Diffusing Particles in a Random Potential: Exact and Approximate Results

(Talk #4)

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Sub-diffusion has been observed in systems ranging from charge carrier transported in amorphous semiconductor to biological macromolecules in the cell. Random trap model is one of the most studied models to describe the anomalous diffusion behavior. In this talk, we first focus on the stationary state of trap dynamics and show the analogy between the random trap model and the random energy model (REM). The equilibrium freezing transition in REM is corresponding to a dynamical transition in random trap model. Castillo and Le Dossal (CLD) have discovered similar dynamical transition in first-passage processes on logarithmically spatial-correlated landscape. The CLD freezing scenario is exact in 1D and conjectured in 2D. We further developed a weighted summation approach, which can exactly calculate the mean first-passage time of trap dynamics in any dimension. Employing this approach, we generalized the CLD freezing scenario to any dimension. To be noticed, the dynamical exponents of the trap dynamics and the gradient dynamics (Metropolis) are different in 1D. This is because the effective barriers felt by the two dynamics are significantly different. Due to the importance of saddle point in the d>=2 gradient dynamics, the two dynamics are expected to share the same exponent in the d>=2 cases.