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DNA walks one step at a time in electrophoresis JUAN GUAN, BO WANG, STEVE GRANICK, U of Illinois-Urbana Champaign — Testing the classical view that in DNA gel electrophoresis, long polymer chains navigate through their gel environment via reptation, we reach a different conclusion: this driven motion proceeds by stick-slip. Our single-molecule experiments visualize fluorescent-labeled lambda-DNA, whose intramolecular conformations are resolved with 30 ms resolution using home-written software. Combining hundreds to thousands of trajectories under amplitudes of electric field ranging from zero to large, we quantify the full statistical distribution of motion with unprecedented statistics. Pauses are seen between steps of driven motion, probably reflecting that the chain is trapped inside the gel matrix. The pausing time is exponentially distributed and decreases with increasing electric field strength, suggesting that the jerky behavior is an activated process, facilitated by electric field. We propose a stretch-assisted mechanism: that the energy barrier to move through the gel environment is first overcome by a leading segment, the ensuing intramolecular stress from stretching causing lagging segments to recoil and follow along.

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