Development of an atom interferometer for testing atom neutrality

M. Bordoux, J. Alibert, B. Décamps, B. Allard and A. Gauguet

Laboratoire Collisions Agrégats Réactivité
IRSAMC
Université de Toulouse, CNRS, UPS, Toulouse, France
e-mail: bordoux@irsamc.ups-tlse.fr

Atom interferometers are of great interest for metrological applications such as gravimeters and gyrometers, they are also used to make competitive measurements of fundamental constants such as the fine structure constant or the Newtonian gravity constant. Some of those measurements require a macroscopic separation between the interferometric paths, which can only be performed with large momentum transfer (LMT) that will be used in our group to achieve a test of the atom neutrality.

In this poster, I will present the development of an atom interferometer based on a Mach-Zehnder geometry. It will consist in a series of three diffracting Bragg pulses that act on both arms of the interferometer. A first π/2 pulse acting as a beam splitter, creates two coherent paths. To reach cm-scale spatial separation between the two arms, accelerating π-pulses are applied to only one of the interferometer arm. Then atoms are decelerated with another π-pulses sequence just before the central mirror pulse, finally the symmetric sequence is applied to recombine the two paths.

Our laser setup is based on the frequency doubling of a laser at 1560 nm that produces 2 W at 780 nm. It is essential to know the contribution of the laser phase noise produced by the multi-pulses sequence to the total interferometer phase noise. Therefore, a study of the phase fluctuations will be presented through an analytical model using the formalism of the sensitivity function applied to the LMT sequence.

A large spatial separation between the two arms will allow setting a pair of electrodes on atoms trajectories, and then to exploit the scalar Aharanov-Bohm effect to test the atom neutrality beyond state of the art. Systematic effects limiting the target sensitivity will be discussed.

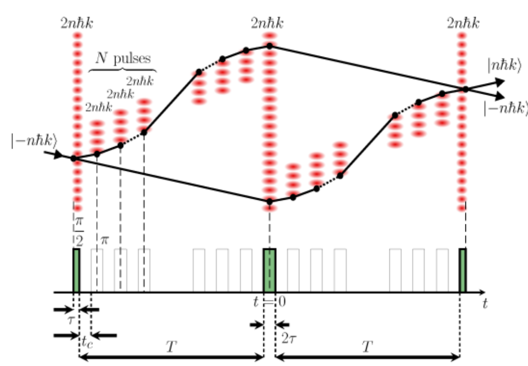

Figure1: Large momentum transfer interferometric sequence.

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