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Principles of topology in understanding and development of topological states of matter

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Abstract

By using concepts of topology in mathematics, quantum mechanics, and their synergetic development during the past few decades, condensed matter physicists have discovered new phases of matter and introduced general frameworks to classify them. The research includes a vast gamut from chemistry of atomic orbitals to material science, promising new applications in the growing technologies. This review article aims to provide a better understanding of these unprecedented electron systems and their underlying topological principles. The article consist of two parts. First, there is a historical review of using topological concepts in condensed matter systems. Then, in the second part, we elaborate on some basics of topology in quantum mechanics and the concept of topological invariants.

Keywords: geometrical and Berry phases, topology, topological materials, Chern invariant

For full article, refer to the Persian section