# High-kinetic inductance coupled cavity arrays for analog quantum simulation

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In the field of analog quantum simulation, coupled cavity arrays (CCAs) have emerged as promising platforms for creating quantum baths of varying complexity, crucial for emulating complex many-body Hamiltonians [1, 2]. However, enhancing the reliability and compactness of these systems is of fundamental interest for their practical utility. Addressing this challenge, our work introduces a novel compact (50x75 $\mu m^2$), versatile, and low-disorder ($\sigma/f$ = 0.21 %) CCA platform based on high-kinetic inductance NbN thin films (Figure 1). Additionally, we present a new approach to study and extract disorder in CCAs by leveraging symmetry-protected topological SSH modes (Figure 2). The adaptability of our platform in controlling the mode density presents exciting prospects for the study of quantum impurity models and atom-photon bound states physics [3,4].

## References

[1] Georgescu et al, Review of Modern Physics, 1 (2014) 153-185.
[2] Zhang et al, Science, 6629 (2023) 278-283
[3] Messinger et al, Physical Review A, 3 (2019) 032325
[4] Scigliuzzo et al, Physical Review X, 3 (2022) 031036

## Figures

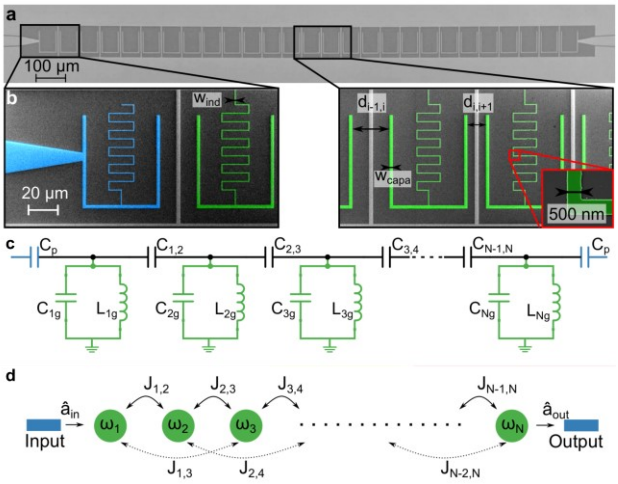


**Figure 1:** High kinetic inductance metamaterial. **a.** Optical micrograph of the metamaterial. **b.** Scanning electron micrograph of the metamaterial. **c.** Lumped-element model **d.** Coupled cavity model of the metamaterial.

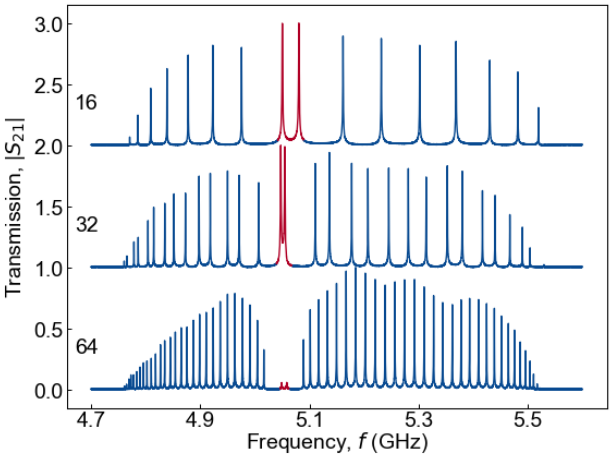


**Figure 2:** Measured spectrum of CCAs with increasing number of cavities in the SSH configuration. With the bulk modes in blue and edge modes in red.