Relativistic Quantum Mechanics

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1. Understand the foundational concepts of Relativistic Quantum Mechanics focusing on the Klein-Gordon equation, the Feynman-Stuckelberg interpretation of negative energy states, and the concept of antiparticles.
2. Analyze the Dirac equation in its covariant form, including the adjoint equation, plane wave solutions, and momentum space spinors.
3. Evaluate the spin and magnetic moment of the electron and recognize the non-relativistic reduction of the Dirac equation.
4. Explore the notions of helicity and chirality, investigating the properties of gamma matrices and charge conjugation.
5. Apply concepts of normalization and completeness of spinors and understand the Lorentz transformation of the Dirac equation.
6. Interpret bilinear covariants and their transformations under parity and infinitesimal Lorentz transformation.
7. Demonstrate an understanding of the Weyl representation and chirality projection operators in the context of Relativistic Quantum Mechanics.
8. Construct the conjugate momentum from Lagrange density and establish commutation relations for bosonic and anti-commutation relations for fermionic fields in terms of field and momentum or creation and annihilation operators.
9. Quantize scalar and complex scalar fields, exploring the basic ideas of field quantization.
10. Apply Feynman diagrams to analyze spinless electron - electron scattering, calculating the matrix element and scattering cross section in Relativistic Quantum Mechanics.