Dimensional Crossover of the Dephasing Time in Disordered Mesoscopic Rings

Oleg Yevtushenko (oleg.yevtushenko@theorie.physik.uni-muenchen.de)
Université Munich, Allemagne

We study dephasing by electron interactions in a small disordered quasi-one dimensional ring weakly coupled to leads. We use an influence functional for quantum Nyquist noise to describe the crossover for the dephasing time from diffusive or ergodic 1D to 0D behavior as temperature drops below the Thouless energy.
The crossover to 0D, predicted by Sivan, Imry and Aronov for 3D systems, has so far eluded experimental observation. The ring geometry holds promise of meeting this longstanding challenge, since the crossover manifests itself not only in the smooth part of the magnetoconductivity but also in the amplitude of Altshuler-Aronov-Spivak oscillations, which result from electron paths winding around the ring.
This observation can be exploited to filter out and eliminate contributions to dephasing from trajectories which do not wind around the ring and may tend to mask the 0D behavior. We discuss in detail contributions of different Cooperons and propose an experimental setup where the crossover to 0D can be finally observed.

M. Treiber, O.M. Yevtushenko, F. Marquardt, J. von Delft, and
I.V. Lerner: Phys. Rev. B 80, 201305(R) (2009) and arXiv:1001.0479