Large Area Cold Atom Gyroscope

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Gyroscopes serve as principal sensors for inertial navigation and are precise tools for geodesic and geophysical measurements and also for testing laws of fundamental physics. Our experiment aims at pushing performance of a cold atom gyroscope on ground. The atom interferometer consists of Cs atoms which are launched vertically upwards from a magneto-optical trap and coherently seperated using two-photon Raman transitions. We achieve a 4-pulse atom interferometer, which consists of a double Mach-Zehnder interferometer in a folded structure. Following the Sagnac effect, the sensitivity of the interferometer to a rotation rate is proportional to the area enclosed by the separation of the atom wave packets. The experimental device is designed to obtain a maximum interferometric area of 11 cm^2 and correspondingly, the sensitivity will scale as this area. We have obtained a preliminary sensitivity to rotation of 2.7×10^{-7} rad $s^{-1}/\sqrt{Hz}$ with a 480 ms long 4 laser-pulse interferometer and an area of 2.5 cm^2, which represents the biggest physical area for a cold atom interferometric area, yet. Moreover, we demonstrate a long term sensitivity of 5.5×10^{-9} rad s^{-1} at 3000 s integration time. This sensitivity level is limited by parasitic vibration noise and I will present the techniques we have implemented to go beyond that limit.

The design of the device also allows us to modify the launching procedure of the atoms so we can perform measurements with no dead-time. Since, the experimental setup is similar to a fountain clock structure; we did a preliminary comparison of the results using the experimental apparatus as a fountain clock, with and without dead-time. I will present the results and the corresponding improvement in sensitivity in no dead time mode. Further on, performing no dead time measurement in atom interferometry will be a significant step forward and it will be very useful for inertial navigation.