

# Strong coupling between the superconducting LC resonator and ensemble spin

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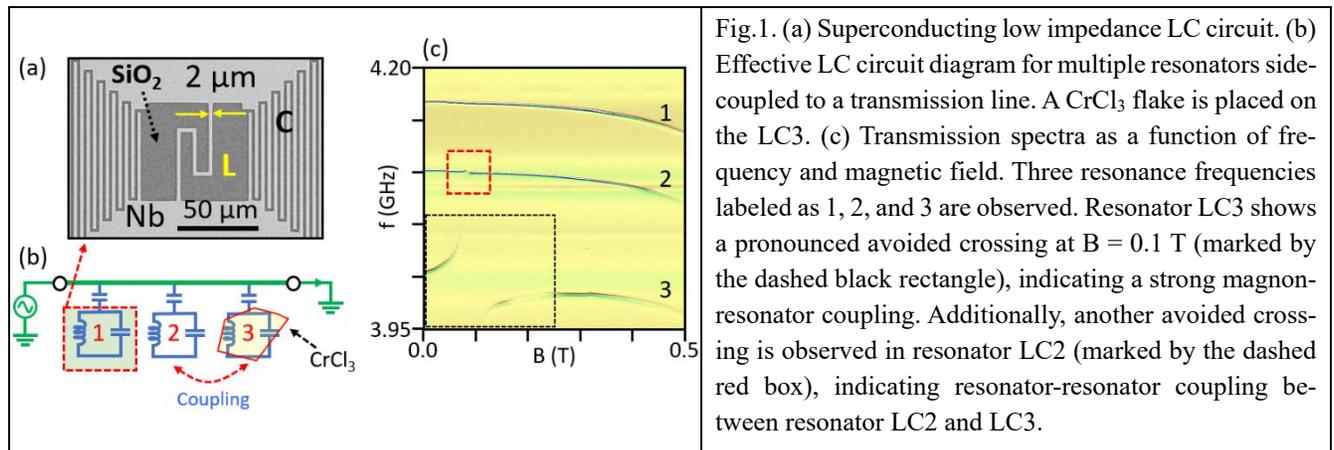
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Recently, superconducting resonators coupled with ensemble spins have drawn great attention since they can serve as a promising platform for quantum information processing based on light-matter interactions.

In this work, we report coupling between superconducting LC resonators mediated by the magnon of van der Waals 2-dimensional (2D)  $\text{CrCl}_3$  magnetic material. For strong coupling, we implemented low impedance superconducting LC circuits consisting of meander-type inductors and interdigitated capacitors, which generate a strong magnetic field around the inductors (Fig. 1(a)). We fabricated multiple LC resonators coupled to a RF feedline (Fig. 1(b)). When  $\text{CrCl}_3$  flake is placed on the superconducting LC resonator (LC3), the ensemble spins of  $\text{CrCl}_3$  are strongly coupled with the resonators through magnetic dipole interaction. We have observed that the coupling strength reaches 450 MHz (Fig. 1(c)).

Furthermore, we observed superconducting resonator-resonator coupling (red dashed box in Fig. 1(c)) in LC circuits mediated by the magnon of a  $\text{CrCl}_3$ . This implies that 2D van der Waals magnets can be used for transferring quantum information between two resonators that are separated in terms of space and resonance energy. We have varied the LC circuit schematic and measurement setup to qualitatively figure out the coupling strength trend between the superconducting resonators.



## References

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