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The semiclassical limit of a closed isotropic model of the Universe with a scalar field

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The report focuses on studying the semiclassical limit in the case of a closed isotropic model with a scalar field, decomposed into modes. The calculations are made within frameworks of two approaches. The first is the Wheeler-DeWitt quantum geometrodynamics, and the second is the extended phase space approach, that is known to be gauge dependent. The work is aimed in comparing results, obtained within the scopes of these approaches. The transition to the semiclassical limit is implemented by using the Born-Oppenheimer type of approximation. The expansion parameter is chosen to be M=cˆ3/16πG, that is analogous to the coefficient in expression for the classical action of gravitational field. It is shown that computations in present case differ from the ones in the case of homogeneous scalar field, and we have to make changes in approximation scheme for obtaining adequate results. In the both approaches, O(1/M) order of the approximation corresponds to a Schrödinger equation with quantum gravitational corrections. The obtained equations coincide if we choose the lapse function N=1. Next, the question of unitary evolution is discussed. In present work we follow the method used in works by Kiefer and Singh, so corrections terms have non-unitary character. This circumstance can be avoided by using other technique, for instance, the one proposed by Maniccia and Montani.

Primary author(s) : KISLYAKOVA, Darya (Department of Theoretical and Computational Physics, Southern Federal University)

Co-author(s) : SHESTAKOVA, Tatyana (Department of Theoretical and Computational Physics, Southern Federal University); AYALA, Roger (Department of Theoretical and Computational Physics, Southern Federal University)

Presenter(s) : KISLYAKOVA, Darya (Department of Theoretical and Computational Physics, Southern Federal University)

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