Optical Pumping Workshop Abstract
BFY (Beyond the First Year)
July, 2015

Optical pumping is a non-laser way to use light, interacting with atoms in the vapor phase, to 'pump' the atoms into states that permit the observation of radio-frequency quantum transitions between energy levels of the atoms' ground states. This experiment is a fine illustration of the polarization properties of light, the energy-level structure of atoms' ground states, and the Zeeman effect of external magnetic fields on these atomic energy levels.

Participants will start with a basic introduction.

- a hands-on familiarization with the parts of the apparatus, and instruction on how to align it for operation
- magnetic-field sweeps through zero (total) field, in the presence of the earth's ambient field, and detection of the 'zero-field resonances'
- optimization of the zero-field resonance, and detection of its width; also application of the resonance to the detection of magnetic-field fluctuations

After that we will observe the RF Zeeman resonaces.

- radio-frequency resonances, induced by the addition of a radio-frequency magnetic field (of frequency 10 - 100 kHz), and the dependence of the resonances' location and size on the frequency and amplitude of the r.f. fields
- the Zeeman effect, in the dependence of the resonance's location on the strength of the steady magnetic field

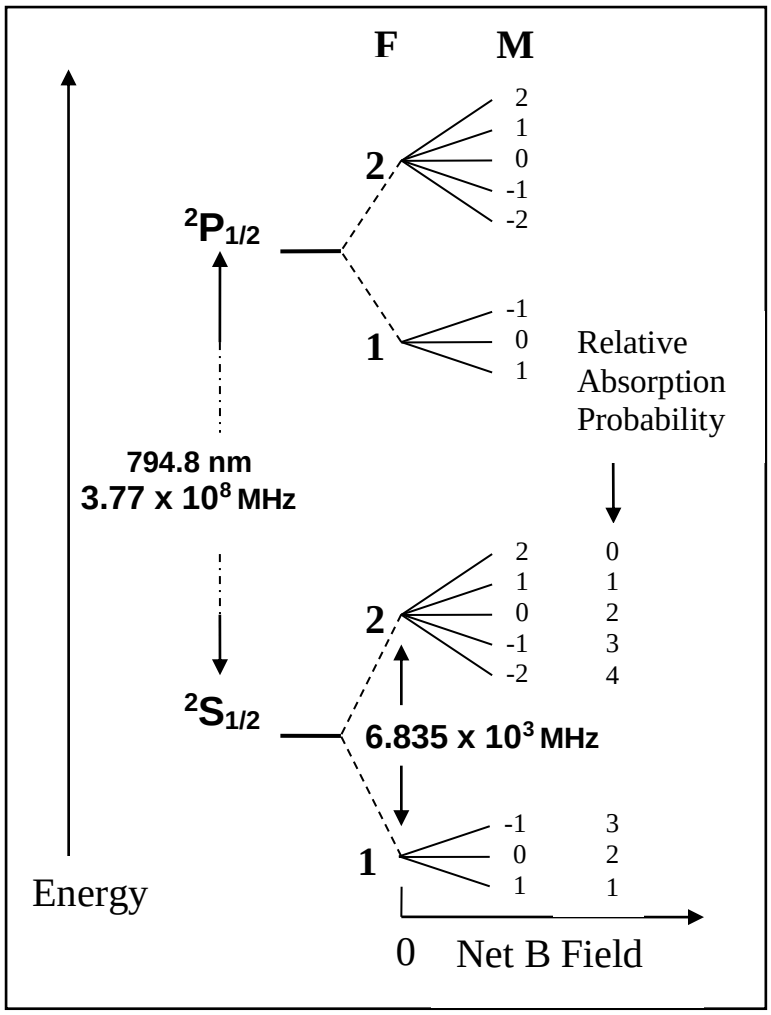

Fig.1: Energy Levels for ^{87}Rb, showing Zeeman differentiation dependence on ambient magnetic field. At B = 0.1 mT = 1.0 gauss, Δ Energy = 0.71 MHz.

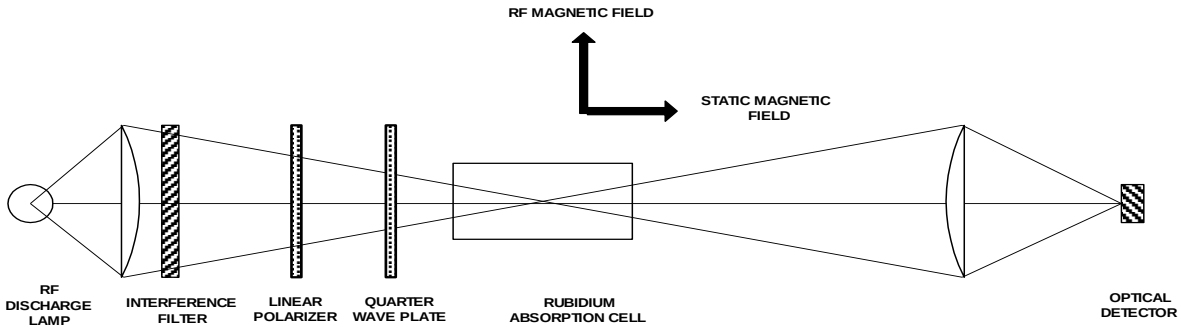

Fig.2: Schematic of Elements on Optical Rail