Symmetry protected low energy electronic states in graphene grain boundaries

MADELEINE PHILLIPS, E.J. MELE, University of Pennsylvania — We study graphene grain boundaries with the goal of predicting whether they support symmetry protected low energy electronic states localized at the boundary. Starting from a structural model for a grain boundary treated in the short range tight binding limit, we provide an algorithm for generating a chiral operator that anticommutes with the full Hamiltonian. For grain boundaries with nonbipartite lattice structures this operator is highly nonlocal. We identify two classes of grain boundaries: those that admit this chiral representation and those that do not. In the former case a zero energy electronic state is required by symmetry. We compare our results with electronic structures computed for various grain boundaries presented in the literature.