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Hyperbolic and Flat-Band Lattices in Circuit QED[1] ALICIA KOLLAR, MATTIAS FITZPATRICK, ANDREW HOUCK, Princeton University — After close to two decades of research and development, superconducting circuits have emerged as a rich platform for both quantum computation and quantum simulation. The unique deformability of coplanar waveguide microwave resonators enables realization of artificial photonic materials which cannot be made from ordinary atomic or ionic systems. We will present two such examples. First, we will show that periodic lattices in hyperbolic spaces of constant negative curvature can be produced on chip, in particular hyperbolic analogs of the kagome lattice. These lattices constitute artificial materials which exist in regions of extreme gravitation or in anti-de Sitter space, and display highly unusual band structures with gapped flat bands. Second, we will present a novel Euclidean lattice, called the heptagon-pentagon-kagome (HPK) lattice, which displays a flat band with a particularly large gap. Because this flat band is spectrally isolated and dispersion-less, interactions are the dominant energy scale, enabling the study of strongly correlated, many-body photon states. We will explore the theoretical origin of this gapped flat band and show experimental results where we introduce effective photon-photon interactions via non-linear materials such as NbTiN.

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