QUPLAS: towards antimatter interferometry

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QUPLAS (Quantum Interferometry with Positrons and Lasers) is an experimental initiative based on the positron beam facility of the L-NESS laboratory (Politecnico di Milano), in collaboration with INFN, the University of Milan and the University of Bern.
Using Talbot-Lau matter-wave interferometry with material diffraction gratings, QUPLAS will probe the properties of antimatter systems such as positrons (e+) and ortho-positronium (Ps), a short-lived (t=142ns) spin-triplet e+/e- bound state. The long-term goal of the experiment is to measure the gravitational acceleration of Ps using Talbot-Lau based inertial sensing. As a WEP test on a purely leptonic, matter/antimatter symmetric system, this would be complementary to the efforts on antihydrogen gravity currently ongoing at CERN.
The current phase of the experiment foresees the detection of matter-wave interference of positrons in the 10-20 keV energy range. To this end we are operating a Talbot-Lau interferometer in a novel period-magnifying configuration using micrometric silicon nitride diffraction gratings, coupled to a high-resolution nuclear emulsion detector [3] capable of directly revealing the micrometric interference pattern. In my talk I will cover the theoretical foundations [1,2], our recent experimental demonstration of the detector performance [4], and report promising updates on positron interferometry.

[1] - S. Sala et al. - J. Phys. B, 48:195002, 2015.
[2] - S. Sala et al. - Phys. Rev. A, 94:033625, 2016.
[3] - S. Aghion et al. - JINST, 11(06):P06017, 2016.
[4] - S. Aghion et al. - JINST, 13(05):P05013, 2018.