Spectral properties of rotationally symmetric massless Dirac operators

K.M. Schmidt

In its original form, the Dirac operator is the fundamental Hamiltonian for relativistic quantum mechanics of a massive particle of spin 1/2. Without the mass term, it can be taken as a model for the neutrino particle; however, as it does not carry electrical charge, the addition of an electrostatic-type potential will not then be of physical interest. Nevertheless, the zero eigenspace of a massless Dirac-type operator with magnetic potential has been shown to be of fundamental importance in the question of the stability of matter. More recently, the massless Dirac operator with a plain electric potential, particularly in two dimensions, has gained interest as a physically relevant description of effective electron movement in graphene.

The results reported here show that the essential spectrum of massless Dirac operators with a rotationally symmetric potential in two and three spatial dimensions covers the whole real line. Moreover, limit values of the potential at infinity can be eigenvalues of the operator, but outside the limit range of the potential the spectrum is purely absolutely continuous under a mild variation condition on the radial potential.