

Abstract Submitted  
for the DAMOP11 Meeting of  
The American Physical Society

**Coherent control of atomic motion in an optical lattice for precise measurements of gravity** MARCO GIACINTO TARALLO, LENS, Università di Firenze, ANDREA ALBERTI, Universitat Bonn, NICOLA POLI, Università di Firenze, MARCO PREVEDELLI, Università di Bologna, FU-YUAN WANG, GUGLIELMO M. TINO, Università di Firenze — Coherent control of atomic motion inside an optical lattice allows precise measurement of forces by means amplitude-modulation (AM) driven resonant tunneling. We report about the recently-performed high precision measurements of gravitational acceleration using ultracold strontium atoms trapped in an AM driven vertical optical lattice.<sup>1</sup> We reached an uncertainty  $\Delta g/g \approx 10^{-7}$  by measuring at the 5<sup>th</sup> harmonic of the Bloch oscillation frequency.<sup>2</sup> We analyzed the systematic effects induced by the trapping optical lattice, such as the intensity gradient and the lattice frequency-induced shift. We accurately measured the lattice frequency by means of a fiber link with a home-made frequency comb. The value of  $g$  obtained with this microscopic quantum system is consistent with the one we measured with a classical absolute gravimeter. Short-distance measurements of gravity near dielectric surfaces are discussed. These results prospect a new way to new tests of gravity at micrometer scale.

<sup>1</sup>A. Alberti *et al.*, New J. Phys. 12, 065037 (2010).

<sup>2</sup>N. Poli *et al.*, Phys. Rev. Lett. 106, 038501 (2011).

Marco G. Tarallo  
Università di Firenze

Date submitted: 02 Feb 2011

Electronic form version 1.4