LAPHIA
Laser & Photonics
in Aquitaine

université de BORDEAUX

**Cluster of Excellence LAPHIA
Seminar**

« Laser Cooling Using Atom Interferometry »

Tim Freegarde
School of Physics & Astronomy, University of Southampton (UK)

Auditorium - Institut d'Optique d'Aquitaine - Talence
08/04/2014 from 11:45 to 12:30

Abstract : Atomic matter-wave interferometers can be used to measure gravitational, magnetic or electric fields [1]. They can also be sensitive to the atom's velocity. In such cases, the interferometer imparts a velocity-dependent impulse, which can reduce the thermal motion of each atom [2,3]. Because the atom interferometer 'beamsplitters' can be short laser pulses with broad bandwidths, this cooling process can in principle be used for atoms with complex level schemes, and perhaps molecules.

The basic atom interferometer can be enhanced by combining the 'beamsplitter' pulses with 'mirror' pulses [4]. These can increase the phase-space area of the interferometer [5,6], allowing faster cooling and reducing the dependence upon spontaneous emission. If the mirror and beamsplitter pulses are interleaved, the combination acts as a form of quantum computer, and the thermal motion is cooled by running an appropriate algorithm [7]. Fidelity can be maintained during the interferometer pulse sequence by using 'composite pulses' - a form of quantum error correction developed for NMR chemistry [8].

[1] A D Cronin, J Schmiedmayer, D E Pritchard, Rev Mod Phys 81, 1051 (2009)
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[3] A Dunning et al., Phys Rev A 90, 033608 (2014)
[4] T Freegarde, G Daniell, D Segal, Phys Rev A 73, 033409 (2006)
[5] J M McGuirk, M J Snadden, M A Kasevich, Phys Rev Lett 85, 4498 (2000)
[6] D L Butts et al., J Opt Soc Am B 30, 922 (2013)
[7] T Freegarde and D Segal, Phys Rev Lett 91, 037904 (2003)
[8] A Dunning et al., arXiv:1408.6877

Postal Address :
Cluster LAPHIA – University of Bordeaux
Institut d'Optique d'Aquitaine
Rue François Mitterrand
33405 Talence cedex - FRANCE
info.laphia@u-bordeaux.fr

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