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Current tuning behavior of an extended-cavity diode laser: experiment and model TIMOTHY ROACH, MICHAEL DEFEO, ANDREW NOVICKI, College of the Holy Cross — Grating stabilized extended-cavity diode lasers (ECDLs) are widely used for probing and manipulating atomic states, and can be tuned by grating adjustment, or at higher rates, by current tuning. A common and inexpensive design uses laser chips with uncoated facets, but interaction between the internal (chip) resonance modes and the extended cavity modes can result in mode hops when tuning by either method, or even unstable oscillation. This is well known generally to depend on the cavity dimensions, chip and grating reflectivities, and optical properties of the semiconductor. We have included these in a model of the laser oscillation of the ECDL system, and found that it reproduces well a range of tuning and mode hop behaviors observed in our experimental system, for a range of cavity lengths. For example, an observed repeating sequence of mode hops described by particular chip mode numbers $\{m_0, m_1, m_2, m_0, m_1, m_2, \text{etc.}\}$ can result from a particular frequency spacing of external modes compared to chip modes. We are presently investigating how the model might be used to improve laser stability and RF modulation characteristics of ECDL systems.

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