CLAIMS

1. A system for optical transduction of quantum information, comprising:

a qubit chip comprising a plurality of data qubits configured to operate at microwave frequencies;

a transduction chip spaced apart from said qubit chip, said transduction chip comprising a microwave-to-optical frequency transducer; and

an interposer coupled to said qubit chip and said transduction chip, said interposer comprising a dielectric material comprising a plurality of superconducting microwave waveguides formed therein, wherein said plurality of superconducting microwave waveguides is configured to transmit quantum information from said plurality of data qubits to said microwave-to-optical frequency transducer on said transduction chip, wherein said microwave-to-optical frequency transducer is configured to transduce said quantum information from said microwave frequencies to optical frequencies, wherein said transduction chip further comprises an optical pump line coupled to said microwave-to-optical frequency transducer, and wherein said optical pump line is configured to transmit said quantum information as an optical-frequency signal from said transduction chip to a second transduction chip coupled to a second qubit chip.

2. The system for optical transduction of quantum information according to claim 1, wherein said microwave-to-optical frequency transducer is further configured to transduce quantum information from said optical frequencies to said microwave frequencies, and wherein said plurality of superconducting microwave waveguides is configured to transmit said quantum information from said microwave-to-optical frequency transducer on said transduction chip to said plurality of data qubits.

3. The system for optical transduction of quantum information according to claim 1, wherein said microwave-to-optical frequency transducer comprises a microwave waveguide coupled to a device configured to operate in an optical frequency domain.

4. The system for optical transduction of quantum information according to claim 3, wherein said device configured to operate in said optical frequency domain comprises an optical resonator.

5. The system for optical transduction of quantum information according to claim 4, where said transduction chip further comprises the optical pump line coupled to said optical resonator, wherein said optical pump line is configured to transmit said quantum information as an optical-frequency signal.

6. The system for optical transduction of quantum information according to claim 3, wherein said device configured to operate in said optical frequency domain comprises a bulk acoustic wave resonator.

7. The system for optical transduction of quantum information according to claim 3, wherein said device configured to operate in said optical frequency domain comprises a mechanical coupler.

8. The system for optical transduction of quantum information according to claim 3, wherein said device configured to operate in said optical frequency domain comprises a membrane.

9. The system for optical transduction of quantum information according to claim 1, wherein said transduction chip comprises a plurality of transduction qubits, at least one of the plurality of transduction qubit being coupled to the microwave-to-optical frequency transducer, wherein said superconducting plurality of microwave waveguides is configured to transmit quantum information from said plurality of data qubits to said plurality of transduction qubits via microwave photons.

10. The system for optical transduction of quantum information according to claim 9, wherein said transduction chip further comprises a plurality of microwave-to-optical frequency transducers, and wherein each of said plurality of transduction qubits is coupled to one of said plurality of microwave-to-optical frequency transducers.

11. The system for optical transduction of quantum information according to claim 1, wherein said transduction chip comprises a substrate comprising an electro-optic material.

12. The system for optical transduction of quantum information according to claim 1, wherein said transduction chip comprises a substrate comprising a piezoelectric material.

13. The system for optical transduction of quantum information according to claim 1, wherein said transduction chip comprises a silicon-on-insulator substrate.

14. The system for optical transduction of quantum information according to claim 1, wherein said microwave-to-optical frequency transducer comprises an optomechanical system.

15. The system for optical transduction of quantum information according to claim 1, wherein said interposer comprises a first surface and a second surface opposite said first surface, wherein said qubit chip is coupled to said first surface, and wherein said transduction chip is coupled to said second surface.

16. The system for optical transduction of quantum information according to claim 1, wherein said qubit chip and said transduction chip are coupled to a same surface of said interposer.

17. A method for performing optical transduction of quantum information, comprising: providing a qubit chip comprising a plurality of data qubits configured to operate at microwave frequencies; transferring quantum information from said plurality of data qubits to a transduction chip spaced apart from said qubit chip, said transduction chip comprising a microwave-to-optical frequency transducer; performing microwave-to-optical frequency transduction of said quantum information while shielding said plurality of data qubits from stray light fields using a dielectric interposer disposed between said qubit chip and said transduction chip; and outputting said quantum information as an optical-frequency signal, wherein said transduction chip further comprises an optical pump line coupled to said microwave-to-optical frequency transducer, wherein said optical pump line is configured

to transmit said quantum information as an optical-frequency signal from said transduction chip to a second transduction chip coupled to a second qubit chip.

18. A quantum computer, comprising: a refrigeration system under vacuum comprising a containment vessel; a qubit chip contained within a refrigerated vacuum environment defined by said containment vessel, wherein said qubit chip comprises a plurality of data qubits configured to operate at microwave frequencies; a transduction chip contained within the refrigerated vacuum environment defined by said containment vessel, the transduction chip being spaced apart from said qubit chip and comprising a microwave-to-optical frequency transducer; and an interposer contained within the refrigerated vacuum environment defined by said containment vessel, said interposer being coupled to said qubit chip and said transduction chip, said interposer comprising a dielectric material comprising a plurality of superconducting microwave waveguides formed therein, wherein said plurality of superconducting microwave waveguides is configured to transmit quantum information from said plurality of data qubits to said microwave-to-optical frequency transducer on said transduction chip, and wherein said microwave-to-optical frequency transducer is configured to transduce said quantum information from said microwave frequencies to optical frequencies, wherein said transduction chip further comprises an optical pump line coupled to said microwave-to-optical frequency transducer, wherein said optical pump line is configured to transmit said quantum information as an optical-frequency signal from said transduction chip to a second transduction chip coupled to a second qubit chip.