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Symplectic quantization: a new deterministic approach to the dynamics of quantum fields inspired by statistical mechanics

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The present work is about a new method to sample the quantum fluctuations of relativistic fields by means of a pseudo-Hamiltonian dynamics in an enlarge space of variables. The proposed approach promotes the fictitious time of Parisi-Wu stochastic quantisation to a true physical parameter controlling a deterministic dynamics. The sampling of quantum fluctuations is guaranteed by the presence of new additionational conjugated momenta, which reprents the rate of variation of ordinary fields with respect to the newly added time variable. The main goal of this approach is to provide a numerical method to sample quantum fluctuations of fields directly in Minkowski space, whereas all existent methods allowed one so far to do this only in Euclidean space, therefore loosing important physics. From the pseudo-Hamiltonian dynanamics one is then able, assuming ergodicity, to retrieve the Feynman path integral as the Fourier transform of a pseudo-microcanonical partition function. The whole framework proposed is not only the source of a new numerical approach to study quantum fields but also and most importantly reveals important connections between quantum field theory, statistical mechanics and Hamiltonian dynamics. Here we will discuss the main ideas behind the formalism and the first successful results of numerical tests, as well as the difficulties we encountered. (Preprint: https://arxiv.org/abs/2403.17149)

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