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The Spectral Geometry of de Sitter Space in Asymptotic Safety

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Within the functional renormalization group approach to Background Independent quantum gravity, we explore the scale dependent effective geometry of the de Sitter solution dS4. The investigation employs a novel approach whose essential ingredient is a modified spectral flow of the metric dependent d'Alembertian, or of similar hyperbolic kinetic operators. The corresponding one-parameter family of spectra and eigenfunctions encodes information about the nonperturbative backreaction of the dynamically gravitating vacuum fluctuations on the mean field geometry of the quantum spacetime. Used as a diagnostic tool, the power of the spectral flow method resides in its ability to identify the scale dependent subsets of field modes that supply the degrees of freedom which participate in the effective field theory description of the respective scale. A central result is that the ultraviolet of Quantum Einstein Gravity comprises far less effective degrees of freedom than predicted (incorrectly) by background dependent reasoning. Exploring the quantum spacetime's spatial geometry carried by physical fields, we find that 3-dimensional space disintegrates into a collection of coherent patches which individually can, but in their entirety cannot be described by one of the effective average actions occurring along the renormalization group trajectory.

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