Introduction to Graphene Physics:
- Bridge between Condensed Matter Physics and QED -

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In this tutorial, we introduce the basic aspects of graphene, a truly two dimensional material, which is a single layer of carbon atoms arranged on a honeycomb structure made out of hexagons. Graphene reveals unusual collective behavior of electrons governed by the Dirac equation of massless Dirac fermions, rather than the usual Schroedinger equation, and, hence, graphene provides an unexpected bridge between the condensed matter physics and relativistic quantum field theory. The peculiar quasiparticle behavior is a direct consequence of the interaction between electrons and the honeycomb lattice. Graphene would be used as a small bench-top QED laboratory and allow us to investigate strange relativistic effects that have never been observed yet. We briefly review the electronic structure of graphene and discuss similarities and differences between physics of carriers in graphene and quantum electrodynamics. We start with a lattice model Hamiltonian of graphene both in the absence of magnetic field and in the presence of a dc magnetic field perpendicular to the system. Low energy structure of quasiparticles and a consequence of their charge-conjugation symmetry will be presented. Unusual properties, such as the anomalous quantum Hall effect and chirality of the massless quasiparticle states, will be illustrated and concepts of Klein paradox and zitterbewegung will be discussed.