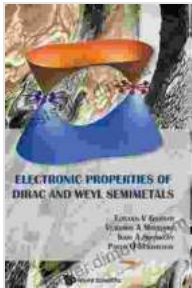


Electronic Properties of Dirac and Weyl Semimetals: A Comprehensive Guide

Unveiling the Extraordinary World of Semimetals with Novel Electronic Properties



Electronic Properties Of Dirac And Weyl Semimetals

by Igor A Shovkovy

★★★★★ 5 out of 5

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In the realm of condensed matter physics, the discovery of Dirac and Weyl semimetals has sparked a revolution in our understanding of materials and their electronic properties. These remarkable materials exhibit unique characteristics that hold immense promise for the future of electronics, spintronics, and quantum computing.

Introducing Dirac and Weyl Semimetals

Dirac and Weyl semimetals belong to a class of materials known as topological semimetals, characterized by the presence of topologically protected surface states. These surface states are responsible for the exceptional electronic properties that set Dirac and Weyl semimetals apart.

In Dirac semimetals, electron dispersion forms a cone-shaped structure, similar to the dispersion of massless Dirac fermions. This leads to extremely high carrier mobilities, making Dirac semimetals promising candidates for high-speed electronic devices.

Weyl semimetals, on the other hand, possess chiral fermions, electrons with an intrinsic spin that locks their momentum and spin together. This unique property gives rise to exotic effects such as the chiral anomaly, which allows for the generation of electric currents without the application of external magnetic fields.

Diving into the Electronic Properties

The electronic properties of Dirac and Weyl semimetals are governed by their unique band structures, which arise from the topological nature of their surface states. These materials exhibit:

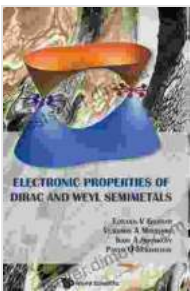
- **Linear dispersion:** The energy-momentum relationship of carriers in Dirac and Weyl semimetals is linear, resulting in high carrier mobilities and a near-zero effective mass.
- **Topological surface states:** The topologically protected surface states of these materials are characterized by a unique spin texture and conduct electricity without dissipation, leading to potential applications in low-power electronics.
- **Chiral anomaly and Berry curvature:** Weyl semimetals exhibit a chiral anomaly and a non-zero Berry curvature, which give rise to unique transport phenomena and magnetoelectric effects.

Harnessing the Potential of Dirac and Weyl Semimetals

The exceptional electronic properties of Dirac and Weyl semimetals have opened up new avenues for materials research and device development in fields such as:

- **Electronics:** The high carrier mobilities and low effective masses make Dirac and Weyl semimetals ideal for high-frequency devices, ultra-fast transistors, and energy-efficient computing.
- **Spintronics:** The spin-locked nature of chiral fermions in Weyl semimetals enables novel spintronic devices, such as spin-polarized transistors and spin-based logic.
- **Quantum computing:** The unique electronic properties of these materials have the potential to revolutionize quantum computing, opening up new possibilities for quantum algorithms.

Dirac and Weyl semimetals represent a groundbreaking class of materials with extraordinary electronic properties. Their potential for transformative applications in electronics, spintronics, and quantum computing is vast. As research in this field continues to advance, we can expect even more remarkable discoveries and innovations that will shape the future of technology.



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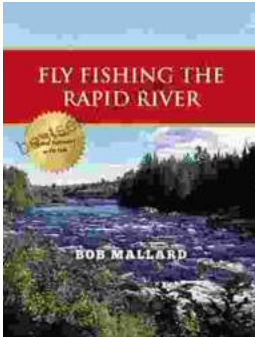
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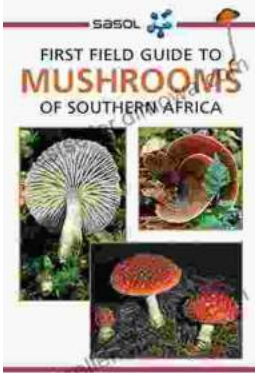
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