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Relativistic quantum chaos—-an analytic Dirac equation approach[1] LIANG HUANG, HONGYA XU, School of Physical Science and Technology, Lanzhou University, YING-CHENG LAI, School of Electrical, Computer, and Energy Engineering, Arizona State University — Relativistic quantum chaos has attracted much attention since the discovery of graphene in 2004. Using graphene billiard as an apparatus of relativistic quantum particles, relativistic quantum scars, level spacing statistics, and relativistic quantum scattering have been widely investigated recently. However, since graphene has two non-equivalent Dirac points which can be coupled together by various processes, it has been wondered that whether the observed phenomena are inherent to the relativistic movement or caused by the discrete graphene lattice structure and boundary terminations. Based on Berry et al.'s work on neutrino billiards, we developed a conformal transformation method to solve the 2D Dirac equation in a confined region resembling chaotic billiards in the classical limit. This method solves both the eigen-energies and the eigen-wavefunctions of the 2D massless Dirac fermions. Level spacing statistics and relativistic quantum scars for a heart-shaped billiard are investigated and comparisons with graphene billiards are made.

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