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Increasing the Stability of External Cavity Diode Lasers

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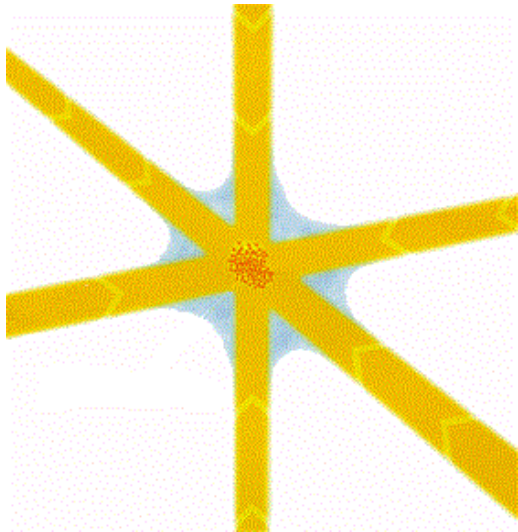
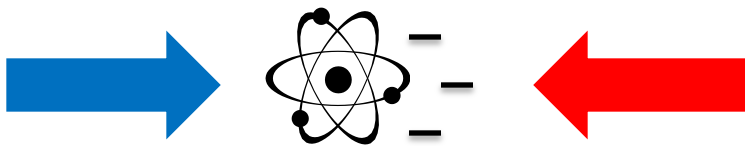
August 2013

The Advanced Lab MiniMot

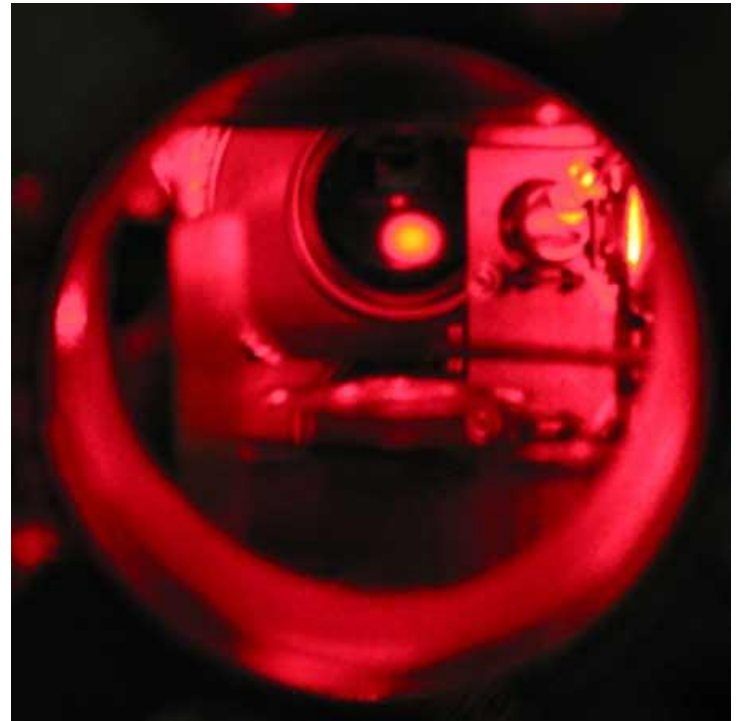


http://www.coldquanta.com/Products__Cold_Atoms.html

Laser Cooling



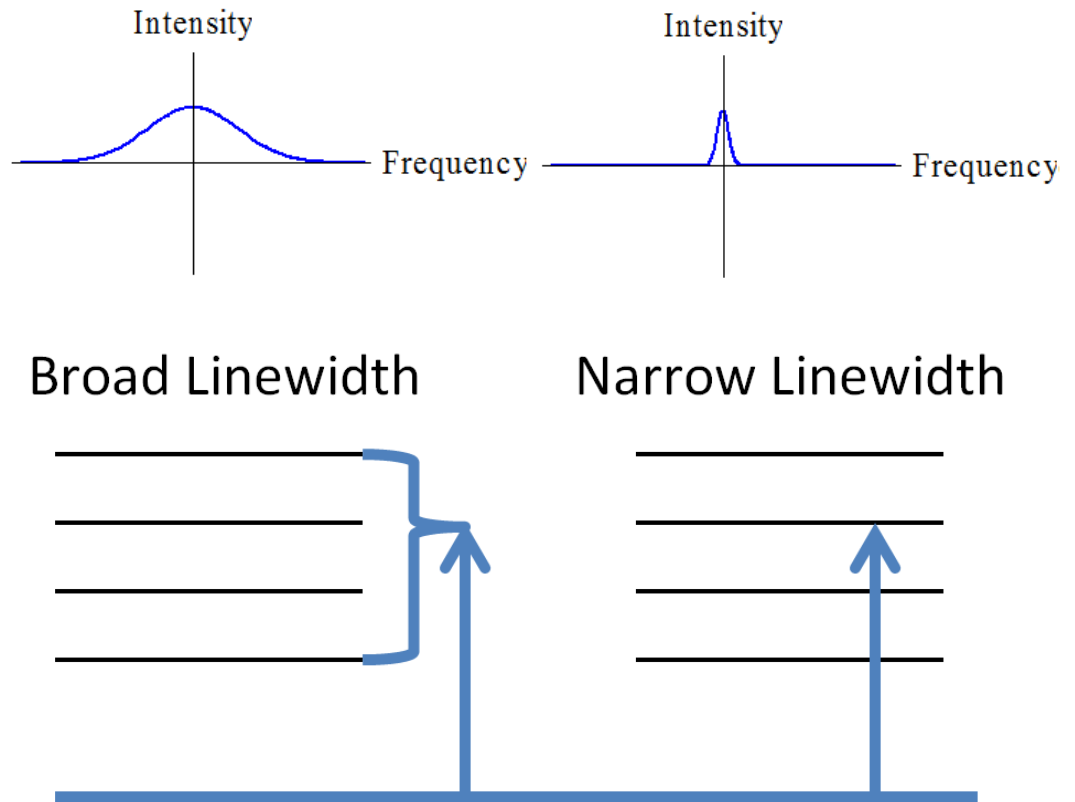
(http://www.nobelprize.org/nobel_prizes/physics/laureates/1997/illpres/trapping.html)



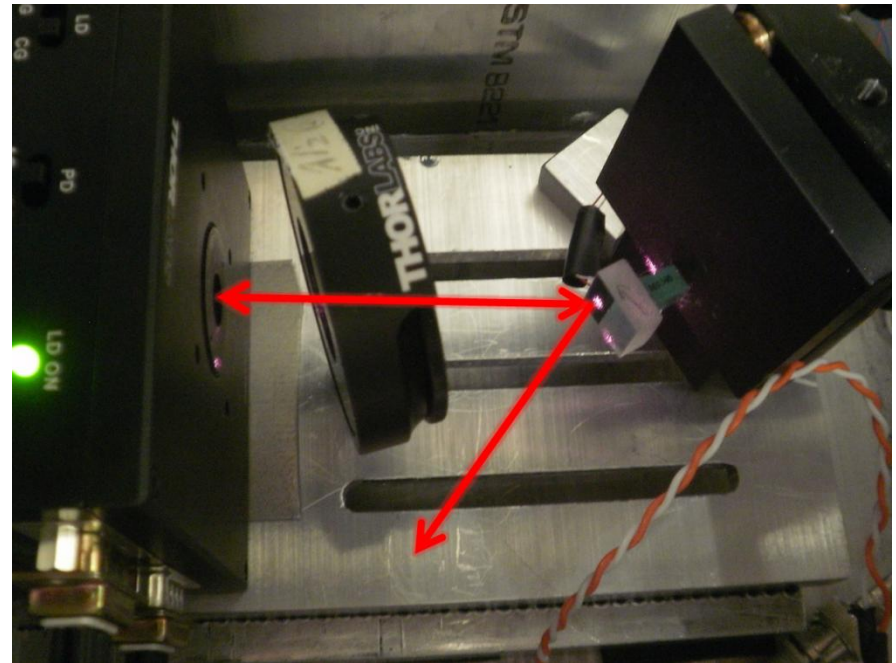
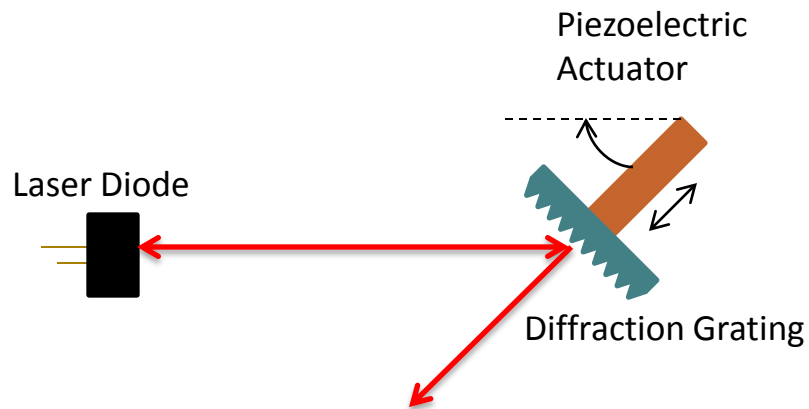
<http://www.laserfest.org/lasers/images/inn-cooling.jpg>

Laser Requirements

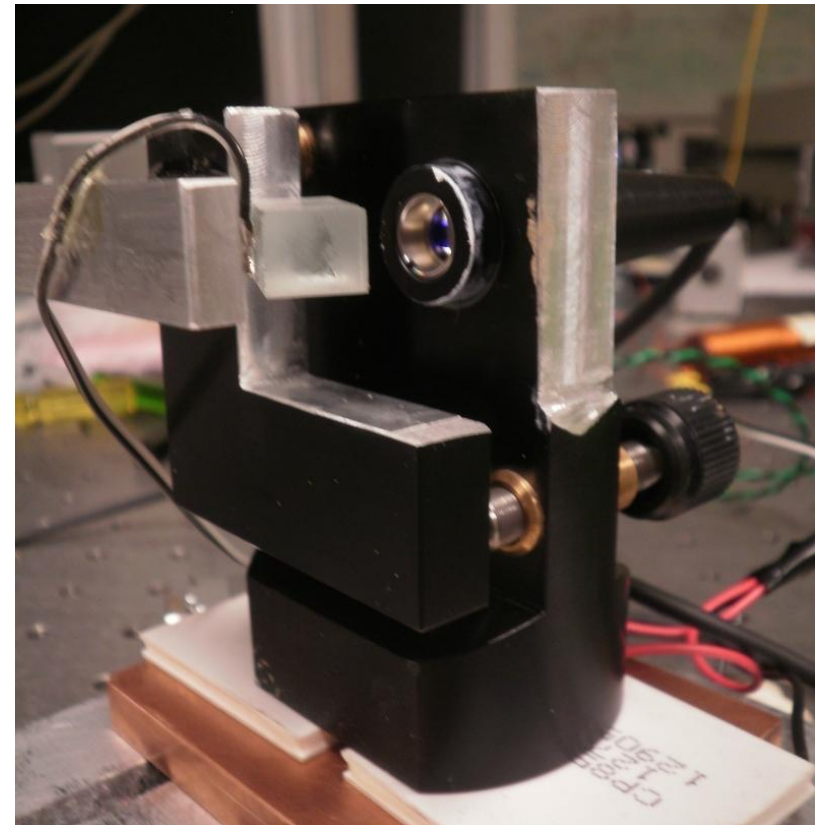
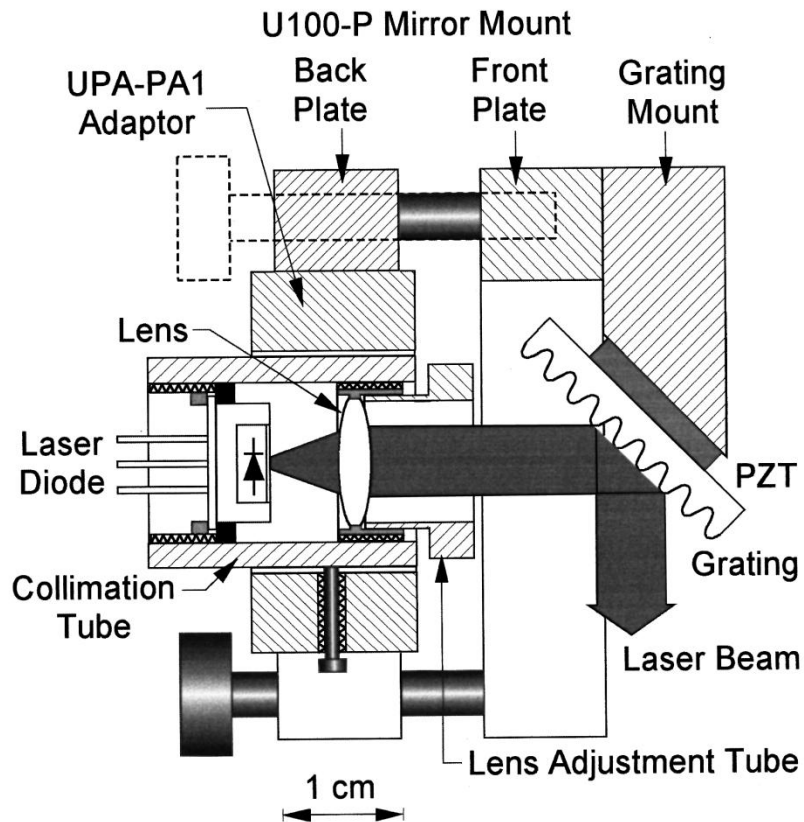
- Narrow linewidth
- Frequency stability



External Cavity Littrow Configuration



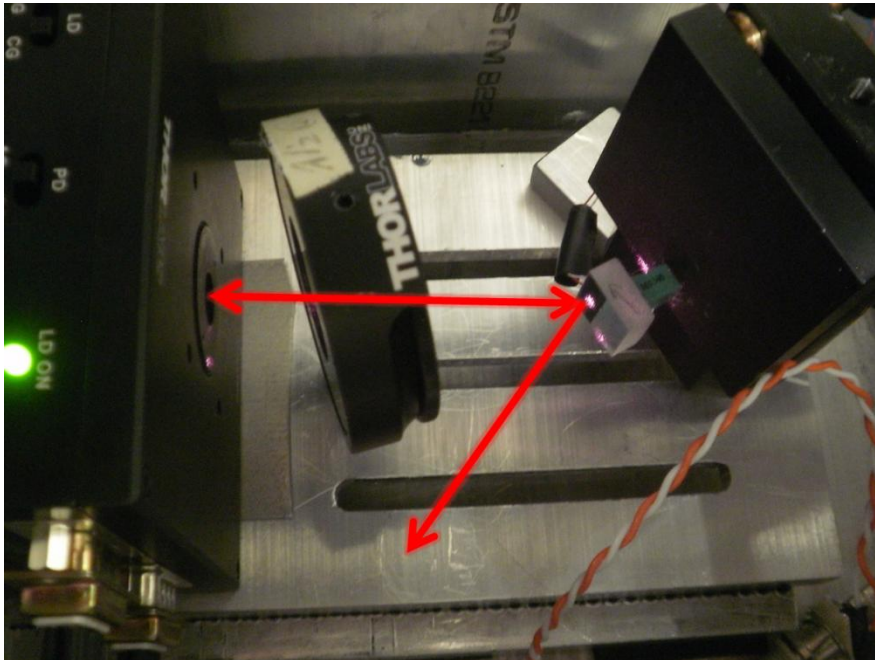
Change in Cavity Design



Mirror mount external cavity
(Arnold, Wilson, & Boshier, 1997).

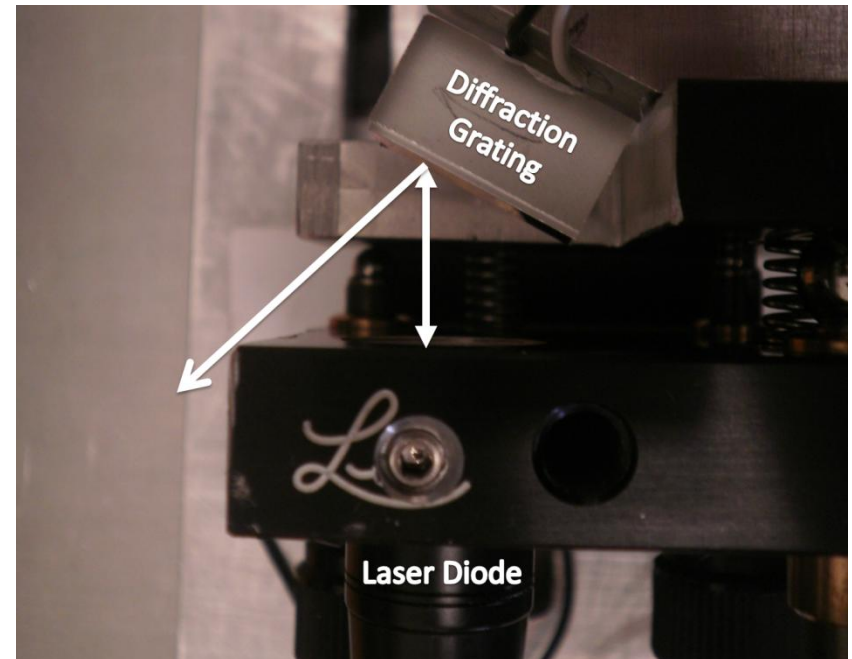
Shorter Cavity Length

Old Design



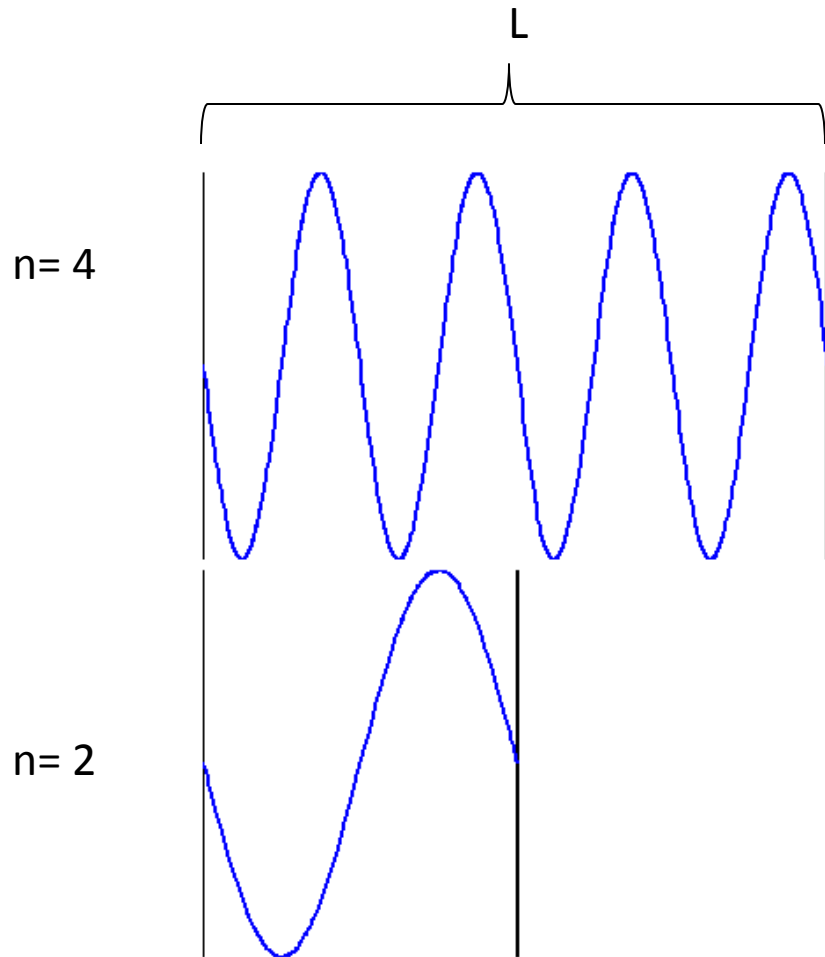
9 cm Cavity Length

New Design



1.5cm Cavity Length

Increased Mode-Hop Free Tuning Range

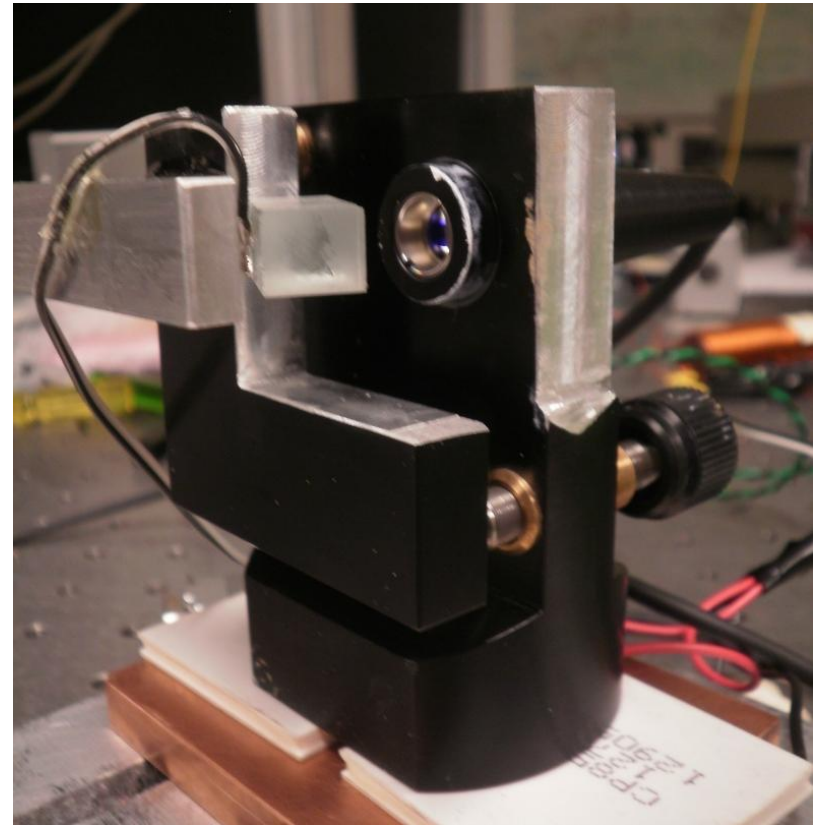
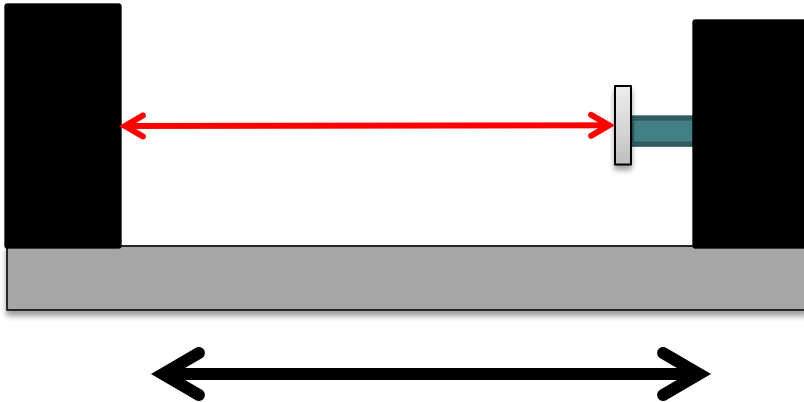


$$\text{Tuning Range} = \frac{c}{2L}$$

Calculated Free Tuning Range	
Old Design	New Design
1.9 Ghz	10 Ghz

Increased Mechanical and Temperature Stability

- Better vibration isolation
- Temperature controlled cavity
- Greater thermal mass



Results

- Stable free running frequency
- Long lock duration
- Increased mode-hop free tuning range





Acknowledgments

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- The University of Rochester Office of Undergraduate Research

References

A Simple Extended-Cavity Diode Laser by A.S. Arnold, J.S. Wilson, and M.G. Boshier. Rev. Sci. Instrum. 69 (3), 1998.

Mode Stability of External Cavity Diode Lasers, by Sebastian D. Saliba, Mark Junker, Lincoln D. Turner, and Robert E. Scholten. Applied Optics 58(35), 2009.

A Narrow-Band Tunable Diode Laser System with Grating Feedback and a Saturated Absorption Spectrometer for Cs and Rb by K.B. MacAdam, A. Steinbach, and C. Wieman. Am. J. Phys. 60 (12), 1992.