

CLAIMS

~~That which is claimed:~~

1. A method comprising:

5 identifying, by a controller corresponding to a quantum system, a phase update trigger for a particular quantum object of the quantum system, the phase update trigger corresponding to an interaction time;

responsive to identifying the phase update trigger, determining, by the controller, a location and transport effect on a phase of the particular quantum object based on one or
10 more locations of the particular quantum object and one or more transport operations performed on the particular quantum object between a first time and the interaction time, wherein an immediately previous phase update for the particular quantum object occurred at the first time;

determining, by the controller, a quantum operation effect on the phase of the
15 particular quantum object based on any quantum operations applied to the particular quantum object between the first time and the interaction time;

based on the location and transport effect, the quantum operation effect, and the interaction time, determining, by the controller, an interaction time phase of the particular quantum object; and

20 causing, by the controller, phases of one or more signals (a) generated by one or more manipulations sources and (b) corresponding to the phase update trigger to be adjusted such that the phases of the one or more signals correspond to the interaction time phase of the particular quantum object at the interaction time.

25 2. The method of Claim 1, wherein the one or more signals are incident on the particular quantum object at the interaction time.

3. The method of Claim 1, wherein the one or more manipulation sources comprise at least one of (a) one or more lasers or (b) one or more voltage sources.

30 4. The method of Claim 1, wherein the quantum operation effect corresponds to a Stark shift.

5. The method of Claim 1, wherein the quantum system is part of a trapped ion quantum computer and the particular quantum object is a qubit of the trapped ion quantum computer.

6. The method of Claim 1, wherein a phase of a signal of the one or more signals corresponds to the interaction time phase of the particular quantum object when an absolute value of a difference between the phase of the signal and the interaction time phase of the particular quantum object satisfies a phase difference threshold requirement.

7. The method of Claim 6, wherein the absolute value of the difference between the phase of the signal and the interaction time phase satisfies the phase difference threshold requirement when the absolute value of the difference between the phase of the signal and the interaction time phase is less than a set phase difference threshold.

8. The method of Claim 1, wherein the phase update trigger is identified by determining that an application of the one or more signals to the particular quantum object is scheduled to occur at the interaction time.

9. The method of Claim 1, wherein the identifying of the phase update trigger corresponding to the particular quantum object, the determining of the location and transport effect of the phase of the particular quantum object, the determining of the quantum operation effect on the phase of the particular quantum object, and the causing of the adjusting of the phases of the one or more signals are performed in real-time ~~or near real-time~~ with respect to one another.

10. The method of Claim 1, wherein the location and transport effect corresponds to a phase change due to changes to an effective frequency of the particular quantum object based on one or more locations of the particular quantum object and transport of the particular quantum object through the one or more locations between the first time and the interaction time.

11. A controller associated with a quantum system, the controller comprising at least one processing element and at least one memory including computer program code, the at least one memory and the computer program code configured to, with the processing element, cause the controller to at least:

identify a phase update trigger for a particular quantum object of the quantum system, the phase update trigger corresponding to an interaction time;

responsive to identifying the phase update trigger, determine a location and transport effect on a phase of the particular quantum object based on one or more locations of the particular quantum object and one or more transport operations performed on the particular quantum object between a first time and the interaction time, wherein an immediately previous phase update for the particular quantum object occurred at the first time;

determine a quantum operation effect on the phase of the particular quantum object based on any quantum operations applied to the particular quantum object between the first time and the interaction time;

based on the location and transport effect, the quantum operation effect, and the interaction time, determine an interaction time phase of the particular quantum object; and

cause phases of one or more signals (a) generated by one or more manipulations sources and (b) corresponding to the phase update trigger to be adjusted such that the phases of the one or more signals correspond to the interaction time phase of the particular quantum object at the interaction time.

12. The controller of Claim 11, wherein the one or more signals are incident on the particular quantum object at the interaction time.

13. The controller of Claim 11, wherein the one or more manipulation sources comprise at least one of (a) one or more lasers or (b) one or more voltage sources.

14. The controller of Claim 11, wherein the quantum operation effect corresponds to a Stark shift.

15. The controller of Claim 11, wherein the quantum system is part of a trapped ion quantum computer and the particular quantum object is a qubit of the trapped ion quantum computer.

16. The controller of Claim 11, wherein a phase of a signal of the one or more signals corresponds to the interaction time phase of the particular quantum object when an absolute value of a difference between the phase of the signal and the interaction time phase of the particular quantum object satisfies a phase difference threshold requirement.

17. The controller of Claim 16, wherein the absolute value of the difference between the phase of the signal and the interaction time phase satisfies the phase difference threshold requirement when the absolute value of the difference between the phase of the signal and the interaction time phase is less than a set phase difference threshold.

18. The controller of Claim 11, wherein the phase update trigger is identified by determining that an application of the one or more signals to the particular quantum is scheduled to occur at the interaction time.

19. The controller of Claim 11, wherein the identifying of the phase update trigger corresponding to the particular quantum object, the determining of the location and transport effect of the phase of the particular quantum object, the determining of the quantum operation effect on the phase of the particular quantum object, and the causing of the adjusting of the phases of the one or more signals are performed in real-time ~~or near real-time~~ with respect to one another.

20. The controller of Claim 11, wherein the location and transport effect corresponds to a phase change due to changes to an effective frequency of the particular quantum object based on one or more locations of the particular quantum object and transport of the particular quantum object through the one or more locations between the first time and the interaction time.