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Dirac and Majorana edge states in graphene and topological superconductors

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List of Publications

1. *Universal temperature dependence of the conductivity of a strongly disordered granular metal*, A. R. Akhmerov and A. S. Ioselevich, JETP Letters **83**, 251 (2006).
2. *Pseudo-diffusive conduction at the Dirac point of a normal-superconductor junction in graphene*, A. R. Akhmerov and C. W. J. Beenakker, Phys. Rev. B **75**, 045426 (2007).
3. *Detection of valley polarization in graphene by a superconducting contact*, A. R. Akhmerov and C. W. J. Beenakker, Phys. Rev. Lett. **98**, 157003 (2007) [Chapter 3].
4. *Valley-isospin dependence of the quantum Hall effect in a graphene p-n junction*, J. Tworzydło, I. Snyman, A. R. Akhmerov, and C. W. J. Beenakker, Phys. Rev. B **76**, 035411 (2007).
5. *Correspondence between Andreev reflection and Klein tunneling in bipolar graphene*, C. W. J. Beenakker, A. R. Akhmerov, P. Recher, and J. Tworzydło, Phys. Rev. B **77**, 075409 (2008).
6. *Boundary conditions for Dirac fermions on a terminated honeycomb lattice*, A. R. Akhmerov and C. W. J. Beenakker, Phys. Rev. B **77**, 085423 (2008) [Chapter 2].
7. *Theory of the valley-valve effect in graphene nanoribbons*, A. R. Akhmerov, J. H. Bardarson, A. Rycerz, and C. W. J. Beenakker, Phys. Rev. B **77**, 205416 (2008) [Chapter 4].
8. *Splitting of a Cooper pair by a pair of Majorana bound states*, J. Nilsson, A. R. Akhmerov, and C. W. J. Beenakker, Phys. Rev. Lett. **101**, 120403 (2008) [Chapter 7].
9. *Nonalgebraic length dependence of transmission through a chain of barriers with a Levy spacing distribution*, C. W. J. Beenakker, C. W. Groth, and A. R. Akhmerov, Phys. Rev. B **79**, 024204 (2009).

10. *Electrically detected interferometry of Majorana fermions in a topological insulator*, A. R. Akhmerov, J. Nilsson, and C. W. J. Beenakker, Phys. Rev. Lett. **102**, 216404 (2009) [Chapter 8].
11. *Quantum Goos-Hänchen effect in graphene*, C. W. J. Beenakker, R. A. Sepkhanov, A. R. Akhmerov, and J. Tworzydło, Phys. Rev. Lett. **102**, 146804 (2009).
12. *Pseudodiffusive transmission of nodal Dirac fermions through a clean d-wave superconductor*, J. K. Asbóth, A. R. Akhmerov, A. C. Berceanu, and C. W. J. Beenakker, Phys. Rev. B **80**, 224517 (2009).
13. *Theory of the topological Anderson insulator*, C. W. Groth, M. Wimmer, A. R. Akhmerov, J. Tworzydło, and C. W. J. Beenakker, Phys. Rev. Lett. **103**, 196805 (2009).
14. *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, and C. W. J. Beenakker, Phys. Rev. B **80**, 195320 (2009).
15. *Domain wall in a chiral p-wave superconductor: a pathway for electrical current*, I. Serban, B. Béri, A. R. Akhmerov, and C. W. J. Beenakker, Phys. Rev. Lett. **104**, 147001 (2010) [Chapter 9].
16. *Theory of non-Abelian Fabry-Perot interferometry in topological insulators*, J. Nilsson and A. R. Akhmerov, Phys. Rev. B **81**, 205110 (2010) [Chapter 11].
17. *Absence of a metallic phase in charge-neutral graphene with a random gap*, J. H. Bardarson, M. V. Medvedyeva, J. Tworzydło, A. R. Akhmerov, and C. W. J. Beenakker, Phys. Rev. B **81**, 121414(R) (2010).
18. *Majorana bound states without vortices in topological superconductors with electrostatic defects*, M. Wimmer, A. R. Akhmerov, M. V. Medvedyeva, J. Tworzydło, and C. W. J. Beenakker, Phys. Rev. Lett. **105**, 046803 (2010).
19. *Flat-lens focusing of electrons on the surface of a topological insulator*, F. Hassler, A. R. Akhmerov, and C. W. J. Beenakker, Phys. Rev. B **82**, 125423 (2010).
20. *Robustness of edge states in graphene quantum dots*, M. Wimmer, A. R. Akhmerov, and F. Guinea, Phys. Rev. B **82**, 045409 (2010) [Chapter 5].
21. *Geodesic scattering by surface deformations of a topological insulator*, J. P. Dahlhaus, C.-Y. Hou, A. R. Akhmerov, and C. W. J. Beenakker, Phys. Rev. B **82**, 085312 (2010).
22. *Topological quantum computation away from the ground state with Majorana fermions*, A. R. Akhmerov, Phys. Rev. B **82**, 020509(R) (2010) [Chapter 6].
23. *Anyonic interferometry without anyons: How a flux qubit can read out a topological qubit*, F. Hassler, A. R. Akhmerov, C.-Y. Hou, and C. W. J. Beenakker, New J. Phys. **12**, 125002 (2010) [Chapter 13].

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24. *Quantized conductance at the Majorana phase transition in a disordered superconducting wire*, A. R. Akhmerov, J. P. Dahlhaus, F. Hassler, M. Wimmer, and C. W. J. Beenakker, *Phys. Rev. Lett.* **106**, 057001 (2011) [Chapter 10].
 25. *Random-matrix theory of Andreev reflection from a topological superconductor*, C. W. J. Beenakker, J. P. Dahlhaus, M. Wimmer, and A. R. Akhmerov, *Phys. Rev. B* **83**, 085413 (2011).
 26. *Effects of disorder on the transmission of nodal fermions through a d-wave superconductor*, J. K. Asbóth, A. R. Akhmerov, M. V. Medvedyeva, and C. W. J. Beenakker, *Phys. Rev. B* **83**, 134519 (2011).
 27. *Probing Majorana edge states with a flux qubit*, C.-Y. Hou, F. Hassler, A. R. Akhmerov, and J. Nilsson, submitted to *Phys. Rev. B* [Chapter 12].
 28. *Scattering formula for the topological quantum number of a disordered multi-mode wire*, I. C. Fulga, F. Hassler, A. R. Akhmerov, and C. W. J. Beenakker, *Phys. Rev. B* **83**, 155429 (2011).
 29. *Quantum point contact as a probe of a topological superconductor*, M. Wimmer, A. R. Akhmerov, J. P. Dahlhaus, and C. W. J. Beenakker, accepted to *New J. Phys.*
 30. *Majorana fermions in equilibrium and driven cold atom quantum wires*, L. Jiang, T. Kitagawa, J. Alicea, A. R. Akhmerov, D. Pekker, G. Refael, J. I. Cirac, E. Demler, M. D. Lukin, and P. Zoller, submitted to *Phys. Rev. Lett.*
 31. *Spin-triplet supercurrent carried by quantum Hall edge states through a Josephson junction*, J. A. M. van Ostaay, A. R. Akhmerov, and C. W. J. Beenakker, accepted to *Phys. Rev. B*.

Curriculum Vitæ

I was born on the 30th of December 1984 in Krasnoobsk, a small Siberian town not far from Novosibirsk. My primary and middle school was the Ecological Gymnasium 13 of Krasnoobsk. I received my secondary education in the years 1999-2001 at the boarding school specialized in physics and mathematics, affiliated with Novosibirsk State University. During these years I participated in the Russian physics olympiad, winning it twice at the national level.

After finishing high school I moved to Moscow to study physics at the Moscow Institute for Physics and Technology. My Bachelor thesis, which I finished in 2005 under supervision of prof. Alexey Ioselevich, is entitled “Universal temperature dependence of the conductivity of a strongly disordered granular metal”. My Master’s education is split equally between the Landau Institute for Theoretical Physics, where I studied for one year, and Leiden University, where I studied for another year under supervision of prof. Carlo Beenakker. The results of my master’s research are reported in my master’s thesis “Pseudo-diffusive conduction at the Dirac point of a normal-superconductor junction in graphene”. Since my graduation in the Summer of 2007 I am employed by the Foundation for Fundamental Research on Matter (FOM), as a member of the Delft–Leiden focus group on “Solid-State Quantum Information Processing”, doing doctoral studies in the group of prof. Beenakker. Part of the research I performed during these years is presented in this thesis.

During my Bachelor studies I coached the Russian team for the international physics olympiad. In Leiden I taught exercise classes in electrodynamics. I was an invited participant of the workshop “Progress in spintronics and graphene research” held in 2010 at the Kavli institute for theoretical physics in Beijing and presented my work at several international conferences.