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Spectrum of Dirac operators describing Graphene Quantum dots

Low energy electronic excitations in graphene, a two-dimensional lattice of carbon atoms, are described effectively by a two–dimensional Dirac operator. For a bounded flake of graphene (a quantum dot), the choice of boundary conditions determines various properties of the spectrum. Several of these choices appear in the physics literature on graphene. For a simply connected flake and a family of boundary conditions, we obtain an explicit lower bound on the spectral gap around zero. We can also study the effect of the boundary conditions on eigenvalue sums in the semiclassical limit. This is joint work with Rafael Benguria, Søren Fournais and Edgardo Stockmeyer.