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Titre : *Fluctuations control the assembly kinetics of semiflexible filaments*

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Résumé : *The problem of irreversible polymerization is fundamental for its many applications to different fields, from material science to biology. In living cells, cytoskeletal filaments grow and bundle together, forming complex networks. Since the assembly and bundling of these filaments often involve energies of the order of hundreds or thousands of kT, the final structure of the network will be heavily influenced by the kinetics of these processes (Kayser et al., Soft Matter, 2012, 8, 8873). Approaches based on equilibrium physics are therefore bound to fail when studying the structural and mechanical properties of such networks, and approaches that explicitly considers the kinetics are necessary.*

We extend a previously developed theoretical framework (De Gennes, J. Chem. Phys., 1982, 76, 3316) to study how the average length L of a system of semiflexible filaments that anneal irreversibly via end-to-end reactions increases with time. We find that filament assembly is controlled by the short-time transversal fluctuations, which lead to a linear growth of L with time. We perform the same calculations also for perfectly rigid rods, which have no transversal fluctuations modes, showing that in this case L increases only as the square root of time. Finally, we compare our theoretical predictions with molecular dynamics simulations of particles that aggregate irreversibly into semiflexible filaments with a tunable persistence length, finding an excellent agreement with the theoretical predictions.