Understanding the Loop Quantum Cosmology and the Concept of Time

Bhuvaneshwari Kashi, CVR College of Engineering, India, bhuvana9kashi@gmail.com

Abstract

Time is an enigmatic property of the universe which confounded physicists for ages. This property is increasingly dark and cryptic when we deal with metric spaces of the microscopic scales in the universe. There are remarkable theories, in particular, the loop quantum gravity (LQG) which helps us in understanding the cosmology of these microscopic scales. However, the theory possesses considerable complications in explaining the concept of time. We redress the notions of quantum cosmology and the loop quantum gravity. The elegance of the theory in describing the microscopic scales is discussed. We try to emphasise the concept of the time interpreted as far as the notion of quantum gravity is concerned. We aim to review and re-analyse the loop gravity, the quantum effects of the black hole's gravitational field cause it to radiate energy as if it were hot, implying a deep connection between quantum theory, gravity and thermodynamics. For ages theorists with this clue are in a quest to find something more fundamental than space and time. One of the possible answers is loop quantum gravity LQG is a theory of quantum gravity where the structure of space is composed of finite loops woven into a network. In LQG the space and time are considered as quantized quantities. It is a network of quantum processes, related to one another, each of which obeys probabilistic laws that the theory captures. The net of quantum interactions between systems is identified with the net of adjacent spacetime regions.

Quantum Cosmology and LQG

Quantum cosmology is a theory which helps us in understanding gravity in quantum scale of the universe. The classical cosmology is based on the general theory of relativity theorized by Albert Einstein where the universe is treated as a space-time fabric. Unlike the classical cosmology, in quantum cosmology we consider the universe as a wave function. There are many theories which attempts to explain the quantum gravity and cosmology which mainly include string theory and LQG. LQG when applied to quantum cosmology it is termed as Loop Quantum Cosmology with certain bounds. It theorizes that the Big Bounce is prior to Big Bang.

The notion of time

In general when speak about time we refer to the occurrence of an event with respect to another. The notion of time in physics plays an important role. In many cases the time is considered to flow uniformly in a linear direction pointed towards the future. In GR we have seen that the time is considered one of the aspects of the dynamical field, gravitational field. $T = \int \sqrt{g_{\mu\nu}dx^\mu dx^\nu}$ LQG is similar to GR in this case. The time is consider as many clock times measured by different clocks. Interestingly there can occur quantum fluctuations and also there can be different superpositions between different values of the same clock.

Introduction

The quantum effects of the black hole's gravitational field cause it to radiate energy as if it were hot, implying a deep connection between quantum theory, gravity and thermodynamics. For ages theorists with this clue are in a quest to find something more fundamental than space and time. One of the possible answers is loop quantum gravity LQG is a theory of quantum gravity where the structure of space is composed of finite loops woven into a network. In LQG the space and time are considered as quantized quantities. It is a network of quantum interactions between systems is identified with the net of adjacent spacetime regions.

Timeless Universe

The universe described by quantum gravity is not flowing along a single time variable, nor organised into a smooth Einsteinian geometry. It is a network of quantum processes, related to one another, each of which obeys probabilistic laws that the theory captures. The net of quantum interactions between systems is identified with the net of adjacent spacetime regions.

Conclusion

The universe described by quantum gravity is not flowing along a single time variable, nor organised into a smooth Einsteinian geometry. It is a network of quantum processes, related to one another, each of which obeys probabilistic laws that the theory captures. The net of quantum interactions between systems is identified with the net of adjacent spacetime regions.

References

- Abhay Ashtekar and Eugenio Bianchi 2021 Rep. Prog. Phys. 84 042001