Arminjon, Mayeul; **Reifler, Frank**

Classical-quantum correspondence and wave packet solutions of the Dirac equation in a curved space-time. (English) Zbl 1253.81048

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Summary: The idea of wave mechanics leads naturally to assume the well-known relation $E = \hbar\omega$ in the specific form $H = \hbar W$, where H is the classical Hamiltonian of a particle and W is the dispersion relation of the sought-for wave equation. We derive the expression of H in a curved space-time with an electromagnetic field. Then we derive the Dirac equation from factorizing the polynomial dispersion equation corresponding with H.

Conversely, summarizing a recent work, we implement the geometrical optics approximation into a canonical form of the Dirac Lagrangian. Euler-Lagrange equations are thus obtained for the amplitude and phase of the wave function. From them, one is led to define a four-velocity field which obeys exactly the classical equation of motion. The complete de Broglie relations are then derived as exact equations.

MSC:

81Q05	Closed and approximate solutions to the Schrödinger, Dirac, Klein-Gordon and other equations of quantum mechanics
35Q41	Time-dependent Schrödinger equations and Dirac equations
83C10	Equations of motion in general relativity and gravitational theory
81U30	Dispersion theory, dispersion relations arising in quantum theory
81Q35	Quantum mechanics on special spaces: manifolds, fractals, graphs, lattices

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