

Cooling and Trapping of Atoms in an Optical Ring Potential for the Application of Sagnac Atom Interferometry

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Sagnac atom interferometry provides a method for accurate and precise measurements of rotation. This is done by coherently splitting a population of cold atoms such that they travel through two separate paths, enclosing some area. Interference of the matter waves produced by any path difference generates fringes when the atoms are recombined. Rotation of the system, in the plane of the enclosed area, will introduce a phase difference between the two paths through the Sagnac effect, which can be measured from the interference fringes and the rotation rate of the system can be inferred [1].

While it is common to perform atom interferometry on atoms in free fall, enclosing large areas requires large drop towers for the atoms to fall through [2]. An alternative approach is to trap the atoms in some atomic waveguide. This allows for the atoms to maintain a fixed path and the atoms can be looped several times before they are recombined resulting in a large effective area while maintaining a more compact system.

It is possible to produce a tailored atomic waveguide for Sagnac atom interferometry with Fresnel Zone Plates (FZPs). These work by spatially altering the phase of the incoming light such that the light will interfere to produce an arbitrary pattern in a specific plane of focus. Careful design of the FZP can therefore produce a focussed toroidal shape, within a plane, in which it is possible to optically trap atoms [3].

Using such a FZP we have been able to load and trap cold rubidium atoms within a toroidal potential with the aim of performing Sagnac atom interferometry on atoms within the waveguide. My poster will discuss the progress of this experiment as well as our next steps on performing atom interferometry.

[1] B. Barrett *et al.*, *C. R. Physique* **15** 10 (2014).

[2] R. Gautier *et al.*, *Science Advances* **8** 23 (2022).

[3] V. A. Henderson *et al.*, *New J. Phys.* **18** 025007 (2016).

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