

Making electrons in a solid twist

The spin degree of freedom of electrons in solids is as a foundation for the most fundamental properties of quantum matter. The relation of numerous properties of magnetic materials to topology and geometry of Bloch states has been intensively researched in particular in the domain of non-equilibrium response. The lecture is an educational overview of topological and geometrical concepts applied to understanding the emergence of old and new spin phenomena such as Hall effects, exchange interactions and spin dynamics out of equilibrium. A particular attention is paid to discussing the emergence of non-equilibrium orbital magnetism, demonstrating its role in mediating the spin response and spin dynamics, and explaining why orbital properties of Bloch electrons in solids have attracted such a considerable attention in the past years. The lecture is complemented by a tutorial where for simple model examples various response properties such as orbital Hall effect and spin-orbit torque will be calculated with provided for download software.