Dynamical Mass Generation in Graphene by Bicircular Laser Fields

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Soon after the dawn of relativistic quantum mechanics, it became evident that no assistance of charged objects is needed to create electron-positron pairs from the quantum vacuum. This process, nowadays called the Sauter-Schwinger mechanism, can only take place with a significant probability for extremely intense fields. However, recent achievements in solid-state physics have shown that in some particular structures, such as graphene or topological insulators, electrons behave like relativistic quasi-particles with very small or even vanishing masses. This creates a possibility to investigate, both theoretically and experimentally, relativistic-type effects using much weaker and thus more easily achievable fields.

The goal of this presentation is to examine the quasi-particle mass-dressing in graphene induced by bicircular laser fields. This dynamical mass generation is due to the inter-band multi-photon resonant transitions, and it can be easily controlled by adjusting the parameters of the laser fields. Physical consequences of this phenomenon, specifically on the high-order harmonic spectrum, are also going to be discussed.