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Beam Production and Stabilization via Frequency Up-conversion in Rubidium Vapor[1]

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Two pumping lasers with wavelengths of 776nm and 780nm produce two-step excitation from the ground state of rubidium. These excited atoms undergo a double cascade through the $6P_{3/2}$ energy state before returning to the ground state. The final transition to the ground state produces a fluorescence of 420nm photons. When the pump lasers are co-propagating and detuned from the resonances, a forward propagating coherent blue beam is observed to emanate from the rubidium vapor cell. The beam is found to be collimated and to have a power up to 15μW. However, the beam has not yet been extensively characterized due to its relative instability related to the precise tunings of the two pump lasers and the temperature of the rubidium vapor cell. This work discusses the attempts to stabilize, characterize, and model the blue beam that results from this process. In our specific set up, two co-propagating external-cavity diode laser beams at 776 nm and 780 nm are directed through a rubidium vapor cell with a natural isotopic abundance of Rb^{85} and Rb^{87}. The power in each beam is approximately 30 mW. The vapor cell is heated via a novel oven design and can be held to a temperature of 25-300^{o}C, and the diode lasers are independently tunable through temperature, current, and external cavity gratings.

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