Intrinsic, robust, and isolated flat bands present at half-filling in the minimal model of the superconducting metal-organic framework, Cu-BHT

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Since the discovery of superconductivity in twisted bilayer graphene [1], there has been a strong interest in the potential connection between flat bands and unconventional superconductivity [2]. We introduce a new lattice, the kagome-Lieb lattice, which is to the kagome lattice as the Lieb lattice is to the square lattice. This is a simple model of the recently discovered metal-organic superconductor, Cu-BHT [3]. A nearest neighbour tight binding model reveals that the system has five flat bands, including three degenerate flat bands at half-filling. We show, using localised states in real space, that these flat bands arise from the topology of the lattice, and that, with the introduction of perturbations, the central degenerate bands remain narrower and more isolated than the flat bands in twisted bilayer graphene. Thus, any system with the kagome-Lieb lattice structure is likely to display exotic strongly correlated properties, leading to a whole new family of largely unexplored materials.

[1] Y. Cao et. al., Nature, **556** 43-50 (2018)

[2] L. Balents et. al., Nature Physics, **16**, 725-733 (2020)

[3] T. Takenaka, Science Advances, **7** 2375-2548 (2021)