S N BOSE NATIONAL CENTRE
FOR BASIC SCIENCES
Block JD, Sector III, Salt Lake, Kolkata 700 106

DEPARTMENTAL SEMINAR

Department of Astrophysics and High Energy Physics

15th December,2022 **4.00 PM** **ONLINE/ FERMION**

SPEAKER

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TITLE OF THE TALK

Loops and non-perturbative effects in primordial cosmic inflation

ABSTRACT

The primordial cosmic inflation was a (quasi-)de Sitter phase of the very early universe, characterised by a rapid, near exponential accelerated expansion. I first review some aspects of inflation and dark energy, emphasising the non-perturbative, infrared secular effect at late cosmological times for certain interacting quantum fields, such as a massless minimal scalar or graviton. I also discuss some open issues, like the possible connection between such non-perturbative effects and the screening of the inflationary cosmological constant. Next I briefly discuss some recent works of our group in this direction. Specifically, we consider a massless minimally coupled quantum scalar field with an asymmetric self-interaction, $V(\phi)=\lambda \phi^4/4!+ \beta \phi^3/3! $ $\lambda >0$). This potential is bounded from below irrespective of the sign of β. Earlier computations mostly considered the quartic part. Our chief motivation behind this study is to assess the vacuum expectation values of $V(\phi)$ and ϕ, both of which can be negative, and hence may lead to some screening of the inflationary cosmological constant. First, using the Schwinger-Keldysh formalism appropriate to non-equilibrium scenarios, the renormalised quantum corrections to the cubic potential appearing in the energy-momentum tensor is computed at two loop, which is the leading order in this case. Next, using some of these results we compute the renormalised vacuum expectation value of ϕ, by computing the tadpoles at ${\calO}(\beta)$ and ${\cal O}\lambda \beta)$. Due to the appearance of the de Sitter symmetry breaking logarithms of the scale factor, the tadpoles cannot be completely renormalised away in this case, unlike the flat spacetime. All these results show secularly growing logarithms at late cosmological times. We next use a recently proposed renormalisation group inspired formalism to resum perturbative secular effects, to compute a non-perturbative $\langle \phi \rangle$, which turns out to be approximately one order of magnitude less compared to the position of the classical minima $\phi=-3\beta/\lambda$ of $V(\phi)$. Estimation on the possible screening of the inflationary cosmological constant due to this $\langle \phi \rangle$ is also presented. Further non-perturbative computations, such as $\langle \phi^2(x)\rangle$ and the dynamically generated scalar mass will also be very briefly discussed.

HOST FACULTY

Dr. S. Gangopadhyay, Associate Professor
ASTROPHYSICS AND HIGH ENERGY PHYSICS

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