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Topological transitions in unidirectional flow of nematic liquid crystal[1] LINDA CUMMINGS, New Jersey Institute of Technology, THOMAS ANDERSON, Caltech, ENSELA MEMA, LOU KONDIC, New Jersey Institute of Technology — Recent experiments by Sengupta et al. (Phys. Rev. Lett. 2013) revealed interesting transitions that can occur in flow of nematic liquid crystal under carefully controlled conditions within a long microfluidic channel of rectangular cross-section, with homeotropic anchoring at the walls. At low flow rates the director field of the nematic adopts a configuration that is dominated by the surface anchoring, being nearly parallel to the channel height direction over most of the cross-section; but at high flow rates there is a transition to a flow-dominated state, where the director configuration at the channel centerline is aligned with the flow (perpendicular to the channel height direction). We analyze simple channel-flow solutions to the Leslie-Ericksen model for nematics. We demonstrate that two solutions exist, at all flow rates, but that there is a transition between the elastic free energies of these solutions: the anchoring-dominated solution has the lowest energy at low flow rates, and the flow-dominated solution has lowest energy at high flow rates.

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