Anomalous diffusion of Dirac fermions

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List of Publications

- *Counting statistics of coherent population trapping in quantum dots*, C. W. Groth, B. Michaelis, C. W. J. Beenakker, Phys. Rev. B **74**, 125315 (2006).
- *Electronic shot noise in fractal conductors*, C. W. Groth, J. Tworzydło, C. W. J. Beenakker, Phys. Rev. Lett. **100**, 176804 (2008) [Chapter 2].
- *Finite difference method for transport properties of massless Dirac fermions*, J. Tworzydło, C. W. Groth, C. W. J. Beenakker, Phys. Rev. B **78**, 235438 (2008) [Chapter 4].
- *Nonalgebraic length dependence of transmission through a chain of barriers with a Lévy spacing distribution*, C. W. J. Beenakker, C. W. Groth, A. R. Akhmerov, Phys. Rev. B **79**, 024204 (2009) [Chapter 3].
- *Switching of electrical current by spin precession in the first Landau level of an inverted-gap semiconductor*, A. R. Akhmerov, C. W. Groth, J. Tworzydło, C. W. J. Beenakker, Phys. Rev. B **80**, 195320 (2009) [Chapter 5].
- *Theory of the topological Anderson insulator*, C. W. Groth, M. Wimmer, A. R. Akhmerov, J. Tworzydło, C. W. J. Beenakker, Phys. Rev. Lett. **103**, 196805 (2009) [Chapter 6].

Curriculum Vitæ

I was born in Gdynia on the Polish Baltic coast on the 15th of December 1980. In 1990 my family moved to Kulmbach in Germany, where I received the remaining primary and secondary education. During school years I attended the science competition *Jugend forscht* six times, winning five times on regional level. In 2001 my project *Fluid simulation for computer graphics* won the second prize on national level. After finishing school in the same year, I worked for ten months in a boarding school for mentally disabled children as my compulsory community service.

In 2002 I enrolled at the University of Bayreuth for a German *Diplom* degree in physics. Having passed the intermediate exams after four semesters, I was granted a scholarship of *Cusanuswerk*. In 2005 I moved to the Netherlands to continue my studies at Leiden University, and obtained there in 2007 a master's degree in theoretical physics with a thesis entitled *Counting statistics of coherent population trapping in quantum dots* supervised by prof. C. W. J. Beenakker. After graduation I stayed in the group of prof. Beenakker employed by *Stichting FOM* to pursue the research which is documented in this thesis.

During my studies in Germany I taught exercise classes in Quantum Mechanics I. In Leiden I taught the exercise classes in Computational Physics and Electromagnetism II. I have attended two summer schools and represented my work at a number of conferences.

Stellingen

behorende bij het proefschrift

Anomalous diffusion of Dirac fermions

1. Our finding that diffusion and subdiffusion have the same Fano factor can explain the carrier-density independent measurements of DiCarlo et al.

   L. DiCarlo, J. R. Williams, Y. Zhang,
   D. T. McClure, and C. M. Marcus,
   Phys. Rev. Lett. **100**, 156801 (2008);
   This thesis, Chapter 2.

2. The strong effects of correlations found in a one-dimensional Lévy glass persist in higher dimensions.

   This thesis, Chapter 3.

3. A Lévy walk with characteristic exponent α has a transmission probability over a length L which decays as $L^{1-\alpha}$ for $1 < \alpha < 2$ and is length-independent for $0 < \alpha < 1$.

4. Inverted-gap semiconductors are ideally suited to realize the Datta-Das transistor.

   This thesis, Chapter 5.

5. The name "topological Anderson insulator" is a misnomer.

   This thesis, Chapter 6.

6. In chiral p-wave superconductors, the tricritical point at the intersection of the metal-insulator and insulator-insulator phase boundaries is repulsive.

   M. V. Medvedyeva, J. Tworzydło, and C. W. J. Beenakker,
   Phys. Rev. B **81**, 214203 (2010).

7. Inclusion of a vector potential in the discretized single-valley Dirac equation breaks gauge invariance.

8. The fact that modern travel is superdiffusive hinders the confinement of epidemics.

   D. Brockmann, L. Hufnagel, and T. Geisel,
   Nature **439**, 462 (2006).

9. The freedom to modify (and therefore to study, fix, and improve) the things one owns is increasingly endangered.

Christoph Groth,
November 2010