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Compact spectrometer for precision studies of multimode behavior in an extended-cavity diode laser TIMOTHY ROACH, JOSIAN GOLEMI, THOMAS KRUEGER, College of the Holy Cross — We have built a compact, inexpensive, high-precision spectrometer and used it to investigate the tuning behavior of a grating stabilized extended-cavity diode laser (ECDL). A common ECDL design uses a laser chip with an uncoated (partially reflecting) front facet, and the laser output exhibits a complicated pattern of mode hops as the frequency is tuned, in some cases even showing chaotic dynamics. Our grating spectrometer (based on a design by White & Scholten) monitors a span of 4000GHz (8nm at 780nm) with a linewidth of 3GHz, which with line-splitting gives a precision of 0.02GHz in determining the frequency of a laser mode. We have studied multimode operation of the ECDL, tracking two or three simultaneous chip cavity modes (spacing ˜30GHz) during tuning via current or piezo control of the external cavity. Simultaneous output on adjacent external cavity modes (spacing ˜5GHz) is monitored by measuring an increase in the spectral linewidth. Computer-control of the spectrometer (for line-fitting and averaging) and of the ECDL (electronic tuning) allows rapid collection of spectral data sets, which we will use to test mathematical simulation models of the non-linear laser cavity interactions.

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