

Ditellurium Spectroscopy for Titanium Laser Cooling and Locking

Luis Castillo González

Matthew Bilotta, Scott Eustice, Jack Schrott, Dan Stamper-Kurn

Department of Physics, University of California, Berkeley, CA 94720

luis.castillo@berkeley.edu

We demonstrate the use of ditellurium ($^{130}\text{Te}_2$) as a frequency reference for laser locking at 391 nm and 498 nm optical wavelengths, which are of interest for titanium laser cooling experiments. Using Doppler-free saturated absorption spectroscopy, we observe 36 transitions of the $X0_u^+ \rightarrow B0_g^+$ electronic transition over a frequency range of 256 GHz near 391 nm. We measure the frequency of these lines, as well as those around 498 nm, relative to nearby transitions in atomic Ti. Subsequently, we stabilize lasers at 391 nm (498 nm) to ~ 60 MHz (~ 50 MHz) wide resonances in $^{130}\text{Te}_2$. We observe robust long-term frequency locks, with Allan deviations of 4.9×10^{-10} (3.6×10^{-11}) at 10 s of averaging time for the 391 nm (498 nm) laser. These results extend $^{130}\text{Te}_2$ frequency references down to 391 nm, providing suitable transitions for laser frequency locking.

References

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Figures

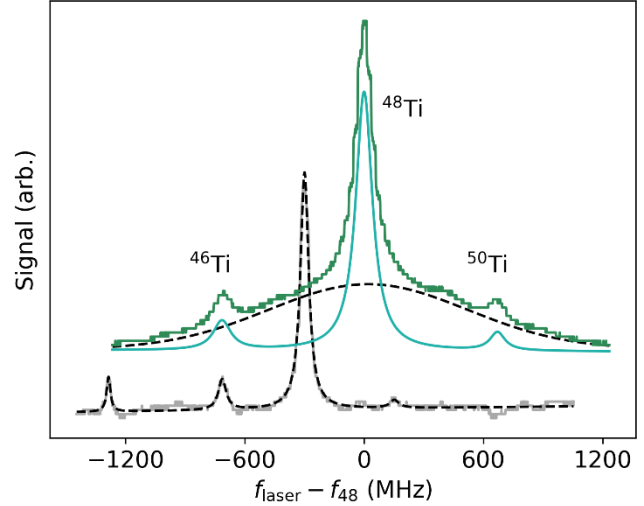


Figure 1: Doppler-free spectrum of ditellurium (grey) and saturated absorption spectrum of titanium (dark green) at 498 nm, relative to an atomic Ti transition.

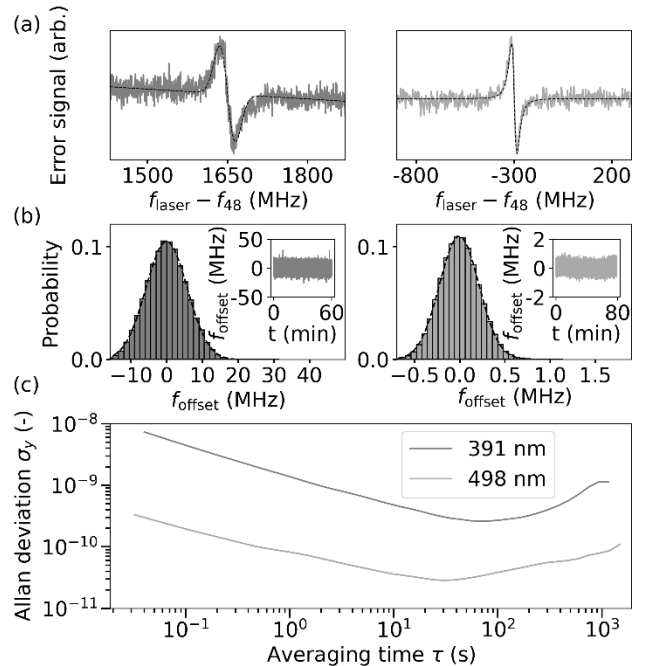


Figure 2: (a) Error signals of the actively locked lasers at 391 nm (dark grey) and 498 nm (light grey). (b) Histograms of frequency deviations from the mean of each actively locked laser, fitted to a Gaussian. (c) Allan deviation of the actively locked lasers, showing their fractional frequency stability as function of the averaging time.