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Two-dimensional directed polymers anchored at curved edges

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It is well known that the equilibrium statistical mechanics of a liquid of mutually avoiding directed polymers in two dimensions can be analyzed by means of an analogy with the imaginary-time many-body quantum mechanics of a system of particles moving in one dimension [1]. In this approach, the polymers have commonly been considered to be anchored to a straight-edge boundary. It has recently been shown that topological obstacles that constrain the polymer configurations, such as point-like pins, can induce voids in which the polymer density profile is heavily suppressed [2]. Here, we extend this approach to the study of the equilibrium statistical mechanics of liquids of mutually avoiding directed polymers that are anchored at boundaries that form closed curves, either circular or (low-eccentricity) elliptic. Specifically, we study how the curvature and eccentricity of these boundaries modifies the free energy of the system. For the case of elliptic boundaries, we show that the eccentricity alters the ground state of the quantum system, and thereby influences the structure of any constraint-induced voids in the density profile.

[1]P. G. de Gennes, J. Chem. Phys. 48, 2257 (1968).
[2]D. Z. Rocklin, S. Tan, and P. M. Goldbart, Phys. Rev. B 86, 165421 (2012)

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