CONDENSED MATTER PHYSICS SEMINAR SERIES

Asymmetric g Tensor in Low-Symmetry Two-Dimensional Hole Systems

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Zeeman coupling characterized by the g factor is a key ingredient to developing novel spin-based technologies such as quantum information protocols. In low-symmetry systems, the g factor becomes a second-rank tensor (a 3x3 matrix) that couples the spin to the magnetic field B. It has long been believed that this tensor g only affects the energy splitting in a magnetic field. We demonstrate [1] that it also encodes the direction of the axis about which the spins precess in the external field B.

Second-rank tensors characterizing materials properties such as electrical conductivity and dielectric constant are usually symmetric. In contrast, our study demonstrates that the tensor g is generally neither symmetric nor antisymmetric. Opposite off-diagonal components can differ in size by up to an order of magnitude. Consequently, the coupling of spins to the magnetic field varies drastically upon interchanging the direction of magnetic field and spin. This work extends the general concept of optical orientation to the regime of nontrivial Zeeman coupling.

[1] C. Gradl, R. Winkler et al., Phys. Rev. X 8, 021068 (2018)

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