Contribution ID: **58** Type: **Talk/seminar**

On the emergence of cosmic space and the first law of thermodynamics in a non-flat universe

Thursday 9 September 2021 15:50 (20 minutes)

Based on connections between gravity and thermodynamics, interpreting the dynamics of the universe as a quest for achieving holographic equipartition is a novel concept proposed by Padmanabhan. However, the generalization of Padmanabhan's conjecture to the non-flat universe had resulted in uncertainty about the choice of volume. We have shown that the exact mathematical formulation of the conjecture is impossible with the proper invariant volume (Volume term derived from the FRW metric) for a non-flat universe. The deep connection between the first law of thermodynamics and the law of emergence motivated us to also explore the status of the first law in a non-flat universe when one uses proper invariant volume. We have shown that the first law of thermodynamics, $dE = TdS + WdV$, cannot be formulated properly for a non-flat universe using proper invariant volume. We can also show that the energy change within the horizon is not equivalent to the outward energy flux in the non-flat universe if one used the proper invariant volume. We further point out that the consistency between the above two forms of the first law will hold only with the use of areal volume, which hints us why our universe appears to be spatially flat.

Authors: THURUTHIPILLY, Hareesh (National Center for Nuclear Research, Poland); Dr P B , Krishna (Cochin University of Science and Technology, India); Prof. K. MATHEW, Titus (Cochin University of Science and Technology, India)

Presenter: THURUTHIPILLY, Hareesh (National Center for Nuclear Research, Poland)

Session Classification: Regular Sessions