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Pseudo-single beam FM spectroscopy for fast, minimally destructive, high SNR detection of Bose-Einstein condensates[1] CHAD FERTIG, MARY LOCKE, KEN KANSKY, University of Georgia, Department of Physics and Astronomy — Frequency modulation spectroscopy (FMS) is a sensitive method of detecting dilute atomic gases. In FMS, the refractive index of an atomic cloud is sensed by an interferometric measurement of the differential phase shift between upper and lower sidebands of a frequency modulated probe laser. In the standard configuration, the probe beam's carrier component acts as both phase reference and amplifier—the electronic beat signal being proportional to $\sqrt{I_{\text{carrier}}}$. This creates a dilemma for using FMS for minimally destructive measurements: a brighter carrier produces a larger signal, but at the cost of greater spontaneous heating. We have developed a new method of FMS which solves the dilemma with an optical analog of a PLL FM-radio receiver. We extract the atomic density information encoded in the probe sidebands by beating the probe against a separately synthesized "local-oscillator" (LO) laser that is optically phase-locked to the probe's carrier component. Here, we report a demonstration of this scheme using an optical cavity as a stable, tunable, stand-in for cold atoms.

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