Claims

1. A quantum circuit, comprising:

a resonator having a plurality of superconducting surfaces and configured to support at least one electromagnetic oscillation mode within a three-dimensional region defined by walls on which are disposed the plurality of superconducting surfaces; and

a physical qubit disposed in an opening in one of the walls.

2. The system of claim 1, wherein the physical qubit comprises at least one planar component that includes at least one Josephson element.

3. The system of claim 2, wherein the at least one planar component includes a superconducting patch antenna.

4. The system of claim 3, wherein the superconducting patch antenna comprises a patch with a circular shape.

5. The system of claim 3, wherein the superconducting patch antenna comprises a patch with a rectangular shape.

6. The system of claim 3, wherein a superconducting patch of the superconducting patch antenna is connected to the first superconducting surface via at least one Josephson element.

7. The system of claim 1, wherein the resonator is a three dimensional cavity resonator.

8. The system of claim 1, wherein the resonator is a whispering gallery mode resonator.

9. The system of claim 8, wherein the whispering gallery mode resonator includes the first superconducting surface and a second superconducting surface parallel to the first superconducting surface, and wherein the first superconducting surface is separated from the second superconducting surface by a first distance.

10. The system of claim 9, wherein the whispering gallery mode resonator supports at least two electromagnetic oscillation modes.

11. The system of claim 10, wherein the at least two electromagnetic oscillation modes are differential modes.

12. The system of claim 10, wherein a first electromagnetic oscillation mode of the at least two electromagnetic oscillation modes is a parallel mode.

13. The system of claim 12, wherein a second electromagnetic oscillation mode of the at least two electromagnetic oscillation modes is a perpendicular mode.

14. The system of claim 9, wherein the first superconducting surface is a first ring-like structure and the second superconducting surface is a second ring-like structure.

15. The system of claim 14, wherein the first ring-like structure is circularly asymmetric such that a first width of the first ring-like structure in a first plane at a first location is less than a second width of the first ring-like structure in the first plane at a second location, different from the first location.

16. The system of claim 1, wherein the quantum mechanical system comprises a plurality of resonators.

17. The system of claim 16, wherein a first resonator of the plurality of resonators is a readout cavity.

18. The system of claim 17, wherein a second resonator of the plurality of resonators is a storage cavity.

19. The system of claim 1, wherein:

the plurality of superconducting surfaces include a first superconducting surface that defines a first plane;

the opening is in a first wall on which the first superconducting surface is disposed; and

the physical qubit comprises at least one planar component that is within the first plane.