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Beyond Symmetry-Reduced Models: Bouncing Cosmology, Regular Black Holes and Gravitational Waves from a Full Theory Perspective

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Current research on quantum gravity inspired bouncing cosmologies and regular black holes, as well as their potential gravitational wave signatures, has largely relied on symmetry-reduced models, such as those assuming spherical symmetry. However, these simplified models may fail to capture essential physical features inherent in the full theory. It is therefore crucial to develop approaches that go beyond symmetry reduction and enable the study of such solutions—including their perturbations—within a complete theoretical framework. In this talk, I will introduce a method for uniquely embedding regular black hole and bouncing cosmological solutions into a two-dimensional dilaton-mimetic gravity model. This model satisfies a Birkhoff theorem, which guarantees the uniqueness of the vacuum solution when the mimetic field is non-dynamical. Furthermore, I will show how this construction can be lifted to a four-dimensional covariant formulation within the framework of extended mimetic gravity. This extension allows us to systematically study the perturbation spectrum in the full 4D theory. Our approach provides a unified and systematic way to explore potential gravitational wave signals associated with regular black holes from a full theory perspective, offering new insights into their physical nature and observable signatures.

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