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Dirac Fermions in Nanoassembled Artificial Graphene[1] KENJIRO K. GOMES, WONHEE KO, WARREN MAR, HARI C. MANOHARAN, Stanford University — In condensed matter, electronic properties derive from the energy band structure created by a periodic potential formed by the atoms that constitute a particular material. The power to design unique electronic states is ultimately tied to the power to design the atomic lattice. Utilizing the technique of atomic manipulation with a scanning tunneling microscope, we create an artificial lattice potential that reshapes the band structure of a normal 2D electron gas—found in the surface states of a normal metal—into a unique and distinct 2D gas of massless Dirac fermions. We present scanning tunneling spectroscopic measurements of nanoassembled honeycomb electron lattices, and we characterize their band structure through Fourier transform analysis of impurity scattering maps. The control of every atomic position in the lattice provides unprecedented control over physical parameters elusive in natural graphene systems. These abilities include atomically sharp doping configurations and the power to embed topological singularities, resulting in unique electronic states rarely encountered in natural systems.

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