Physical Sciences 2009



Tackling the origins of the universe

"The kind of awards they (the Infosys Science Foundation) have instituted I'm certain is going to go a long way in instilling a sense of belonging in this country. And, also to feel what we achieve here will be duly recognized and it is more appropriate because of the kind of international standing which these awards are destined to occupy very soon."

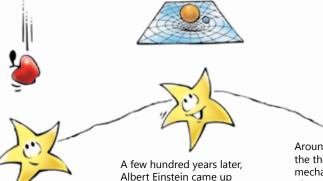
Thanu Padmanabhan

Professor and Dean of Core Academic Programs of Inter-University Center for Astronomy and Astrophysics (IUCAA), Pune

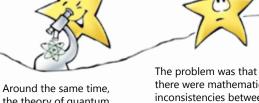
- B.Sc. in Physics from Kerala University
- M.Sc. in Physics from Kerala University
- Ph.D. in Physics from the Tata Institute of Fundamental Research, Mumbai
- Post doctoral research at the Institute of Astronomy, University of Cambridge

Professor Padmanabhan has distinguished himself with fundamental contributions to several areas of theoretical astrophysics. Through a series of papers, he has shown that the link between Einstein's Theory of General Relativity and thermodynamics is far deeper than suggested by the early work done in the 1970s. This work opens a new perspective on gravity as an emergent phenomenon and is expected to provide fresh insights into the nature of dark energy in the universe.





Sir Isaac Newton's theory of gravitation stated that all bodies attract each other and the attraction depends on the mass of the bodies. A few hundred years later, Albert Einstein came up with the theory of relativity that explained gravity as being more than a force that attracts objects at a distance. It defined gravity's relationship to space and time. The general theory of relativity describes the force of gravity and the large-scale (macroscopic) structure of the universe.



the theory of quantum mechanics showed phenomena on the microscopic level of atoms and elementary particles such as electrons, protons and neutrons. there were mathematical inconsistencies between these two theories. In order to have a unified theory that explains our universe, it is necessary to align the theories explaining the macroscopic and the microscopic. One of the challenges in physics has been to combine the two theories and come up with a quantum theory of gravity. This is essential to our understanding of the universe around us.

Prof. Thanu Padmanabhan has made major contributions to this endeavor. His work has provided deeper insights into Einstein's theory of gravity using the language of thermodynamics, specifically in terms of entropy and temperature which can be attributed to space-time itself, and shows that the physics of gravity is similar to physics of a fluid or elastic solid. It is emergent from deeper structures rather than a fundamental description by itself.

This leads to an important consequence: Scientists have hypothesized that 'dark energy' is what has led to the accelerated expansion of the universe, as determined from observations. Prof. Padmanabhan's research has contributed to a better understanding of the nature of dark energy and holds the promise for solving the key problem in theoretical physics today.