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Complex Time Propagation to Smooth the Quantum Leap JOHN RUSSELL, PAUL ARENDT, JR., New Mexico Tech — As is often noted, the propagator of quantum mechanics has much in common with the partition function of thermodynamics: $\exp(-it\hat{H})$ looks like $\exp(-\beta\hat{H})$, where β is inverse temperature, when $t \to -i\beta$. It seems natural to combine these to form a "complex time" propagator, but this is commonly done only for fixed β, to include thermal effects. We instead allow β to vary with time, and apply the propagator to the density matrix of a two-state system undergoing measurement. Zurek and others have developed decoherence and environment-induced superselection to allow the measurement process of quantum mechanics to behave quantum mechanically. However, there remains a quantum "jump" or "leap" of the state when an observer finally consults the measurement apparatus. Here, we adapt decoherence models into complex time propagation of the reduced system when the pointer basis is also the energy eigenbasis. Within a many-worlds or conditional probability interpretation, the evolution to the measured state is then smooth, preserves entanglement with the measuring apparatus, and gives meaning to the energy-time uncertainty relation. This may prove useful as a tool in qubit manipulation.

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