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The PhANTM algorithm: measurement-based generation and preservation of cat and grid states

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Abstract

We present an algorithm to reliably generate various quantum states critical to quantum error correction and universal continuous-variable (CV) quantum computing, such as Schrödinger cat states and Gottesman-Kitaev-Preskill (GKP) grid states, out of Gaussian CV cluster states. Our algorithm is based on the Photon-counting-Assisted Node-Teleportation Method (PhANTM), which uses standard Gaussian information processing on the cluster state with only the addition of local photon-number-resolving measurements. We show that PhANTM can apply polynomial gates and embed cat states within the cluster. This method also stabilizes cat states against Gaussian noise and perpetuates non-Gaussianity within the cluster. Finally, we show that existing protocols for breeding cat states can be embedded into cluster state processing using PhANTM.