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Droplet motion in flexible channels: Effects of opening angle and wettability

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Passive and directional droplet transport has gained significant interest due to their potential applications, e.g., self-cleaning surfaces and atmospheric water harvesting. One novel mechanism, known as *bendotaxis*, involves droplets spontaneously deforming an elastic channel via capillary pressure, thereby inducing droplet motion. However, current studies have primarily focused on parallel channels, neglecting the potential influence of channel geometry on droplet motion and transport efficiency. This study aims to investigate the combined effects of channel opening angle, structural flexibility, and surface wettability on droplet motion dynamics. We employ a comprehensive approach, combining macroscopic-scale experiments, numerical simulations, and a simplified mathematical model to explore different transport modes and their associated timescales. The current study offers insights into directional droplet transport phenomena, leading to potential technological advancements in various fields.

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