From Quantum Time to Emergent Spacetime?

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Nothing stops the quantum state vector from being in a superposition of yesterday, today, and tomorrow. In fact, this is unavoidable under broad conditions (Unruh and Wald, 1989; Hegerfeldt and Ruijsenaars, 1980): if there are no negative energies, states initially localized at one Schrödinger time immediately spread over all Schrödinger past and future times.

But we experience a definite present time, not a superposition of all times. I argue that this is because macroscopic pointer states resolve the superposition of times. An intrinsic time observable emerges, and time is not what it seems to be in the Schrödinger equation. The Schrödinger equation is automatically replaced by a Wheeler-DeWitt equation, even if there is no explicit gravitational force in the theory.

An unexpected consequence is that the self-location probability over intrinsic time induces curvature even without presupposing gravity. FLRW cosmologies emerge from simple four-dimensional spherically symmetric solutions in Euclidean space. This extends to four-dimensional spacetime curvature, although I do not know yet whether this is the same as in general relativity.