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Ultrastable lasers for precision spectroscopy in a ^{87}Sr optical lattice clock[1]

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Optical interferometers are central components of many modern experiments (*e.g.*, LIGO, cavity QED, optomechanics, and optical clocks). These experiments share a common thread: their precision is in many cases limited by fundamental thermo-mechanical noise within the interferometer. A focus of our current work has been to reduce the impact of this noise on the length stability of optical cavities used for laser stabilization, and we have achieved fractional frequency instability at the 10^{-16} level in several systems. Of these systems, the new ultrastable clock laser at JILA has enabled us to explore the many-body physics of interactions in a ^{87}Sr optical lattice clock. The impetus to continue improving laser stability has also led us, in collaboration with colleagues at PTB, beyond glasses typically employed in optical cavities for laser stabilization. By constructing an optical cavity out of monocrystalline silicon, we have been able to demonstrate laser linewidths below 35 mHz, and short-term instability below 1×10^{-16}. In this talk I will present these new developments in precision laser stabilization and how they relate to exploring the many-body nature of the JILA ^{87}Sr optical lattice clock.

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