Entanglement Distillation: Building a QED Circuit to Alleviate Decoherence

Mossman, Elijah Keene

Quantum computing is a theory that is slowly becoming a reality. In specific, entanglement distillation is an essential part to constructing quantum computers, the next frontier for the information era. However, there are still many problems with quantum computers, including factors like information loss and decoherence. Decoherence happens when two entangled particles “lose” their entanglement due to environmental interactions. To minimize decoherence, an inverse environmental operator can apply itself onto one of the entangled particles to cancel out the previous interactions with the environment (environmental correction). These particles can be operated on through quantum electrodynamic (QED) circuitry gates, coded using python (sub-package numpy and scipy). All the circuitry is designed through Easyeda (a circuit design website), and entangled particles are modeled by sending them through a Hadamard gate. Environmental operators modeled for include temperature, and electromagnetic field. Individual entangled particles are sent through the algorithm and tested to see if their intrinsic wave state values remain unchanged. Multiplication of the environmental against its inverse (using the kronecker delta) cancel out, producing an identity matrix. This matrix does not affect the particle's wave state value, keeping it coherent. A series of temperatures were used, ranging from 0.02 K (current temperature) to 298 K (room temperature). Various vector potentials and scalar potentials were used as variables for the electromagnetic equation. Also, wave state values were measured at different times (1-5 seconds) to look for decoherence range. A working circuitry system was designed which will model future tests.

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