

**Theoretical study of the magnetoresistance phenomena in 2D structures
with strong spin-orbit interaction**

The motivation for this project is the need of explaining the physical origins of the new kind of magnetoresistance phenomenon, measured experimentally very recently at the surface of topological insulators and oxides interfaces, that reveals linear response to both electric and magnetic field simultaneously. This so-called **bilinear magnetoelectric resistance** (BMR) emerging in the systems with a strong spin-orbit coupling (SOC) is a manifestation of higher order responses as well as specific properties of the systems that come from symmetry. The non-linear (with respect to the electric field) effects assisted by the spin-orbit interaction need a consistent theoretical formulation, that should take into account all possible origins (both intrinsic and extrinsic) of such system response.

Over the project duration, it is assumed to study the peculiar properties of BMR and other **unidirectional magnetoresistive phenomena** as well as some related spin and transport effects like **spin, anomalous and planar Hall effects** as well as **current-induced spin polarization**.

The main objectives might be divided by the four tasks:

- Theoretical description of BMR in selected models described by the most important effective Hamiltonians for transport modelling in spintronics: **surface states of TI, graphene-like 2D crystals and Van der Waals heterostructures, 2D gas at the interfaces** of semiconductor heterostructures and oxides perovskites.
- Theoretical description of **spin-orbit driven phenomena beyond linear-response limit**
- Identification of the **possible origins of negative magnetoresistance** in systems with spin-orbit interaction **beyond the weak localization regime**.
- Investigation of electronic and spin transport through two-dimensional layered systems and interfaces.

FORM OF EMPLOYMENT: scholarship

REMUNERATION: 1500 PLN per month

TIMELINE: 2 years, since October 2019

PROJECT INFO: <http://zfmezo.home.amu.edu.pl/Sonata14.php>

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Adam Mickiewicz University in Poznan (Poland)

QUALIFICATIONS:

- At least good academic scores from the undergraduate level
- Bachelor (or equivalent) in physics (preferably in the issues related to spintronics, electron transport in nanosystems, magnetism)
- Comfortable communication in English
- self-reliance, availability, good organisation of working time

DOCUMENTS:

- Cover Letter
- CV (info about education, publications, participation in conferences, awards, etc.)
- Reference Letter from the supervisor of Your master thesis or from the advisor of current research activities (should be send directly to PI)
- Diploma Supplement (list of courses with marks)
- Please attached to Your application the following statement:

„I agree to the processing of personal data provided in this document for realising the recruitment process pursuant to the Personal Data Protection Act of 10 May 2018 (Journal of Laws 2018, item 1000) and in agreement with Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation)”.

Applications should be sent by email to the PI (Anna Dyrdał) .