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Comparison of absorption, fluorescence, and polarization spectroscopy of atomic rubidium SETH ASHMAN, CAYLA STIFLER, JOAQUIN ROMERO, Providence College — An ongoing spectroscopic investigation of atomic rubidium utilizes a two-photon, single-laser excitation process. Transitions accessible with our tunable laser include $5P_{1/2}\,(F') \leftarrow 5S_{1/2}\,(F)$ and $5P_{3/2}\,(F') \leftarrow 5S_{1/2}\,(F)$. The laser is split into a pump and probe beam to allow for Doppler-free measurements of transitions between hyperfine levels. The pump and probe beams are overlapped in a counter-propagating geometry and the laser frequency scans over a transition. Absorption, fluorescence and polarization spectroscopy techniques are applied to this basic experimental setup. The temperature of the vapor cell and the power of the pump and probe beams have been varied to explore line broadening effects and signal-to-noise of each technique. This humble setup will hopefully grow into a more robust experimental arrangement in which double resonance, two-laser excitations are used to explore hyperfine state changing collisions between rubidium atoms and noble gas atoms. Rb-noble gas collisions can transfer population between hyperfine levels, such as $5P_{3/2}\,(F'=3) \overset{Collision}{\longleftarrow} 5P_{3/2}\,(F'=2)$, and the probe beam couples $7S_{1/2}\,(F''=2) \leftarrow 5P_{3/2}\,(F'=3)$. Polarization spectroscopy signal depends on the rate of population transfer due to the collision as well as maintaining the orientation created by the pump laser. Fluorescence spectroscopy relies only on transfer of population due to the collision. Comparison of these techniques yields information regarding the change of the magnetic sublevels, m_F, during hyperfine state changing collisions.

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