[P4] The role of hard-core interaction on complex networks

Junghwa Kim, Kyung-Hee University

In one dimensional lattice, HC exclusion severely restricts the motion of particles by forbidding overtaking one another, which results in unexpected and interesting phenomena in driven systems such as asymmetric exclusion process and biomolecular chemical reactions. In higher dimensions, however, since diffusion of particles is normal even with HC exclusion, HC exclusion is irrelevant to high dimensional properties. In this work, however, we show that HC interaction drastically changes the critical behavior of a system with the conservation of the total particle number on scale-free networks (SFNs) even without external driving field. For this aim, we investigate the diffusive epidemic process (DEP) on SFNs with degree distribution $P(k)\sim k^{-\gamma}$. DEP consists of two species of particles, namely A and B, and evolves via the following three dynamical processes: (i) A- and B-particles randomly diffuse to one of the directly linked nodes with rate D_A and D_B, (ii) each A-particle is spontaneously transformed into a B-particle with rate p, (iii) when a A-particle attempts to the node occupied by B-particle, the B-particle is transformed into A-particle with rate q. The dynamical process conserves the number of total particles. On regular lattice, DEP was shown to belong to the universality class distinct from directed percolation (DP) class. However, on SFNs, we show that DEP of HC particles exhibits the mean-field behavior of DP class rather than the behavior of bosonic DEP. It results from the fact that heterogeneous degree distribution drives particles to hub nodes with finite fractions of total degree. As a result, particles are compactly packed around the hub nodes and thus the diffusion is of no effect.