Condensed matter theory

Prof. Baruch Horovitz, (Physics)

Interference in presence of dissipative environments

The research studies quantum systems that are affected in a fundamental manner by dissipative environments. The experimentally relevant systems are of two types: (i) Solid state devices probed by electron transport in confined geometries such as rings, quantum dots and wires. These are controlled by gate electrodes that form inevitably a dissipative environment. (ii) Cold atoms and ions as well as condensates trapped by electric or magnetic fields created by surface currents on a chip. These chips necessarily generate noise that limits the visibility of quantum interference of the atoms or ions. E.g., Fig. 1 shows the absorption image of Rb atom cloud with its reflection from a superconducting chip [Nirrengarten et al. PRL 97, 200405 (2006)].

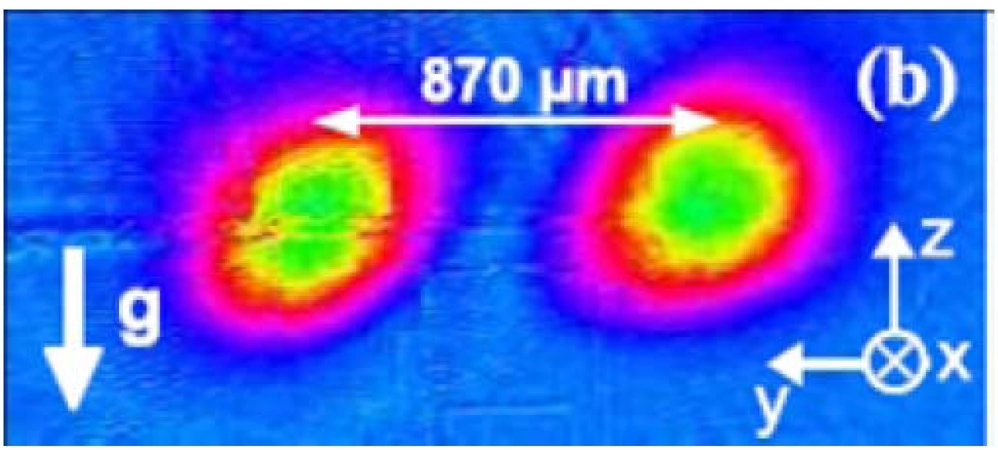

Fig 1 Absorption image of Rb atom cloud.

Our theoretical study considers a well known interference phenomena -- the Aharonov-Bohm oscillations of a particle on a ring due to a magnetic flux through the ring. The chip or gate produce noise, inducing dissipation on the particle and affecting the oscillation amplitude; the geometry is shown in Fig. 2. This connection between interference and dissipation is an essential aspect of all quantum information devices. Our system allows one to learn a variety of methods of theoretical physics, such as renormalization group and

nonequilbrium Keldysh methods, and apply these to the front edge of research on mesoscopic devices and cold atoms.