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Electron Interactions in Graphene

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Electrons confined in two dimensions (2D) can exhibit strongly correlated states. Recent experimental discovery of integer and fractional quantum Hall effect in graphene amplified interest in correlated 2D electronic systems, owning to presence of the unusual topological phase associated with zero effective mass of charge carriers. In this talk, we will discuss the role of the many-body effects due to the electron-electron interaction in graphene manifested in electron transport phenomena. In particular, we will discuss the nature unusual spontaneous symmetry breaking Landau levels graphene under the extreme quantum condition, the appearance of unique low density insulating states and fractional quantum Hall states. Employing extremely high quality samples obtained by suspending graphene and graphene on atomically flat defect free insulating substrate such as hexa-bron nitride, we now investigate various broken symmetry states under high magnetic field. The nature of these broken symmetry state can be explained generally considering underlying SU(4) symmetry in the single particle level of the Landau levels.