Dual-wavelength ultra-stable laser operating at 780 nm and 852 nm.

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Summary: We present the development of a dual-wavelength ultra-stable laser operating at 780 nm and 852 nm. The laser is based on a 5 cm optical cavity with a finesse measured to be about 2.1×10^5 across the wavelengths from 780 nm to 852 nm[1,2]. Utilizing the Pound-Drever-Hall (PDH) locking technique[3,4], we achieved an ultra-low background noise of 2.8 $\mu V/\sqrt{Hz}$ with a high-speed laser locking circuit. Additionally, we improved laser power stability by two orders of magnitude through laser power stabilization techniques. Finally, we achieved long-term locking of a frequency-stabilized laser system capable of simultaneously providing stable frequencies at 780 nm for rubidium atoms and at 852 nm for cesium atoms. Our system has a locked laser linewidth of 1.9 Hz and a frequency stability reaching 1.8×10^{-15} at 1 second, approaching the thermal noise limit. This cavity will be used for precise spectroscopic measurements of clock lines of rubidium and cesium atoms[5].

Keywords: Ultra-stable laser, Optical cavity, Rubidium, Cesium

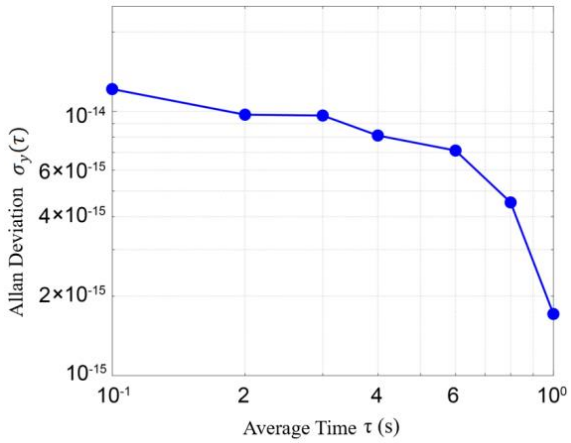

Fig. 1: The fractional frequency Allan deviation of the laser.

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