Project 4.5 Properties and interactions of group IV-VI semiconductor multiferroics (experimental)

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www: http://www.ifpan.edu.pl/ON-1/on13.html

Background:

The use of mutual interactions between electronic states and spin and orbital degrees of freedom combined with the fundamental breaking of symmetry is currently one of the most exciting research areas. This effect is the basis for the giant magnetoresistance, manipulation of magnetic domains by means of momentum momentum transfer and the use of the Rashba effect to manipulate the electron spin. These effects have also led to prominent discoveries of new quantum phases, such as topological insulators, Weyl half-metals and Majorana fermions. Materials with large Rashba splitting and with helical ferromagnetic ordering such as Ge1-xMnxTe provide extraordinary physical properties due to the coexistence and coupling between ferromagnetism and ferroelectricity in one system. Multiferroic Ge1-xMnxTe inherits from the □-GeTe ferroelectricity the gigantic Rashba splitting of three-dimensional volumetric states, which competes with Zeeman's spin-induced fission induced by magnetic exchange interactions. Through the use of strong magnetic fields, manipulation of spin textures can be shown, which is also possible for electric fields based on multiferroic coupling. The control of spin fission and blocking by using ferromagnetism and ferroelectricity opens fascinating new paths for highly multifunctional Rashba multiferroic devices adapted to reprogrammable logic and memory applications.

Aim:

PhD student will study the coupling between the ferromagnetic and ferroelectric properties of tunable multiferroic (Ge,Sn,Mn)Te system. Multiferroics, such as (Ge,Mn)Te, combine interplay between spin and orbital degrees of freedom, with fundamental breaking of symmetries. The combination of the above effects in a single material can be utilized in spin-torque manipulation of magnetic domains. The use of Rashba splitting for spin manipulation is important in view of recent outstanding discoveries of new quantum phases such as topological insulators, Weyl semimetals, and Majorana fermions. Acquired knowledge will be used to understand the spin-texture and domain wall dynamics of (Ge,Sn,Mn)Te multiferroics in view of possible applications in spintronics.

Requirements:

- high grades in core subjects at the master's level studies,
- passing courses in physics at academic level,
- knowledge of experimental techniques in condensed matter physics,
- experience in laboratory work with ferromagnetic semiconductors,
- interest in condensed matter physics, ability to work in an interdisciplinary team and learning new subjects,
- analytical thinking, diligence in work,
- computer programming skills at advanced level,
- good spoken and written English skills,
- ability to work under a pressure of time,
-high motivation for scientific work (publications, conference presentations or other achievements are highly welcome).

- Master's degree in physics (or an equivalent that qualifies one for PhD studies in physics in the country of issue).

- To be employed, the candidate must be accepted into the PhD school in which the Institute of Physics participates. Applications for the position are through recruitment to the School, online at warsaw4phd.eu.

Funding:

Scholarship: grant funding of 4500 PLN per month, before subtracting obligatory employer and employee social security contributions (~15%), for 36 months. Afterwards, standard Polish PhD scholarship (about 2100 PLN/month net in years 1-2, 3240 PLN/month net in years 3-4).

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