

Introduction to Berry Phase and Pair Production

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Understanding Berry Phase

Quantum States

The Berry phase arises from the evolution of a quantum system's wave function as it traverses a cyclic path in the parameter space.

2 Geometric Phase

This phase shift is a geometric property of the quantum system, independent of the dynamic phases, and depends on the path taken in the parameter space.

3 Applications

The Berry phase has important applications in various fields, including condensed matter physics, quantum computing, and topological materials.

Pair Production Phenomenon

Pair production is the process by which high-energy photons or particles are converted into matter in the form of an electron-positron pair. Pair production is the process by which high-energy photons or particles are converted into matter in the form of an electron-positron pair.

Particle-Antiparticle Creation

Photon

The pair production process begins with a high-energy photon, which interacts with the electric field of a nucleus or another particle.

Electron

The photon's energy is converted into the rest mass and kinetic energy of an electron-positron pair, conserving energy and momentum.

Positron

The positron, the antiparticle of the electron, is also created during the pair production process, with equal mass and opposite charge.

Implications of Pair Production

High-Energy Physics

Pair production is a fundamental process in high-energy physics, enabling the study of particle interactions and the creation of new particles.

Astrophysics and Cosmology

Pair production plays a role in various astrophysical and cosmological phenomena, such as the formation of black holes and the study of the early universe.

Medical Applications

Pair production is utilized in medical imaging techniques, such as positron emission tomography (PET), which can help diagnose and monitor various health conditions.

Conclusion

Berry Phase

A geometric phase acquired by a quantum system as it evolves in a cyclic path in parameter space, with important applications in various fields.

Pair Production

The process by which high-energy photons or particles are converted into matter in the form of an electron-positron pair, with wide-ranging implications.