Ph.D. Position

Realizing spin valves in magnetic insulators

Within the collaborative research center SPIN+X (https://www.uni-kl.de/trr173) of the German science foundation we investigate the spin properties from various perspectives and by connecting several scientific disciplines. Its research encompasses the whole range of spin research spanning from microscopic properties, to emergent spin phenomena and to the coupling to the macroscopic world. This constitutes a new discipline that we refer to as Advanced Spin Engineering, which seeks to create new functionalities based on spin physics. Spin+X builds on an outstanding research infrastructure in physics and chemistry at the Technical University Kaiserslautern (TUK) and at the Johannes Gutenberg University (JGU) Mainz TUK and JGU, as well as in engineering at TUK, which are at the forefront of spin-related science and technology.

While spin transport was often considered to be accompanied by charge transport and moving electrons, it became clear in recent years that spin transport in insulating materials can offer advantages, especially with respect to energy losses and achievable transport lengths. The magnons that are responsible for the spin transport exist not only in ferromagnetic materials but also in antiferromagnets, where even higher speeds are achievable due to the stronger exchange coupling in the magnon system. In metallic systems Tunneling Magnetoresistive Devices and Giant Magneto Resistive devices exploit the charge transport that is coupled to the spin transport for their function. Complementary devices based on magnetic insulators are still missing.

The objective of the PhD will be to realize physical system based on thin magnetic insulator heterostructures that are analogous to the thin film giant magnetoresistive structure known in the metallic ferromagnetic case. For this purpose we will grow epitaxial heterostructures of oxides that posses ferro-, ferri-, or antiferromagnetic order and (de)couple them by paramagnetic interlayers. The growth will be performed by pulsed laser deposition using reflective high energy electron diffraction in situ in order to monitor the layer by layer growth on atomic/unit cell scale. With x-ray diffraction the structure of the grown system will be verified. For demonstration of the function as a spin valve we will employ in-house measurements of thermally excited spins as well as investigate the spin transport induced dynamically at ferromagnetic resonance. Within SPIN+X further investigations are planned in cooperation with colleagues at TUK, where our sample structures will enable a control of the spin transport.

The PhD education within SPIN+X will offer not only training on the science but a structured education with training on all aspects of your future career. We expect the candidate to have background knowledge in solid state physics and a master in physics. You should have an open personality in order to interact with the large and international group of scientists working in our lab (https://www.klaeui-lab.physik.uni-mainz.de/) and like doing experiments in a responsibly way.

The Johannes Gutenberg-University of Mainz (https://university.uni-mainz.de/) is one of the largest universities in Germany. With its location next to Rhine river and Frankfurt Intl. airport it is close to nature while being part of the Rhein-Main metropolitan area. The physics department z has been consistently ranked as one of the leading physics departments in Germany. In the recent 2017 Shanghai and CHE rankings it was selected for the excellence group in Europe and in 2018 Physics in Mainz was ranked #1 in Germany by the German Research Foundation. It is particularly strong in the area of condensed matter physics and houses the Collaborative Research Center Spin+X, the excellence centre TopDyn and the Max Planck Graduate Centre to support excellent PhD students.

For further details on the position and applications contact
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