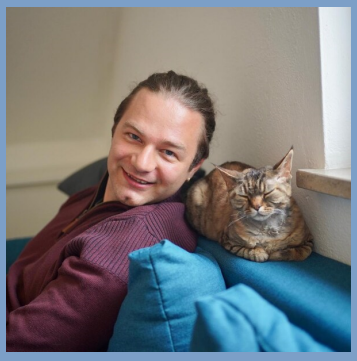


MARKO MILIVOJEVIC

Institute of Informatics
Slovak Academy of Sciences

Project number
1247/02/01

Project duration
9/2022 - 8/2025

"The SASPRO2 Programme represents an excellent opportunity for pursuing independent research topics, simultaneously developing new expertise in correlated electronic structure methods and largest-scale distributed computing. Additional benefits lie in soft skills acquired, including project management and proposal writing. I plan to continue the applications for external research funding in Bratislava, work hard on building my professional research network, and further increase my visibility and recognition in the field of spintronics. The SASPRO2 project will considerably enhance my chances for a permanent position and the possibility to form my research group in Europe or overseas."

S A S P R O 2

BIOGRAPHY

Marko Milivojević received his Ph.D. degree in physics from the University of Belgrade, Serbia, in 2019. His research focuses on the various effects of spin-orbit coupling in semiconductor physics, including quantum dots, nanotubes, and novel two-dimensional materials and their heterostructures. The potential application of these research topics is in the field of quantum computing and spintronics, where spin is used as a carrier of information.

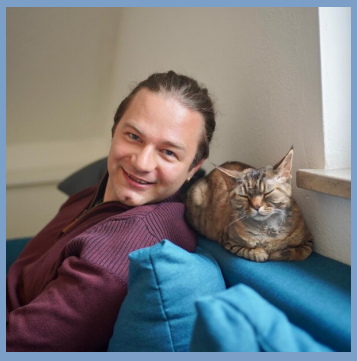
PROJECT SUMMARY

Manipulation of spin properties in 2D materials

Recently, layered two-dimensional (2D) semiconducting materials have attracted a lot of attention due to their extraordinary electronic properties, representing the currently most active field of materials science research. We propose to focus on the computer design of spintronics properties of 2D materials via van der Waals proximity effects (vdW-PE) and application of strain. vdW-PE in 2D have already demonstrated the ability to modify/induce electronic, optical, magnetic, and spin properties. For example, a ferromagnet in proximity to nonmagnetic graphene can make graphene magnetic or a strong spin-orbit (SO) coupling material, such as WSe2, can induce giant SO coupling into another 2D material, without destroying its essential electronic properties.

Besides the vdW-PE, the application of strain can also lead to modification of the electronic and SO properties of the material. It has been shown that in carbon nanotubes strain can significantly alter SO effects in electrons and holes, motivating by analogy the search for 2D materials that can be modulated by strain. For example, a sizable direct semiconducting gap and high carrier mobility make phosphorene very promising for replacing gapless graphene in future electronics. However, weak SO coupling does not make it useful for spintronics applications.

Using sophisticated simulation techniques, we propose to study strain and vdW-PE effects in different 2D materials with the quest to enhance their spin-dependent properties. The project builds on strong applicant/host expertise complementarity and strong national and international collaborations. While computational, the project has strong links to experiments via international collaborations. In the short term, the project is expected to generate cutting-edge publications which in longer-term will be useful for integrating the designed 2D materials into spintronics circuits with novel transport, spin relaxation, and spin manipulation effects.



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PUBLICATIONS

Marko Milivojević
Electrical control of the hole spin qubit in Si and Ge nanowire quantum dots
Phys. Rev. B 104, 235304 (2021)
https://doi.org/10.1103/PhysRevB.104.235304

Pavle Stipsić and Marko Milivojević
Control of a spin qubit in a lateral GaAs quantum dot based on symmetry of gating potential
Phys. Rev. B 101, 165302 (2020)
https://doi.org/10.1103/PhysRevB.101.165302

Suzana Miladić, Pavle Stipsić, Edib Dobardžić, and Marko Milivojević
Electrical control of a spin qubit in InSb nanowire quantum dots: Strongly suppressed spin relaxation in high magnetic field
Phys. Rev. B 101, 155307 (2020)
https://doi.org/10.1103/PhysRevB.101.155307

Marko Milivojević, Saša Dmitrović, Milan Damnjanović, and Tatjana Vuković
Spin–Orbit Effects in MoS2 Nanotubes
J. Phys. Chem. C 124, 11141–11149 (2020)
https://doi.org/10.1021/acs.jpcc.0c00929

Marko Milivojević
Symmetric spin–orbit interaction in triple quantum dot and minimisation of spin–orbit leakage in CNOT gate
J. Phys.: Condens. Matter 30, 085302 (2018)
https://doi.org/10.1088/1361-648X/aaa736

https://orcid.org/0000-0002-9583-3640

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