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Contribution ID: **3646** Type: **Poster Competition (Graduate Student) / Compétition affiches (Étudiant(e) 2e ou 3e cycle)**

(G*) (POS-41) An ultra-low phase noise microwave synthesizer for quantum sensing with cold atoms

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We present progress towards an ultra-low phase noise microwave synthesizer, critical for achieving high-precision quantum gravimeters and gyroscopes based on cold-atom interferometry. The microwave synthesizer is used both for laser cooling ^{87}Rb atoms and inducing ground-state Raman transitions that function as momentum-transfer pulses in our atom interferometer. During these pulses, the phase of the Raman laser is directly imprinted on the atomic wavefunction. Thus, for high-precision quantum measurements, a very low noise is desired for the microwave signal phase that is transferred to the atoms. Our synthesizer design generates two independent microwave signals: one at 6.6 GHz that acts as a repump frequency for laser cooling, and one at 6.834 GHz in accordance with the ^{87}Rb ground state hyperfine splitting. Both of these signals are derived from an ultra-stable 100 MHz OXCO (ovenized crystal oscillator) and a PLDRO (phase-locked dielectric resonator oscillator) operating at 3.35 GHz. The two microwave signals are combined and sent to an electro-optic phase modulator to generate the desired optical frequencies in our 780 nm laser system. Preliminary measurements of the microwave power spectral density at 6.7 GHz yield a phase noise of −81 dB·rad^2/Hz at an offset of 10 Hz. For a Mach-Zehnder-type atom interferometer with a free-fall time of T = 100 ms, we estimate a root-mean-squared phase noise of 4.8 mrad—corresponding to a sensitivity of 3×10^{-9} g per shot in a quantum gravimeter.

Keyword-1

Microwave Synthesis

Keyword-2

Radio Frequency Electronics

Keyword-3

Laser Cooling

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