Sonderforschungsbereich 1277

Emergent Relativistic Effects in Condensed Matter -
From Fundamental Aspects to Electronic Functionality

SFB – Colloquium

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Topic: Linear and nonlinear spin-orbit driven phenomena in graphene based heterostructures and topological insulators

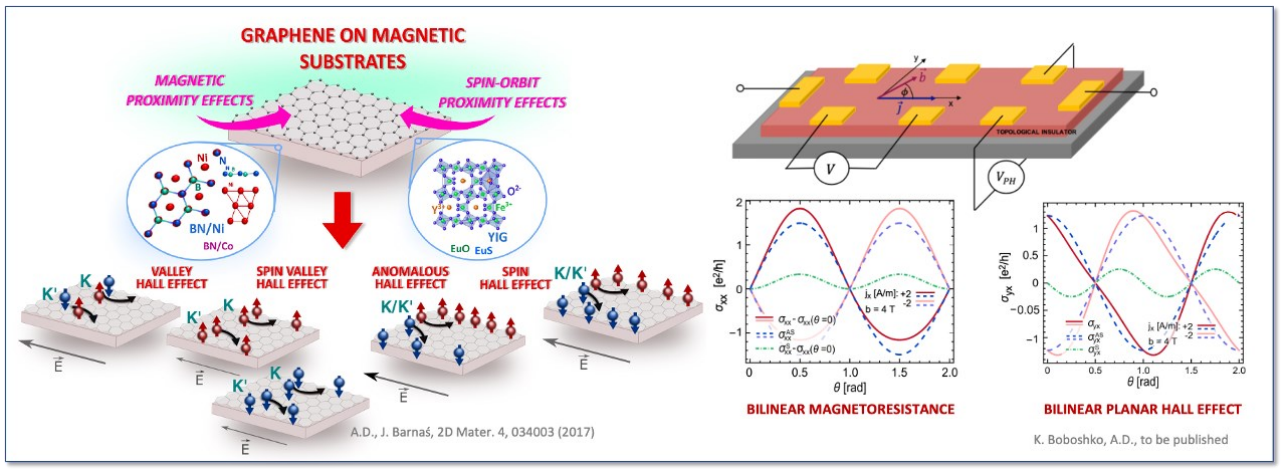
Abstract:

Spin-orbit interaction is responsible for certain states of matter, like chiral spin textures, surface spin-polarized states, and electrical control of the electron spin. Accordingly, the spin-orbit driven-phenomena, such as the spin Hall effect or the current-induced spin polarization, are crucial not only due to the fundamental aspects of solid-state physics but also because of possible applications in spintronics.

I will focus on graphene-based van-der-Waals heterostructures where one can observe not only spin polarization and Hall effects but also topological phase transitions. Next, I will provide an overview of recent studies on nonlinear magnetotransport in selected 2D systems (TIs, perovskite oxides), where the spin-orbit interaction is strong and induces sizable current-induced spin polarization and nonlinear effects (e.g., bilinear magnetoresistance and bilinear planar Hall effect). Finally, I will discuss a method that we proposed for determination of the Rashba parameter from the analysis of bilinear response in the angle-dependent magnetotransport experiments.

Host: Prof. Dr. Jaroslav Fabian

[1] A. Dyrdał, J. Barnaś, 2D Mater. 4, 034003 (2017)
[2] P. Högl, T. Frank, K. Zollner, et al., PRL 124, 136403 (2020)
[3] A. Dyrdał, J. Barnaś, A. Fert, PRL 124, 046802 (2020)
[4] D. C. Vaz, F. Trier, A. Dyrdał, et al., PRM 4, 071001(R) (2020)



Schematic of graphene-based structures and possible Hall effects (left). Schematic of angle-resolved magnetotransport measurement with an example of diagonal end transverse conductivity containing bilinear term (right).