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Hybrid Josephson junctions and their qubit applications

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Citation

Vakhtel, T. (2024, September 3). *Hybrid Josephson junctions and their qubit applications*. Retrieved from <https://hdl.handle.net/1887/4039618>

Version: Publisher's Version

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Note: To cite this publication please use the final published version (if applicable).

Curriculum Vitæ

I was born on November 24, 1997, in Kyiv, and spent a significant part of my childhood there and in Berdiansk (Ukraine). My grandmother and grandfather were both theoretical physicists, so I learned about this profession very early and have been interested in natural sciences all my life. I studied at Kyiv Natural Science Lyceum no. 145, which produced many talented Ukrainian scientists. During high school, I attended lectures at the Bogoliubov Institute for Theoretical Physics on various math and physics subjects. These lectures and exceptionally positive experiences at the lyceum convinced me to pursue physics as a career.

In 2014, I enrolled in the Quantum Field Theory Bachelor programme at the National University of Kyiv. The programme was mainly focused on the quantum field theory applications to high-energy physics, but after the Higgs boson discovery in 2012 and the subsequent absence of further discoveries, I became interested in condensed matter physics. After defending the Bachelor's thesis under the supervision of Prof. Vadim Cheianov, I continued my studies as a Master's student at the Lorentz Institute for theoretical physics of Leiden University. During the programme, I also took math and physics courses at various institutions nationwide, such as the University of Amsterdam, Utrecht University, and the Technical University of Delft. I graduated in 2020 with a Master's thesis on thermalization in integrable field theories under the supervision of Prof. Koenraad Schalm.

In September 2020, I started my PhD in mesoscopic physics under the supervision of Prof. Carlo Beenakker. The lectures at TU Delft and the University of Amsterdam sparked my interest in experiments, so I also joined the laboratory of Prof. Leo Kouwenhoven in Delft as a guest theorist, where Dr. Bernard van Heck became my second supervisor. The main subjects of my research were circuit QED, quantum transport in 2D materials and hybrid Josephson junctions. I also performed a beamline experiment with Dr. Gesa Welker at a low-energy muon facility at the Paul

Scherrer Institute in Switzerland. In the last two years of my PhD, I spent 4 months in Grenoble (France), working with Prof. Nicolas Roch and Prof. Denis Basko on superconducting circuits and many-body localization. I also presented my research at various international conferences and during group visits in France, Spain and Switzerland.

After finishing my PhD, I'm excited to continue my path as a postdoc in Dr. Maximilian Rimbach-Russ' group in Delft, studying semiconductor spin qubits.

List of Publications

- [1] Philippe Sabella-Garnier, Koenraad Schalm, Tereza Vakhtel, Jan Zaanen, *Thermalization/Relaxation in integrable and free field theories: an Operator Thermalization Hypothesis*, arXiv:1906.02597 2019.
- [2] T. Vakhtel, D. O. Oriekhov, C. W. J. Beenakker, *Bloch oscillations in the magnetoconductance of twisted bilayer graphene*, Phys. Rev. B **105**, L241408 (2022) [Chapter 5].
- [3] D. O. Oriekhov, T. T. Osterholt, T. Vakhtel, A. R. Akhmerov, and C. W. J. Beenakker, *Breathing mode in open-orbit magnetotransport: a magnetic lens with a quantum mechanical focal length*, Phys. Rev. B **106**, 235413 (2022) [Chapter 6].
- [4] Tereza Vakhtel and Bernard van Heck, *Quantum phase slips in a resonant Josephson junction*, Phys. Rev. B **107**, 195405 (2023) [Chapter 2].
- [5] C. W. J. Beenakker and T. Vakhtel, *Phase-shifted Andreev levels in an altermagnet Josephson junction*, Phys. Rev. B **107**, 075425 (2023) [Chapter 4].
- [6] T. Vakhtel, P. D. Kurilovich, M. Pita-Vidal, A. Bargerbos, V. Fatemi, B. van Heck, *Tunneling of fluxons via a Josephson resonant level*, Phys. Rev. B **110**, 045404 (2024) [Chapter 3].
- [7] W. Ardati, S. Léger, S. Kumar, V. N. Suresh, D. Nicolas, C. Mori, F. D'Esposito, T. Vakhtel, O. Buisson, Q. Ficheux, N. Roch, *Using bi-fluxon tunneling to protect the Fluxonium qubit*, arXiv:2402.04495 (2024).