Condensed Matter Physics Seminar Series

Higher-dimensional topology and fractional states of matter in superconducting systems

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Topology is ultimately unveils the roots of the perfect quantization observed in complex systems. The 2D quantum Hall effect is the celebrated archetype. Remarkably, topology can manifest itself even in higher-dimensional spaces defined by control parameters playing the role of synthetic dimensions. However, so far, a very limited number of implementations of higher-dimensional topological systems have been proposed, a notable example being the so-called 4D quantum Hall effect. In this talk I will show that mesoscopic superconducting systems can implement higher-dimensional topology and represent a formidable platform to study a quantum system with a purely nontrivial second Chern number. I further demonstrate that the absorption intensity in microwave spectroscopy is quantized and the integer is directly related to the second Chern number. Finally, I discuss that these systems also possess a non-Abelian Berry phase or exotic topologies like tensor monopoles. Another class of nontrivial topology relates to fractional states of matter occurring in quantum Hall systems due Coulomb interactions. I will present a realisation of a fractional state of a superconducting nanostructure that manifests itself in an analogy to the fractional conductance, that can be measured experimentally in a specially engineered circuit of Josephson junctions.

Prof. Dr. Wolfgang Belzig is a theoretical physicist in the fields of condensed matter and quantum mechanics with expertise in superconductivity, magnetism, quantum measurement and quantum transport. He is the spokesperson of the Collaborative Research Centre 767 Controlled Nanosystems, author of 180 publications and organizer of 10 workshops. In 2005 he received the Walter-Schottky-Prize of the Deutsche Physikalische Gesellschaft (DPG), is an Outstanding Referee and Member of the American Physical Society (APS), and an Elected Member of the Council of the DPG.

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