Abstract Submitted
for the MAS14 Meeting of
The American Physical Society

Tuning and Locking a Diode Laser for a Magneto-Optical Trap
RACHEL LIVINGSTON, MATTHEW GIFT, JOHN HUCKANS, JU XIN, Bloomsburg Univ — The purpose of a MOT is to utilize the atomic structure of rubidium-87 to manipulate a sample into an ultra-cold atom cloud in a vacuum sealed environment via a laser array. The extended cavity diode lasers used in this experiment must be tuned using an absorption spectroscopy system which utilizes the Doppler effect of light through a rubidium cell as the extended cavity of the diode laser is scanned across the rubidium absorption peaks with a piezo stack. The laser is then locked with a lock-in amplifier to ensure the frequency remains stable. When the lasers are locked they will be ready for use in the creation of a MOT. The light will be red-detuned so as to excite atoms moving towards each beam. When an atom absorbs the photon it will lose momentum along the photon's axis of motion, then spontaneously emit a photon of the observed frequency in a random direction. The isotropic nature of the emitted photons creates a randomly-directed recoil momentum in the affected atoms and reduces the average energy of the sample as a whole. With the orthogonal laser set-up and in conjunction with an anti-Helmholtz magnetic field this will create a point where the least energetic atoms will form an ultra-cold cloud with a temperature on the order of 200 microkelvins.

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Date submitted: 29 Aug 2014 Electronic form version 1.4