[P5] The kinetics of irreversible bimolecular chemical reactions on weighted scale-free networks

Woosik Choi, Kyung-Hee University

We investigate the kinetics of bimolecular chemical reactions $A + A \to 0$ and $A + B \to 0$ on weighted scale-free networks (WSFNs) with degree distribution $P(k) \sim k^{-\gamma}$. On WSFNs, a weight w_{ij} is assigned to the link between node *i* and *j*. We consider the symmetric weight given as $w_{ij} = (k_i k_j)^{\mu}$, where k_i and k_j are the degree of node i and j. The hopping probability T_{ij} of a particle from node i to j is then given as $T_{ij} \propto (k_i k_j)^{\mu}$. From a mean-field analysis, we analytically show in the thermodynamic limit that the kinetics of $A + A \to 0$ and $A + B \to 0$ are identical and there exist two crossover values μ, $\mu_{1c} = \gamma - 2$ and $\mu_{2c} = (\gamma - 3)/2$. The density of particles $\rho(t)$ algebraically decays in time *t* as $t^{-\alpha}$ with $\alpha = 1$ for $\mu < \mu_{2c}$ and $\alpha = (\mu + 1)/(\gamma - \mu - 2)$ for $\mu_{2c} \leq \mu < \mu_{1c}$. For $\mu \geq \mu_{1c}$, ρ decays exponentially. With the mean-field rate equation for $\rho(t)$, we also analytically show that the kinetics on the WSFNs is mapped onto that on unweighted SFNs with $P(k) \sim k^{-\gamma'}$ with $\gamma' = (\mu + \gamma)/(\mu + 1)$.