General Relativity and Quantum Cosmology

The stationary Weyl equation and Cosserat elasticity

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The paper deals with the Weyl equation which is the massless Dirac equation. We study the Weyl equation in the stationary setting, i.e. when the spinor field oscillates harmonically in time. We suggest a new geometric interpretation of the stationary Weyl equation, one which does not require the use of spinors, Pauli matrices or covariant differentiation. We think of our 3-dimensional space as an elastic continuum and assume that material points of this continuum can experience no displacements, only rotations. This framework is a special case of the Cosserat theory of elasticity. Rotations of material points of the space continuum are described mathematically by attaching to each geometric point an orthonormal basis which gives a field of orthonormal bases called the coframe. As the dynamical variables (unknowns) of our theory we choose the coframe and a density. We choose a particular potential energy which is conformally invariant and then incorporate time into our action in the standard Newtonian way, by subtracting kinetic energy. The main result of our paper is the theorem stating that in the stationary setting our model is equivalent to a pair of Weyl equations. The crucial element of the proof is the observation that our Lagrangian admits a factorization.

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