

**Dynamics of supercoiled DNA:
some recent insights from single-molecule experiments**

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Abstract:

DNA supercoiling plays a crucial role in a number of essential cellular processes such as gene expression, DNA replication and recombination. To quantitatively understand how both physical processes (e.g. plectoneme diffusion) and biological processes (e.g. topoisomerase activity) contribute to supercoiling regulation, an accurate description of the dynamics of supercoiled DNA is required.

We have first studied the dynamics of single supercoiled DNA molecules in the absence of protein, using an apparatus that combines optical and magnetic tweezers to apply sudden changes in tension or torsion. Experimental results were accurately analyzed without having to include the rotational drag originating from supercoil removal, indicating fast internal dynamics of supercoiled DNA.

Recently, we have also studied the dynamics of enzyme-mediated DNA relaxation, by transposing previous experiments performed with topoisomerases to the case of DNA ligases. Indeed, these enzymes exhibit topoisomerase-like activity when provided an adequate cofactor. Interestingly, our experiments show that, contrary to topoisomerases, ligases do not significantly slow down DNA relaxation (no friction being experimentally observed), but occasionally dissociate from nicked DNA. They also yield a lower bound for DNA ligation rate.