A T-cubed atom interferometer

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We have been working on a novel atom interferometer whose phase scales as T cubed, where T is the time between the light pulses that form the atom optics of the interferometer. Implementation of this interferometer requires that the atoms move in a linear potential. However, different from a standard Kasevich-Chu interferometer, the linear potential must change with the state of the atom in order to see the T-cubed scaling. We use an appropriately tailored magnetic field to generate this linear potential. I will discuss details of the techniques we use to image the magnetic field, using Raman and Ramsey spectroscopy. I will next discuss our techniques to measure Raman and Ramsey spectra in a magnetic field that varies linearly with position, which includes applying a chirp to the laser system providing the Raman fields. The spectra are produced and displayed as 2D images, and the analysis requires a de-skewing algorithm. Our preliminary measurements on a full atom interferometer showed oscillations that indeed scale as T-cubed, but subsequent measurements showed that the oscillations may not be the effect we seek. I will discuss the interplay of the gradient applied in the direction of the atoms' velocity and the gradient in the orthogonal directions, as dictated by Maxwell's equations. The talk will end with a mystery.