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Partial Wick Rotation in Quantum Random Walk

Quantum decoherence occurs when a quantum system undergoes the dynamics that loses its quantum properties over time, and turns a quantum system to its classical counterpart. Wick's rotation transforms a real-valued time to an imaginary time. When apply to Shrödinger Equation, the equation becomes Diffusion Equation. Instead of fully turns time into imaginary, we investigate the decoherence of a quantum random walk under partial wick rotation, $t \to zt$ and $z \in \mathbb{C}$. We found that as the imaginary part of z grow, partial wick rotation increasingly turns Quantum Random Walk into Classical Random Walk. This indicates that errors in measurement that affect the phase of a quantum state can result in decoherence which destroys quantum properties.

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