Antimatter wave interferometry. First observation

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Interference of matter waves is at the heart of quantum physics and has been observed for a wide range of particles from electrons [1,2] to complex molecules [3]. In this work will be demonstrated matter wave interference of single positrons using a period-magnifying Talbot-Lau interferometer [4]. The system produced high contrast periodic fringes (see an example in Fig. 1), which were detected by means of nuclear emulsions capable of determining the impact point of each individual positron with submicrometric resolution. The measured energy dependence of fringe contrast in the range of 8 to 16 keV proves the quantum-mechanical origin of the periodic pattern and excludes classical projective effects, providing the first observation to date of antimatter wave interference. Some of the future applications of this interferometric technique will be illustrated, including decoherence studies and measurement of the gravitational acceleration of neutral antimatter systems that take advantage of the inertial detection capabilities of Talbot-Lau interferometry.

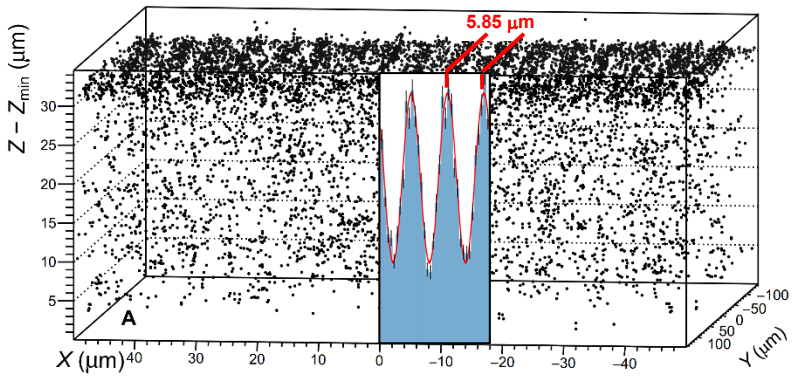

Figure 1 *Three-dimensional distribution of the reconstructed clusters limited to a 100-mm-wide region along X. A hint of the periodic fringes is even appreciable by visual inspection. The inset shows a histogram of the experimental points and a sinusoidal fit for the highest contrast view (error bars represent poissonian counting uncertainties).*

References

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*QUPLAS: QUantum interferometry and gravity with Positrons and LASers
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