Docket #: S22-107

Strong Spin-Microwave Coupling for Quantum Technologies

Researchers at Stanford are designing a class of "2.5-dimensional" microwave cavities that enables coupling/interaction between microwave photons and solid-state quantum spins in a way which is strong compared to loss. This will enable individual spins, or ensembles of spins, to be used in applications such as high fidelity quantum transduction and quantum information processing. Solid-state spins can have excellent properties but are generally limited by their weak coupling/interaction with the electromagnetic field. The Stanford team looks to dramatically enhance this interaction compared to loss by placing the spin in a 2.5-dimensional microwave cavity. This cavity design has both a small magnetic mode volume for strong coupling, and a large electric mode volume for low loss. This design is useful for strongly coupling quantum spin centers to microwave photons when implemented in a superconducting architecture at cryogenic temperatures. The strong interaction between quantum spin centers and microwave photons enabled by this 2.5-dimensional architecture will have applications in quantum transduction, communication and information processing.

Stage of Development
Proof of concept

Applications

- Quantum memories for quantum computation, including on-demand storage and retrieval of quantum states.
- Quantum communication including microwave-to-optical transducers and quantum repeaters.

Advantages

- Predicted to have considerably lower loss than previous designs while also having strong coupling.
- The large spin-microwave coupling enabled by this design will allow quantum spin centers in semiconductors to be used for quantum transduction and as quantum memories for information processing.

Patents

- Published Application: 20230289644

Innovators

- Eric Rosenthal
- Chris Anderson
- Jelena Vuckovic

Licensing Contact

David Mallin

Licensing Manager, Physical Sciences

Email