General Relativity and Quantum Cosmology

Non-uniqueness of the Dirac theory in a curved spacetime

Mayeul Arminjon, Frank Reifler

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We summarize a recent work on the subject title. The Dirac equation in a curved spacetime depends on a field of coefficients (essentially the Dirac matrices), for which a continuum of different choices are possible. We study the conditions under which a change of the coefficient fields leads to an equivalent Hamiltonian operator H, or to an equivalent energy operator E. In this paper, we focus on the standard version of the gravitational Dirac equation, but the non-uniqueness applies also to our alternative versions. We find that the changes which lead to an equivalent operator H, or respectively to an equivalent operator E, are determined by initial data, or respectively have to make some point-dependent antihermitian matrix vanish. Thus, the vast majority of the possible coefficient changes lead neither to an equivalent operator H, nor to an equivalent operator E, whence a lack of uniqueness. We show that even the Dirac energy spectrum is not unique.

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