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Development and testing of an external cavity diode laser and controller

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Diode lasers are compact, low-cost devices that are widely used in many applications requiring coherent light. However, for high precision atomic spectroscopy applications these devices are not suitable due to their large spectral linewidth. The laser wavelength is also dependent on the operating temperature and laser current. One way around the large linewidth problem is to enclose the diode in an external cavity arrangement as follows: the back facet of the diode is usually reflecting, and this can be used as one of the mirrors forming the cavity. The other mirror of the cavity can be a diffraction grating that is placed in front of the diode, directing one of orders of the diffracted light back into the diode. The diffraction grating is mounted on a piezo electric transducer, thus allowing fine control of the cavity length. This arrangement is referred to as an external cavity diode laser. Further, by using feedback control of the diode current, temperature and cavity length, the wavelength can be accurately controlled.
In the present project we have developed and tested a diode laser in an external cavity arrangement for applications in laser cooling of atoms and quantum optics experiments. The laser head consists of a diode laser and an external cavity using a diffraction grating as discussed above. The laser head also contains a piezo electric device for fine tuning of the cavity length, as well as a Peltier device for temperature control of the diode. The laser controller consists of feedback control circuits to adjust the diode current, the cavity length and the temperature of the diode. Also contained within the controller is a digital data acquisition module for monitoring system parameters and a PC interface. In this paper we will provide the performance characteristics of the system, including the temperature stability of the laser head, and linewidth measurements. Further, we have used the facility of controlling the temperature and current to study how the output wavelength varies with changes in operating temperature and current, and these results will also be presented.

Apply to be considered for a student ; award (Yes / No)?

No

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