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Unzipping, Twisting, and Unknotting: How Nanopore Translocation Reshapes DNA

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Polymer translocation — the process of pulling single filamentous molecules through narrow pores — has long been studied as an example of out-of-equilibrium statistical mechanics and for its rel- evance in DNA sequencing and biological processes. However, the case in which the polymer structure itself is deeply altered by translocation remains largely unexplored. Here, we address this phenomenon in two prototypical cases involving DNA filaments. First, we discuss DNA unzipping, where one of the two strands is pulled through a nanopore while the other remains outside. Next, we examine the consequences on DNA organization of a recently discovered effect, namely that the double-helical segment inside the pore is subject to a solvent-induced rotation. The physical implications of the two settings are discussed for DNA filaments with and without knots.

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