

CLAIMS:

1. Arrangement for selectively shifting qubit resonance frequencies, comprising:

5 a plurality of qubits comprising at least a first qubit and a second qubit, each of the first qubit and the second qubit having a respective resonance frequency;

10 a plurality of coupling control resonators comprising at least a first coupling control resonator and a second coupling control resonator each having a respective resonance frequency band; and

15 a coupling control signal line for feeding a coupling control signal to at least the first coupling control resonator and the second coupling control resonator;

20 wherein the first coupling control resonator is configured to shift the resonance frequency of the first qubit when the coupling control signal comprises a frequency component in the resonance frequency band of the first coupling control resonator and the second coupling control resonator is configured to shift the resonance frequency of the second qubit when the coupling control signal comprises a frequency component in the resonance frequency band of the second coupling control resonator.

2. The arrangement according to claim 1, the plurality of qubits further comprising a third qubit and a fourth qubit, each of the third and the fourth qubit

having a respective resonance frequency, wherein the first qubit is capacitively coupled to the third qubit and the second qubit is capacitively coupled to the fourth qubit.

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3. The arrangement according to claim 1 or claim 2, wherein each qubit in the plurality of qubits comprises at least one Josephson junction.

10 4. The arrangement according to any preceding claim, wherein each qubit in the plurality of qubits comprises a superconducting quantum interference device, SQUID.

15 5. The arrangement according to any preceding claim, wherein the resonance frequency band of the first and/or second coupling control resonator is located in a frequency range less than the resonance frequency of the first qubit and the resonance frequency of the second qubit.

20 6. The arrangement according to any preceding claim, wherein the shift of the resonance frequency of the first qubit is proportional to an amplitude of the frequency component in the resonance frequency band of the first coupling control resonator and/or the shift of the resonance frequency of the second qubit is proportional to an amplitude of the frequency component in the resonance frequency band of the second coupling control resonator.

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7. The arrangement according to any preceding claim, wherein the first qubit and the second qubit are capacitively coupled to each other, and wherein when the
5 first qubit and the second qubit are set in resonance, quantum gate operations are performed on the first qubit and the second qubit.

8. The arrangement according to any preceding
10 claim, wherein the first coupling control resonator is configured to shift the resonance frequency of the first qubit by tuning a Josephson inductance of the first qubit.

15 9. The arrangement according to claim 8, wherein the first coupling control resonator is configured to shift the resonance frequency of the first qubit by tuning a Josephson inductance of the first qubit by inducing a magnetic flux through the first qubit or by
20 causing a current flow through the first qubit.

10. The arrangement according to any preceding claim, further comprising:

a plurality of coupling control signal lines including the coupling signal line; and
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wherein the plurality of qubits is arranged into a matrix, each qubit in the plurality of qubits having a respective resonance frequency, each coupling control signal line in the plurality of coupling control signal
30 lines corresponding to a column/row of the matrix;

wherein each coupling control resonator in the plurality of coupling control resonators is configured to shift the resonance frequency of a corresponding qubit in the plurality of qubits when a coupling control signal in a corresponding coupling control signal line comprises a frequency component in the resonance frequency band of that coupling control resonator.

11. A quantum computing system comprising:
the arrangement according to any preceding claim;
and
a control unit electrically coupled to the coupling control signal line of the arrangement, wherein the control unit is configured:
set an amplitude of the frequency component in the resonance frequency band of the first coupling control resonator according to a frequency difference between the resonance frequency of the first qubit and a resonance frequency of another qubit in the plurality of qubits; and
transmit the coupling control signal to the coupling control signal line.

12. The quantum computing system according to claim 11, wherein the control unit is further configured to set a temporal duration of a pulse comprising the frequency component in the resonance frequency band of the first coupling control resonator according to a preconfigured coupling parameter, wherein the preconfigured

coupling parameter indicates an intended coupling strength between the first qubit and the another qubit.

13. The quantum computing system according to claim
5 11 or claim 12, wherein the control unit is further
configured to frequency-division multiplex the frequency component in the resonance frequency band of the first coupling control resonator and the frequency component in the resonance frequency band of the second
10 coupling control resonator into the coupling control signal.

14. A method for selectively shifting qubit resonance frequencies in a quantum computing system comprising the arrangement according to any of claim 1 -
15 10, the method comprising:

setting an amplitude of the frequency component in the resonance frequency band of the first coupling control resonator according to a frequency difference between the resonance frequency of the first
20 qubit and a resonance frequency of another qubit in the plurality of qubits; and

transmitting the coupling control signal to the coupling control signal line.

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15. A computer program product comprising program code configured to perform the method according to claim 14 when the program code is executed on a computer.