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Classical Gravity Contains Quantum Mechanics

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Our search for a quantum theory of gravity is aided by a unique and perplexing feature of the classical theory: General Relativity already “knows” about its own quantum states (the entropy of a black hole), and about those of all matter (via the covariant entropy bound). The results we are able to extract from classical gravity are inherently nonperturbative and increasingly sophisticated. Recent breakthroughs include a derivation of the entropy of Hawking radiation, a computation of the exact integer number of states of some black holes, and the construction of gravitational holograms in our universe using techniques from single-shot quantum communication protocols.

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