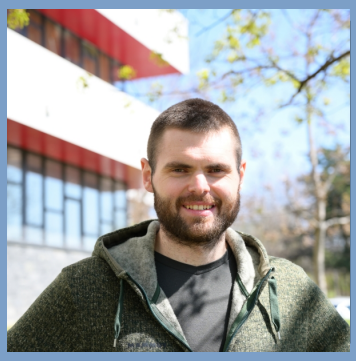


FRANTIŠEK HERMAN

Faculty of Mathematics,
Physics and Informatics
Comenius University

Project number
3257/02/01

Project duration
3/2022 - 9/2025

"My original motivation to apply for the SASPRO2 fellowship was to secure the best possible conditions for my research as I was arriving from my postdoc stay at ETH Zurich.
I am very pleased of the overall very professional, efficient and understandable attitude of the SASPRO2 administrators during the application and negotiation periods. I believe, that SASPRO2 fellowship will help me to establish operational science group within the Comenius University, which is currently my hosting institution."

BIOGRAPHY

CURRENT POSITION:
2020 – 2025 Assistant professor - teaching assistant, Department of Experimental Physics/ Faculty of Mathematics, Physics and Informatics, Comenius University in Bratislava, Slovakia

PREVIOUS POSITION:
2017 – 2020 Postdoc, Department of Physics, ETH Zurich, Switzerland

"Projects related to my Ph.D. study (Dynes superconductivity) are based on the suitable formulation of a Green function describing Dynes superconductors. My most important contribution was constructing the CPA (Coherent Potential Approximation) equations in a suitable form and successfully solving them. In the projects focused on Graphene quantum dot-like systems, I came up with the idea to match theory and experiment. The last published paper reports the results of the master student J. Bucko. I was supervising the project. I came up with the original idea to treat the large twisting angles between quantum dots by reducing the Fermi velocity."

PROJECT SUMMARY

The Augmented Physical Properties of the Dynes Superconductor

The well-knit theory of the Dynes superconductor has been introduced recently at the Comenius University in Bratislava. This elegant BCS generalization formulated within Green's function approach focuses on the role of the disorder in a superconductive state. It shows to be worthy of attention from the theoretical as well as experimental point of view. Naturally, the rising number of its successful implementations within other projects is encouraging towards its further augmentations. Presented fellowship application planned for three years of my research activity elaborates on the further development of the physics captured by the Dynes superconductor theory in four main directions:

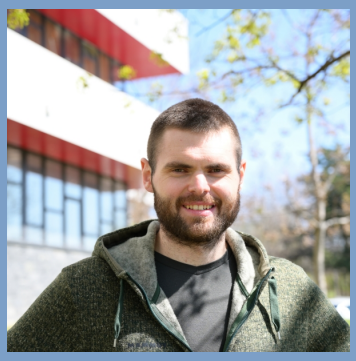
A) Analyze its implications towards experimentally used superconductive devices to understand better their energy losses (i.e. making them more efficient).

B) Study the role of the pair-breaking disorder close to the quantum critical point of the superconductor-normal metal (insulator) transition.

C) Investigate the Gaussian fluctuations in the presence of pair-breaking scattering processes.

D) Examine the spectroscopic peculiarities beyond the Dynes superconductor. I plan to provide a detailed analysis of the scanning tunneling microscopy measurements beyond the capability to read out the spectroscopic gap and pair-breaking scattering rate related to Dynes superconductor.

These items create an opportunity to discover new properties of the Dynes superconductor theory and therefore are crucial for its development.



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PUBLICATIONS

1. J. Bucko and **F. Herman,**
   Large twisting angles in Bilayer graphene Moire quantum dot structures, Phys. Rev. B 103, 075116 (2021),
   preprint arXiv:2101.11698

2. M. Eich, **F. Herman**, R. Pisoni, H. Overweg, A. Kurzmann, Y. Lee, P. Rickhaus, K. Watanabe, T. Taniguchi, M. Sigrist, T. Ihn and K. Ensslin,
   Spin and Valley States in Gate-Defined Bilayer Graphene Quantum Dots,
   Phys. Rev. X 8, 031023 (2018),
   preprint arXiv:1803.02923

3. **F. Herman** and R. Hlubina,
   Thermodynamic properties of the Dynes superconductors,
   Phys. Rev. B 97, 014517 (2018),
   preprint arXiv:1710.03465

4. **F. Herman** and R. Hlubina,
   Electromagnetic properties of impure superconductors with pair-breaking processes,
   Phys. Rev. B 96, 014509 (2017),
   preprint arXiv:1705.04674

5. **F. Herman** and R. Hlubina,
   Microscopic interpretation of the Dynes formula for the tunneling density of states,
   Phys. Rev. B 94, 144508 (2016),
   preprint arXiv:1606.02983

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 945478.