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A STUDY OF TOPOLOGICAL AND SYMMETRY CLASSIFICATION FOR DENSITY WAVE SYSTEMS

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ABSTRACT

Topological and symmetry classification for density wave systems provides a powerful framework for understanding the complex phases of matter in these materials. Density waves, such as charge density waves (CDWs) and spin density waves (SDWs), involve the periodic modulation of charge or spin density within a material. Traditional classification methods rely on symmetry considerations, where the order parameter's transformation properties under symmetry operations like rotations, reflections, and time-reversal are analysedQ. However, topological classification introduces a new dimension by considering the global properties of the wave functions that cannot be captured by symmetry alone. In topological classification, the focus is on invariants that remain unchanged under continuous deformations of the system, leading to robust edge states and quantized physical properties. For density wave systems, this means that even when the symmetry of the material is low or broken, certain topological features can protect specific electronic states, giving rise to novel phases of matter. The interplay between symmetry and topology in density wave systems can lead to exotic phenomena like topological insulators, where insulating bulk properties coexist with conductive edge states. Understanding this dual classification is crucial for predicting and harnessing new electronic phases in advanced materials with potential applications in quantum computing and spintronics.