Physikalisches Institut
Fakultät für Mathematik und Physik
Albert-Ludwigs-Universität Freiburg

QE

Quantum Efficiency Seminar und Colloquium

ALEXANDER STIBOR

Physikalisches Institut
Universität Tübingen

Quantum optical experiments with charged matter-waves

In the history of quantum optics most interference experiments have been performed with neutral particles or pointlike electrons. The advantage of neutral atoms and molecules is the possibility to manipulate their inner structure, e.g. with lasers or by thermic excitation. The benefit of electrons is their easy manipulation and detection. Both characteristics can be combined by performing interferometry experiments with ions and charged molecules. We present new developments and potential applications for the first ion interferometer realized by Hasselbach et al. [1]. Helium or hydrogen ions are thereby field emitted from a novel single atom tip. They are separated and combined by an electrostatic biprism. We propose quantum optical experiments with such a setup in connection with the ion structure dependency in the magnetic and the first direct proof of the electrostatic Aharonov-Bohm effect.

We additionally describe new capabilities for an experiment where electron wave decoherence is observed in a biprism interferometer in the vicinity of a semiconducting plate [2]. A coherent electron beam is separated by a biprism wire and guided a few micrometers above a silicon waver before the partial waves are combined and interfered. The separated electron states gain 'which-path' information, when the electron waves image charges suffer dissipation and are weakly localized at the surface of the semiconductor. It can be clearly observed, that the interference contrast decreases with smaller beam distances towards the surface. We describe efforts to replace the silicon waver by a gold and a superconducting plate at various temperatures to measure the electronic interaction and decoherence above such surfaces.

References

[1] F. Hasselbach, U. Maier, Quantum Coherence and Decoherence: Proc. ISQM- Tokyo '98, ed. by Y.A. Ono, K. Fujikawa (Elsevier, Amsterdam, 1999), p. 299

[2] P. Sonnentag and F. Hasselbach, Phys. Rev. Lett. 98, 200402 (2007)

Date: **Tuesday, June 18th, 2013 16:15**
Location: **Lecture Hall 1, Hermann-Herder-Str. 3, Freiburg**

Contact: Andreas Buchleitner, Institute of Physics, Quantum Optics and Statistics
T +49 761 203 5821 F +49 761 203 5967 E buchleitner_office@physik.uni-freiburg.de
www.physik.uni-freiburg.de