Πανεπιστήμιο Κύπρου
Τμήμα Φυσικής

Το Τμήμα Φυσικής του Πανεπιστημίου Κύπρου
σας προσκαλεί την

Τρίτη, 20 Ιανουαρίου 2026, ώρα 11:00
στην αίθουσα Β229, στο κτίριο 13 στην Πανεπιστημιούπολη

στην παρουσίαση της Διδακτορικής Διατριβής του Ευτύχιου Καϊμακκάμη

"A quantum probabilistic approach to the emergence of an inflationary Starobinsky Universe"

In this thesis, our proposition is that the necessary conditions for the existence of inflation could possibly be explained through a quantum probabilistic approach. We interpret the physical states ψ obtained via the path integral formulation as probability density amplitudes for the Universe to be found in a certain state with a particular geometric configuration. By solving for these wave functions, we can calculate relative probabilities for each cosmological regime.

In our first piece of research, we examine the problem of ordering ambiguities in the Wheeler-DeWitt (WDW) equation. We develop a formalism to handle ambiguities in the canonical quantization of a 1d minisuperspace by defining ambiguity functions within the WDW equation. We define a Hilbert space inner product for calculating physical observables, and using an argument from the hermiticity of the Hamiltonian, we obtain an expression for its measure μ in addition to constraints on the ambiguity functions. By defining a new quantum state $\Psi = \sqrt{\mu}\,\psi$ and using the path integral formalism, we are able to resolve ambiguities and prove the theory is universal. We then generalize for any M-dimensional minisuperspace system, for which we can prove universality in the semi-classical approximation for a large class of models. We also show that this universality extends to all orders of quantum theory if the target space manifold of the theory is flat.

In our second work, we calculate probability amplitudes for various cosmological scenarios involving Starobinsky inflation. We summarize the Hartle-Hawking no-boundary proposal for GR and we comment on the distinct possibilities of defining a contour of integration: the sign choice of Hartle-Hawking and the one of Linde-Vilenkin. We make an analogous calculation for R^2 gravity and find that for the Linde-Vilenkin choice it is statistically more likely for the Universe to emerge in its inflationary stage. Finally, we calculate transition amplitudes when the kinetic energy of the inflaton field φ takes non-zero values.

Η παρουσίαση θα είναι ανοικτή στο κοινό.