The application of atom lasers to precision measurement

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Abstract

Atom interferometry with laser cooled atoms has been shown to be a competitive platform for inertial sensors and as a testbed for fundamental measurements. Using laser cooled atoms offers two advantages over hot thermal beams: a smaller velocity width, and hence higher beam-splitting efficiency, and a more compact apparatus for the same enclosed area. In this seminar we will look at using BEC and atom lasers as a source for matter wave interferometry. We will first give an overview of our research into atom laser output couplers [[1]], and discuss our work on pumping [[2]]. With an M^2 value of 1.4 and an instantaneous flux of 10^7 atoms/s in a pure $m_F = 0$ beam, a freely falling atom laser looks to be a good candidate for atom interferometry. In addition to having a narrower velocity width than a laser cooled source, atom lasers offer the possibility of quadrature squeezing as a path to improved signal to noise in a measurement. We will discuss two prototype 'clock state' systems running in our labs. A free space interferometer operating at the projection noise limit with 10^4 atoms [[3]] and a trapped atom system currently limited to a factor of 2.5 off the projection noise limit with 10^6 condensate atoms. I will discuss the technical and fundamental noise sources that limit our current systems, and outline our solutions to these problems.

Keywords: atomlaser, interferometry

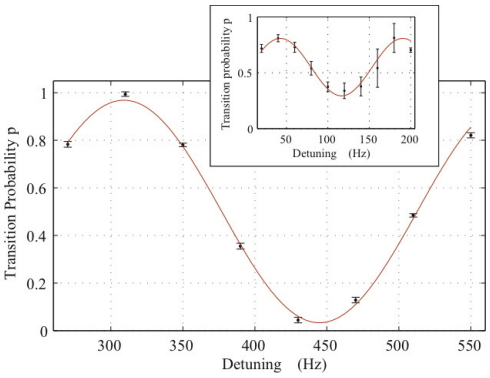

Figure 1: Noise measurement on a Ramsey fringe. The graph illustrates a significant improvement in signal-to-noise as compared to the data in our previous work, Opt. Express **17**, 20661 (2009) (see inset).

References

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