Abstract Submitted
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The $p_{x,y}$-orbital counterpart of graphene – cold fermions in the honeycomb optical lattices CONGJUN WU, Physics Department, UCSD, DORON BERGMAN, Physics Department, Yale, LEON BALENTS, Physics Department, UCSB, SANKAR DAS SARMA, Physics Department, Univ. of Maryland — We study the ground states of cold atoms in the tight-binding bands built from p-orbitals on a two dimensional honeycomb optical lattice. The band structure includes two completely flat bands. Exact many-body ground states with on-site repulsion can be found at low particle densities, for both fermions and bosons. We find crystalline order at n=1/6 with a $\sqrt{3} \times \sqrt{3}$ structure breaking a number of discrete lattice symmetries. In fermionic systems, if the repulsion is strong enough, we find the bonding strength becomes *dimerized* at n=1/2. Experimental signatures of crystalline order can be detected through the noise correlations in time of flight experiments.

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