discuss the performance levels that have been achieved in state-of-the-art devices, and try to forecast future performance levels and novel structures/materials that may one-day be used in these devices.

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