Final Year Project

An optical elevator for ultracold gas

The objective of this internship will be to design and realize an optical elevator for an ultracold atomic gas. The gas is initially trapped into an optical standing wave, made of two counter propagating laser fields at the same optical frequency. Then, one or both optical frequencies are changed such that their difference $\Delta\omega$ is none zero. In this situation, the standing wave is moving at a velocity $c\Delta\omega/2\omega$, and could drag the atoms at the same speed. The change of the laser frequency has to be smooth enough such that the atoms are following adiabatically the moving standing wave. The condition of this adiabatic following will be derived during the internship. Moreover, the total displacement of the atoms has to be known at an interferometric level, i.e. better than the laser wavelength. To do so, a Michelson-like interferometer will be inserted into the setup to keep track of the relative phase variation of the counter propagating laser.
Then, this system will be used to create two atomic cloud with precise separation to measure local gravitational field or general relativity red shift. In future, the goal of the experiment will be to better understand the impact of proper time in quantum measurements.

Supervisor: David Wilkowski, Kwong Chang Chi