Numerical simulations in Loop Quantum Cosmology

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Abstract:
Loop Quantum Gravity (LQG) is an (as yet incomplete) approach to the quantization of gravity. When applied to symmetry reduced cosmological spacetimes, one of the predictions of the theory is that the Big Bang is replaced by a Big Bounce, i.e. a previously existing contracting universe underwent a bounce at finite volume before becoming our expanding universe. This behavior has been shown analytically and numerically for a small number of models and for a subset of the possible quantum states. Based on these results, a continuum effective description has been developed that incorporates LQG effects and shows the same bounce behaviour. These effective models are important tools in determining observable effects of LQC (if any) in cosmological observations.

In this talk I will discuss new numerical simulations that revisit such models in regimes that where previously infeasible, in order to study the robustness of the bounce and the applicability of the effective models. I will describe the necessary numerical techniques, present some results, and discuss some of the unique numerical challenges posed by the equations derived in Loop Quantum Cosmology.