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Novel Numerical Approaches to Loop Quantum Cosmology[1]

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Loop Quantum Gravity (LQG) is an (as yet incomplete) approach to the quantization of gravity. When applied to symmetry reduced cosmological spacetimes (Loop Quantum Cosmology or LQC) 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. The evolution equations of LQC take the form of difference equations (with the discretization given by the theory) that in the large volume limit can be approximated by partial differential equations (PDEs). In this talk I will first discuss some of the unique challenges encountered when trying to numerically solve these difference equations. I will then present some of the novel approaches that have been employed to overcome the challenges. I will here focus primarily on the Chimera scheme that takes advantage of the fact that the LQC difference equations can be approximated by PDEs in the large volume limit. I will finally also briefly discuss some of the results that have been obtained using these numerical techniques by performing simulations in regions of parameter space that were previously unreachable.

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