Interaction quench in the IHM

Soumen Kumar Bag

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1 Introduction

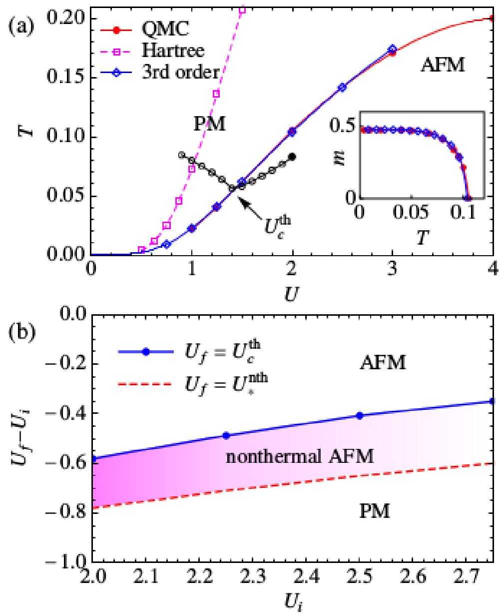
The study of the temporal evolution of systems undergoing symmetry breaking phase transitionswhether it is incondensed-matter physics, cosmology or finance 16 is difficult because they are hard to repeat, or they occur very rapidly.

$$H_{IHM} = -t \sum_{\langle i\in A, j\in B\rangle,\sigma} (\hat{c}^{\dagger}_{j\sigma}\hat{c}_{i\sigma} + hc) + \Delta \sum_{i\in A} \hat{n}_i - \Delta \sum_{i\in B} \hat{n}_i - \mu \sum_{i,\sigma} \hat{c}^{\dagger}_{i\sigma}\hat{c}_{i\sigma} + U \sum_{i} \hat{n}_{i\uparrow}\hat{n}_{i\downarrow} \tag{1}$$

Here t is the nearest neighbor hopping and, U the Hubbard repulsion has been Δ is the staggered one body potential which doubles the unit cell. When Δ is zero it is exactly Hubbard Hamiltonian.

Phase diagram of this model is studied [2, 4]. In non interacting case it is charge density wave(CDW) band insulator. As one increase U in this model CDW stat are suppressed and band insulating phase crossover to correlated metal state. If you increase U farther at certain critical U_c there will be metal to Mott insulating transition in para-magnetic calculation. We want to study at certain U(BI,M,MI) if one suddenly turn on Δ in HM how CDW phase appear in the Hamiltonian. Previously in Hubbard model(HM) interaction quench problem already done for both para[3, 1, 6] and AFM phase[5, 6] using IPT-DMFT. Double occupancy, jump of the distribution function across fermi level has been studied. Some people also studied the Melting of CDW state in the system.

2 interaction quench



(a) HF

FIG. 1 (color online). (a) Equilibrium phase diagram of the Hubbard model in the weak-coupling regime at half filling, calculated by DMFT with several different impurity solvers. QMC data are taken from Ref. [25]. Effective temperatures for quenches from a fixed initial state ($U_i = 2$, black dot) to various final states (open dots) are shown. Inset: Staggered magnetization m as a function of T at $U = 2$. (b) Nonequilibrium phase diagram for a quench $U_i \to U_f$ with the fixed initial magnetization, $m(0) = 0.4$. For $U_f > (<) U_c^{\rm th}$, the system finally thermalizes to an AFM (PM) state. A nonthermal AFM order emerges in the colored region. The shading indicates the increasing lifetime of the nonthermal AFM state as U_i is reduced.

(b) DMFT

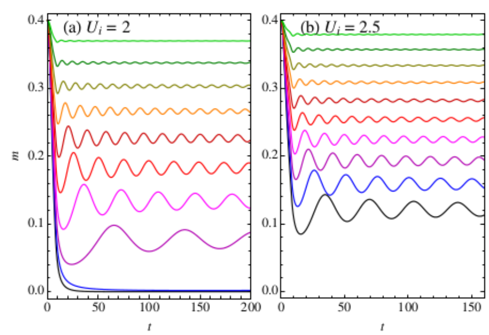


FIG. 1: Time evolution of m calculated with the Hartree approximation for quenches (a) $U_i = 2 \to U_f = 1.0, 1.1, \ldots, 1.9$ (from bottom to top) and (b) $U_i = 2.5 \to U_f = 1.5, 1.6, \ldots, 2.4$ (from bottom to top). The color codes are the same as Fig. 2 in the main text. Note that the temperatures of the initial states are chosen to be different values from those of Fig. 2 in the main text to fix $m(0) = 0.4$.

(a) HF

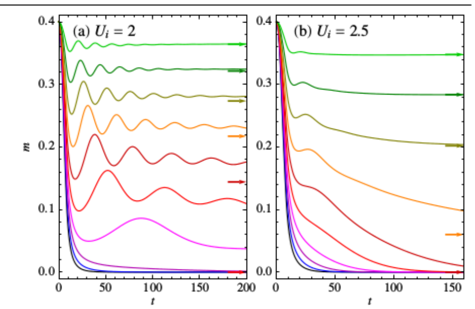


FIG. 2 (color online). Time evolution of m for quenches (a) $U_i = 2 \to U_f = 1.0, 1.1, \ldots, 1.9$ (from bottom to top), and (b) $U_i = 2.5 \to U_f = 1.5, 1.6, \ldots, 2.4$. The arrows indicate the corresponding thermal values $m_{\rm th}$ reached in the long-time limit.

(b) DMFT

for the Hubbard model we see that steady double occupancy is larger than the equilibrium value. where as for IHM case its is lower

References

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