INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

In the present thesis, we studied the phenomenon of coherent and incoherent Rabi oscillations (ROs) in suspended and supported graphene based systems near and far from resonance using rotating wave approximation (RWA) and asymptotic rotating wave approximation (ARWA), respectively. These oscillations are defined as follows: the interaction between the atom and the electromagnetic field leads to a periodic exchange of energy between the electromagnetic field and the two-level system, known as Rabi oscillations. Mishchenko and Ishikawa among others have studied Rabi oscillations in single flake of graphene using rotating wave approximation (RWA). The first part of the thesis describes the phenomenon of coherent ROs in suspended and substrate-graphene system in conventional and far from conventional resonance. Rabi oscillations show anomalous behavior far from conventional resonance in graphene based systems. These oscillations have no counterparts either in two-level atoms or conventional semiconductors. The phenomenon of anomalous ROs (AROs) is unique to graphene systems. These oscillations are attributable to the pseudospin degree of freedom these systems possess.

In the preceding studies coherent AROs are described in graphene-based systems because the relaxation term is not taken into account. We are also interested to study the relaxation dynamics of carriers in these systems. This is described in the second part of the thesis. The relaxation dynamics may appear in a several ways like- electron-electron interaction, screening effects and electron-phonon interaction etc. Our main focus is the study of relaxation dynamics of carriers in these systems by means of electron-phonon (optical, acoustic and flexural) interaction. This can be done by calculating the dephasing rate which is the imaginary part of the particle's self-energy. We have calculated the self-energy of the system with the help of Dyson-equation. It is found that AROs in presence of electron-phonon interaction are not damped near the Dirac point. The electron-phonon interaction plays an important role in dephasing of AROs only far away from the Dirac point.