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Hydrodynamics Meets Topology

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Abstract:

Topology is an intriguing parameter to study in polymer science. Due to recent progress in polymer synthesis, many distinct topologies, e.g. unknotted or differently knotted ring polymers, are now synthesizable, in addition to linear chains. Nevertheless, it remains challenging to produce topologically pure samples, which are necessary to investigate the impact of topology on material properties. Using computer simulations that take hydrodynamic interactions explicitly into account, I investigate the transport of chains, rings and knotted rings in micro- and nanofluidic devices. Rings can be separated from chains at high mass throughput by applying pressure-driven flow to semi-dilute mixtures of any composition. In addition, high purity filtration of chains and rings can be achieved at dilute conditions, when decorating the channel walls with attractive spots interacting with single monomers via a short-range potential. Finally, knotted ring polymers can be separated from unknotted ones by applying weak flows in cylindrical channels of varying cross-section.