Sr OPTICAL LATTICE CLOCK

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Recently, optical lattice clocks based on Sr and Yb atoms have started to demonstrate impressive overall performance in several laboratories [1-5]. One significant progress for the Sr lattice clock is that recent absolute frequency measurements of the ^{87}Sr $^1S_0$-$^3P_0$ clock transition performed in JILA, U. Tokyo, and SYRTE, have agreed at the 10^{-14} level [1, 4, 5]. After the first measurements we performed in JILA last year, our effort has been directed to improving the quality factor of the observed spectra, resulting in hertz-level linewidth (Q ~2.4 x 10^{14}). Figure 1 shows an absorption spectrum of 2.1 Hz (FWHM) that we routinely obtain on a daily basis. The ultra-narrow linewidth greatly facilitates the evaluation of clock systematics. Residual magnetic field, which gave arise one of the major uncertainties in our 2005 frequency measurement, can now be reduced to less than 5 mG uncertainty, with a corresponding frequency uncertainty of < 1 x10^{-15}. Other important systematic problems, including frequency shifts associated with atom density and lattice intensity, will also be addressed. By imposing a bias magnetic field of ~0.1-1G, 10 hyperfine states of the $^1S_0$ and $^3P_0$ are fully resolved by probing either π transition or σ+, σ- transition. This has allowed a direct measurement of the differential Landé g-factor between the two states.

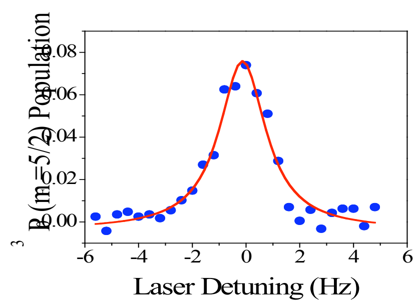

FIG 1: Observed spectrum of m_F=5/2↔5/2 transition with a bias magnetic field of 0.8G. FWHM of 2.1Hz is mainly limited by probe-time and routinely obtained on a daily basis.

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