Towards the Understanding of Quantum Cosmology from Loop Quantum Gravity

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(Dated: February 28, 2019)

Loop quantum cosmology (LQC) provides an elegant resolution of the big bang singularity by a quantum bounce in the deep Planck era. Now an important issue that has remained open is its connection with loop quantum gravity (LQG). To understand it, various approaches have been proposed in the framework of LQG, such as the group field theory and quantum reduced loop gravity. In this talk, I shall first give a brief review on various different approaches proposed so far, and then present our recent results of a systematic study of the cosmological dynamics resulting from an effective Hamiltonian, lately derived in LQG using Thiemann's regularization and earlier obtained in LQC, but by keeping the Lorentzian term explicit in the Hamiltonian constraint. Although the resulted quantum difference equation is of the fourth-order, in contrast to the second-order difference equation in LQC, a non-singular bounce occurs generically. The corresponding dynamics can be described by either the Hamilton's or the Friedmann-Raychaudhuri equations, but the map between the two descriptions is not one-to-one. A careful analysis resolves the tension on symmetric versus asymmetric bounce in this model, showing that the bounce must be asymmetric and symmetric bounce is physically inconsistent, in contrast to the standard LQC. In addition, the current observations only allow a scenario where the pre-bounce branch is asymptotically de Sitter and the post-bounce branch yields the classical general relativity.

- **Ref.:** B.-F. Li, P. Singh, A. Wang, *Towards cosmological dynamics from loop quantum gravity*, Phys. Rev. D**97**, 084029 (2018) [arXiv:1801.07313].

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