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Polymer Quantization of the Isotropic Universe: comparison with the Bounce of Loop Quantum Cosmology

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We implement Polymer Quantum Mechanics on the Hamiltonian formulation of the isotropic Universe in both the representations of the standard Ashtekar-Barbero-Immirzi connection and of a new generalized coordinate conjugate to the Universe volume. The resulting morphology is a bouncing cosmology; when quantizing the volume-like variable the Big Bounce is an intrinsic cut-off on the cosmological dynamics, while when using the standard connection the Bounce density results to be dependent on the initial conditions of the prepared wave packet. Then we compare the nature of the resulting Bounce with what emerges in Loop Quantum Cosmology, where the dependence of the critical density on the initial conditions is present when the minimum area eigenvalue is implemented in a comoving representation instead of the physical one. We conclude that the preferable scenario in this framework should be a Big Bounce whose density depends on initial conditions, in view of the privileged SU(2) character that the Ashtekar-Barbero-Immirzi connection possesses in the full Loop Quantum Gravity.

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