

## Strong correlations in massive and massless Dirac systems

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In the first part of this talk I will review our recent works on the effects of Hubbard interaction on Dirac systems. For moderate values of Hubbard  $U$  in 2+1 dimensional Dirac systems we find a triplet branch of particle-hole excitations [1,2,3,4,5]. Further increase in the Hubbard  $U$  renders the system Mott insulating. This is a second order phase transition characterized by vanishing of the Fermi velocity [6]. For massive 2+1 dimensional Hubbard  $U$  first compensates the single-particle gap parameter,  $m$ , and gives rise to a massless Dirac theory for a range of Hubbard parameter. Eventually for strong enough Hubbard  $U$  the system ends in a Mott phase [7]. We obtain similar results with strong coupling expansion method [8]. In the second part of this talk, I will present results on the local moment problem in Dirac systems. We find that the spin-orbit coupling inherent in the 3+1 dimensional Dirac theory allows for local moment formation with small values of Hubbard  $U$  that allows for local moment formation even in  $p$  orbital systems [9]. We also discuss peculiar features of the Kondo problem in vacant graphene that raises from  $p$ -wave hybridization [10,11].

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