Abstract

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My PhD research focuses on the development of a continuous atomic fountain using laser-cooled strontium atoms, with the goal of achieving continuous superradiant light emission in an optical cavity. Currently, I am working on narrowing the linewidth of the clock laser (698 nm) by Pound-Drever-Hall (PDH) locking scheme to a high-finesse, ultrastable optical cavity.

The frequency comb allows for precise optical frequency comparisons. To achieve high stability over both short and long timescales, the instrument is locked using an integrated time signal from GPS or REFIMEVE (an optical clock distributed over the telecom network) for long-term stability, while the strontium clock laser at 698 nm is stabilized on the ultra-stable optical cavity for short-term stability. In addition to finalizing this stabilization process, I am also working on determining the thermal response of the cavity assembly and optimizing the PID parameters to ensure precise frequency control. Another critical aspect of my work is identifying the temperature inversion point of the ultra-low expansion (ULE) spacer, where the cavity's sensitivity to temperature fluctuations is minimized. Furthermore, I am developing two original electronic schemes to suppress noise contributions arising from the resistance of the cable connecting the cavity to the temperature driver, as well as fluctuations in the voltage and resistance references used to measure the cavity's temperature.