

Nonperturbative Quantum Gravity for the Uninitiated

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I will talk about a radically conservative approach to finding the fundamental quantum theory underlying Einstein's classical General Relativity. The research program of "Causal Dynamical Triangulations" does not assume unobserved symmetries or dimensions, and does not require a modification of the principles of standard quantum (field) theory, but merely adapts the latter to the situation where spacetime is itself dynamical, without an a priori metric background structure.

Using powerful calculational tools, we are able to evaluate a 'sum over histories' in a nonperturbative, Planckian regime. Reassuringly, the resulting quantum spacetime has a number of large-scale features that match the expected classical limit. By contrast, its quantum geometry reveals completely unexpected properties on Planckian distance scales, which are due to the complex dynamics of the system's microstates, and because of their 'entropic' origin are believed to be generic. I will outline potential consequences for quantum gravity and our understanding of time and causality.