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Quantum Imaging of Interaction-Induced Spontaneous Broken-Symmetry Phases in Molecular Graphene DOMINIK RASTAWICKI, YAN SUN, YANG LIU, YI-TING CHEN, HARI C. MANOHARAN, Stanford University — We present a survey of quantum states with interaction-induced broken symmetries observed in molecular graphene, assembled with atomic manipulation. These materials are assembled with atomic precision by patterning the Cu(111) two-dimensional electron gas surface state by single molecules; the molecules function as local potentials which form a coherently coupled system of electron quantum dots in a honeycomb lattice embedding massless Dirac fermions and tunable graphene properties. By crafting different local molecular arrangements together with varying lattice constants, we are able to probe a large parameter space of the strength of the intersite hopping parameter (bond strength), the doping level, and the interaction strength. The assembled nanomaterials are probed through STM/STS measurement, differential conductance maps, and quasiparticle interference with Fourier-transform STS. We observe both spontaneous nematic states and sublattice symmetry breaking in molecular graphene at very low band filling factors, and a nematic state in graphene variants where kinetic energy is effectively quenched. We show it is possible to modify and enhance the symmetry breaking effects by controlling certain boundary conditions and lattice geometry.

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