Polymer translocation through a nanopore studied by Langevin dynamics

LEI GUO, ERIK LUIJTEN, Department of Materials Science and Engineering, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801 — Polymer translocation through a nanopore has gained considerable attention in recent years, due to its potential application in DNA-sequencing. The design of a corresponding device requires a full understanding of the translocation dynamics. The scaling of polymer translocation time $\tau$ with polymer chain length $N$ is an important measure of the underlying dynamics. A recent experiment\(^1\) has uncovered a scaling behavior $\tau \propto N^{1.26}$ that differs from the linear law observed in other experiments. To explain this newly-observed scaling behavior, we have employed Langevin dynamics simulations. Using a bead–spring model for the polymer chain and a membrane composed of one layer of hard-sphere particles, we have studied a wide range of chain lengths $20 \leq N \leq 640$, for different friction coefficients $\xi$. A crossover scaling behavior was found for $\tau$, which is controlled by both $N$ and $\xi$. We explain the measured scaling behavior from the chain conformations and instantaneous translocation velocities.