Simulating artificial graphene with superconducting resonators

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We present experimental studies of two artificial honeycomb lattices made of superconducting resonators. We image the spatial distributions of the modes using a low temperature laser scanning microscopy based on the variation of the microwave transmission of the lattice (Fig. 1.a and 1.b). This variation is induced by the absorbed laser power by a site of the lattice and is proportional to the weight of the probed mode on this site. In addition to mode labeling, mode imaging enables the reconstruction of the dispersion relation by Fourier transform. We were able with this technique to investigate edges-states modes of graphene (Fig. 1.b, bottom right image) and domains walls modes at the interface between two gapped graphene (see Fig 1.d).

We also have developed an *ab initio* method to calculate lattice spectrum by simulating a few resonators on electromagnetic software. This provides an effective tight-binding Hamiltonian that is in good agreement with experimental data (Fig. 1.c for the graphene).

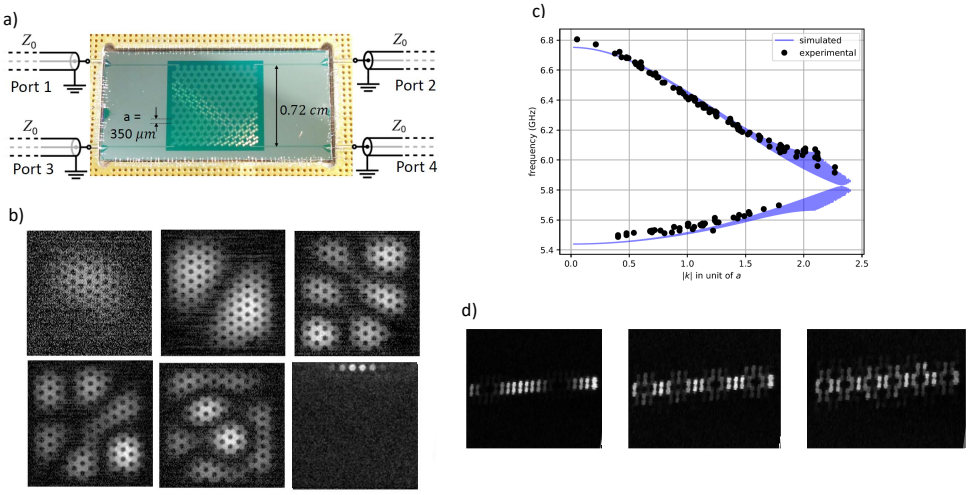

Figure 1. a) Image of the artificial graphene sample. b) Spatial distribution of a few modes. The one at the bottom right is one of the observed edge state. c) Comparison of experimental results and simulation for the dispersion relation of the lattice. d) Wall domains modes at the interface of two gapped graphene.