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Numerical Investigations of the Universe Beyond the Big Bang

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Abstract:

Einstein's theory of classical General Relativity predicts that the spacetime ends at singularities. One such example is the big bang which is an inevitable event in the past evolution of our universe if General Relativity is true at all scales. All known laws of physics end at singularities. A fundamental goal of theoretical physics is to overcome the problem of singularities and develop a theory incorporating a marriage of quantum theory with classical gravity. We will discuss how loop quantum gravity results in a different picture of spacetime in the very early universe and the way reliable and robust physics can be extracted using computational methods. These numerical methods which we have been developing at LSU in last few years, have shed important insights on the resolution of singularities and have opened a new field of Numerical Loop Quantum Cosmology. We will discuss the way the big bang singularity gets resolved, novel properties of the quantum spacetime as deduced from numerical techniques and avenues to test predictions of quantum gravity in the near future.

Speaker's Bio:

Dr. Singh received his PhD from Inter-University Center for Astronomy and Astrophysics in India in 2004, and was then a postdoc at Penn State and a distinguished research fellow at Perimeter Institute in Waterloo. He joined LSU in 2010 as an assistant professor in Department of Physics and Astronomy. He has received CAREER award from National Science Foundation and was named LSU mid-career Rainmaker scholar in 2015.

Dr. Singh's academic research is focused on understanding the physical implications of quantum gravity in particular for cosmological spacetimes, using a blend of analytical and computational methods. His research program on numerical loop quantum cosmology has focused on a better understanding of the way singularities such as big bang are resolved in quantum gravity.

