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Einstein Prize Talk: The Quantum Origin of Our Classical Universe

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A striking feature of our indeterministic quantum universe is the wide range of time, place, and scale on which the deterministic laws of classical physics hold. This talk will describe the origin of this quasiclassical realm in a quantum cosmology based on Hawking's no-boundary quantum state of the universe. Classical spacetime is the key to the quasiclassical realm, and the no-boundary probabilities for different classical spacetimes lead to different predictions for cosmological observations today. In a simple model, these probabilities favor a minimum amount of matter, a long period of inflation, small fluctuations such as those seen in the CMB, but significant fluctuations away from homogeneity on very large scales. Probabilities will also be discussed of early properties such as whether the universe was singular or bounced at a small radius, and the direction of the arrow of time.