New technique illuminates DNA helix

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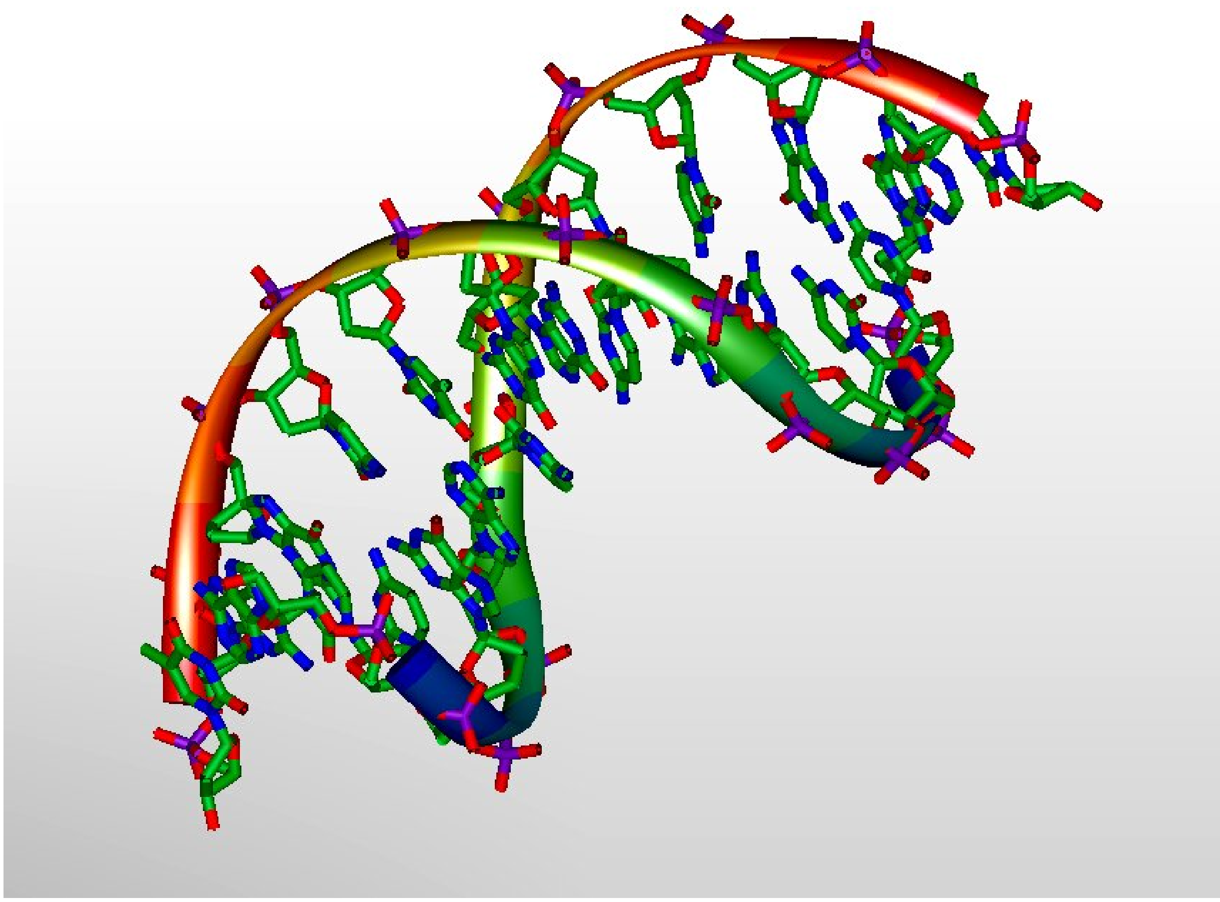

3D-model of DNA. Credit: Michael Ströck/Wikimedia/ GNU Free Documentation License

Cornell researchers have identified a new way to measure DNA torsional stiffness—how much resistance the helix offers when twisted—information that can potentially shed light on how cells work.

Understanding DNA is critically important: It stores the information that drives how cells work and is increasingly being used in nano- and biotechnology applications. One key question for DNA researchers has been what role the helical nature of DNA plays in processes that take place on DNA.

As a motor protein moves forward along DNA, it must twist or rotate the DNA, and therefore work against the torsional resistance of the DNA. (These motors can carry out gene expression or DNA replication as they move along DNA.) If a motor protein encounters too much resistance, it may stall. While scientists know that DNA torsional stiffness plays a crucial role in the fundamental processes of DNA, measuring torsional stiffness experimentally has been exceedingly difficult.

In "Torsional Stiffness of Extended and Plectonemic DNA," published July 7 in *Physical Review Letters*, researchers report on a new way to measure DNA torsional stiffness by measuring how hard it is to twist the DNA when the DNA end-to-end distance is held constant.

"We figured out a very clever trick to measure the torsional stiffness of DNA," said senior author Michelle Wang, the James Gilbert White Distinguished Professor in the Physical Sciences in the Department of Physics in the College of Arts and Sciences and investigator of the Howard Hughes Medical Institute.

"Intuitively, it seems that DNA will become extremely easy to twist under an extremely low force," Wang said. "In fact, many people have made this assumption. We found that this is not the case, both experimentally and theoretically."

The first author is Xiang Gao, postdoctoral fellow in the Laboratory of Atomic and Solid State Physics.

The technique also offers new opportunities to study twist-induced phase transitions in DNA and their biological implications. "Many colleagues commented to me that they were really excited about this finding as it has broad implications for DNA processes in vivo," Wang said.

More information: Xiang Gao et al, Torsional Stiffness of Extended and Plectonemic DNA, *Physical Review Letters* (2021). DOI: 10.1103/PhysRevLett.127.028101

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