

CLAIMS

What is claimed is:

1. A method of operating a circuit quantum electrodynamics system comprising an ancilla qubit dispersively coupled to a first logical qubit, the method comprising:
performing a quantum operation at least in part by:
generating and applying a first drive waveform to the ancilla qubit, the first drive waveform comprising a first comb of π -pulses having selective frequencies corresponding to a first selection of even and odd cavity resonance frequencies of the first logical qubit, the first selection comprising the selective frequencies 3χ , 4χ , 7χ , and 8χ ; and
reading out a state of the ancilla qubit.
2. The method of claim 1, further comprising, prior to reading out the state of the ancilla qubit, generating and applying a second drive waveform to the ancilla qubit, the second drive waveform comprising a second comb of π -pulses having selective frequencies corresponding to a second selection of even and odd cavity resonance frequencies of the first logical qubit, the second selection comprising the selective frequencies 1χ , 2χ , 5χ , and 6χ .
3. The method of claim 1, wherein the circuit quantum electrodynamics system further comprises a second logical qubit coupled to the first logical qubit by a first beamsplitter, the method further comprising, prior to reading out the state of the ancilla qubit, applying a third drive waveform to the first beamsplitter to enact a detuned beamsplitter interaction between the first logical qubit and the second logical qubit.
4. The method of claim 3, wherein performing the quantum operation comprises generating a Bell state between the first logical qubit and the second logical qubit.
5. The method of claim 3, wherein enacting the detuned beamsplitter interaction between the first logical qubit and the second logical qubit comprises enacting the detuned beamsplitter interaction between a first cavity resonator and a second cavity resonator.

6. The method of claim 1, wherein generating and applying the first drive waveform comprises generating and applying a microwave waveform.
7. The method of claim 1, wherein generating and applying the first drive waveform comprises generating and applying the first drive waveform to a transmon.
8. The method of claim 3, further comprising generating a first four-qubit cluster state at least in part by:
 - applying a fourth drive waveform to a second beamsplitter coupling the first logical qubit and a third logical qubit; and
 - applying a fifth drive waveform to a third beamsplitter coupling the second logical qubit to a fourth logical qubit.
9. The method of claim 8, further comprising generating a many-qubit cluster state at least in part by:
 - applying a sixth drive waveform to a fourth beamsplitter coupling the first logical qubit of the first four-qubit cluster state and a first logical qubit of a second four-qubit cluster state.
10. A quantum information processing system, comprising:
 - an ancilla qubit;
 - a first logical qubit dispersively coupled to the ancilla qubit; and
 - at least one controller configured to:
 - perform a quantum operation at least in part by:
 - generating and applying a first drive waveform to the ancilla qubit, the first drive waveform comprising a first comb of π -pulses having selective frequencies corresponding to a first selection of even and odd cavity resonance frequencies of the first logical qubit, the first selection comprising the selective frequencies 3χ , 4χ , 7χ , and 8χ ; and
 - reading out a state of the ancilla qubit.
11. The quantum information processing system of claim 10, wherein the at least one controller is further configured to, prior to reading out the state of the ancilla qubit, generate and apply a second drive waveform to the ancilla qubit, the second drive waveform

comprising a second comb of π -pulses having selective frequencies corresponding to a second selection of even and odd cavity resonance frequencies of the first logical qubit, the second selection comprising the selective frequencies 1χ , 2χ , 5χ , and 6χ .

12. The quantum information processing system of claim 10, further comprising a second logical qubit coupled to the first logical qubit by a beamsplitter.

13. The quantum information processing system of claim 12, wherein the at least one controller is further configured to, prior to reading out the state of the ancilla qubit, generate and apply a third drive waveform to the beamsplitter to enact a detuned beamsplitter interaction between the first logical qubit and the second logical qubit.

14. The quantum information processing system of claim 13, wherein the at least one controller being configured to perform the quantum operation comprises the at least one controller being configured to generate a Bell state between the first logical qubit and the second logical qubit.

15. The quantum information processing system of claim 12, wherein the first logical qubit and the second logical qubit comprise a first cavity resonator and a second cavity resonator.

16. The quantum information processing system of claim 10, wherein the first drive waveform comprises a microwave waveform.

17. The quantum information processing system of claim 10, wherein the ancilla qubit comprises a transmon.