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# Time Operator from Parametrization Invariance and Implications for Cosmology

Prof Nikolaos Dimakis (University of the Frontier, Chile)

Thursday, 15 May 2025 | 14h00 – 15h00 SAST

Attend online or in the Physics Seminar Room, Stellenbosch University

## ABSTRACT

In this talk we review the basic symmetries of parameterization invariant systems that describe the motion of particles in curved spacetimes. Motivated by the analogy of such systems to cosmological Lagrangians, we attempt to address the problem of time in quantum cosmology. To this end, we introduce a time operator which is canonically conjugate to the vanishing Hamiltonian. We discuss the resulting "time-energy" uncertainty relation and explore possible interpretations.

## BIOGRAPHY

Prof Nikolaos Dimakis received his PhD in 2014 from the University of Athens, Greece, where he specialised in theoretical and mathematical aspects of cosmology. After completing his doctorate, he joined the Austral University of Chile in Valdivia as a postdoctoral researcher from 2014 to 2017. He then moved to Sichuan University, Chengdu, China, where he held a postdoctoral position in the Department of Physics for five years, further developing his work on cosmological models and their symmetries. Since 2023, he has been serving as an Assistant Professor at the University of the Frontier in Temuco, Chile. His research lies at the intersection of classical and quantum cosmology, with a strong emphasis on uncovering and analysing symmetries – both geometric and dynamical – that govern the behavior of the universe. His work contributes to a deeper understanding of the mathematical structures underpinning cosmological evolution and quantum gravitational frameworks.



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