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Surprises in Noncommutative Dynamics

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Abstract

We present several unexpected consequences of the noncommutativity of coordinates in classical and quantum mechanics. Classically, a standard Lagrangian variational approach cannot be formulated, dynamics is quite strange, and gauge invariance is broken for a particle minimally coupled to an electromagnetic field. Quantum mechanically, the Schrödinger equation is quite nonstandard, and no configuration-space Feynman formulation exists. Integrating out the momenta in the phase-space path integral one obtains an effective Lagrangian, which however depends also on the accelerations.