Electrons in graphene heterostructures with hexagonal crystals.

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We analyze the transformation of the spectrum of electrons in monolayer graphene and bilayer graphene due to the influence of a tightly bound insulating or semiconducting layer with a slightly incommensurate highly oriented hexagonal lattice, such as boron nitride, or InAs/GaSb. We present a symmetry-based classification and quantitative analysis of generic miniband structures for electrons in graphene heterojunction with 2D crystals with the hexagonal lattice which has the period almost matching the period of graphene lattice or the period of $\sqrt{3}x\sqrt{3}$ enlarged cell of graphene. We identify conditions for which the first moire miniband is separated from the rest of the spectrum, either by one or a group of three isolated mini Dirac point (not obscured by dispersion surfaces coming from other minibands), or by a well-developed gap. In such cases the Hall coefficient exhibits two distinct alternations of its sign as a function of charge carrier density. Then, we study the Hofstadter spectrum of electrons in such moire superlattice in a magnetic field.