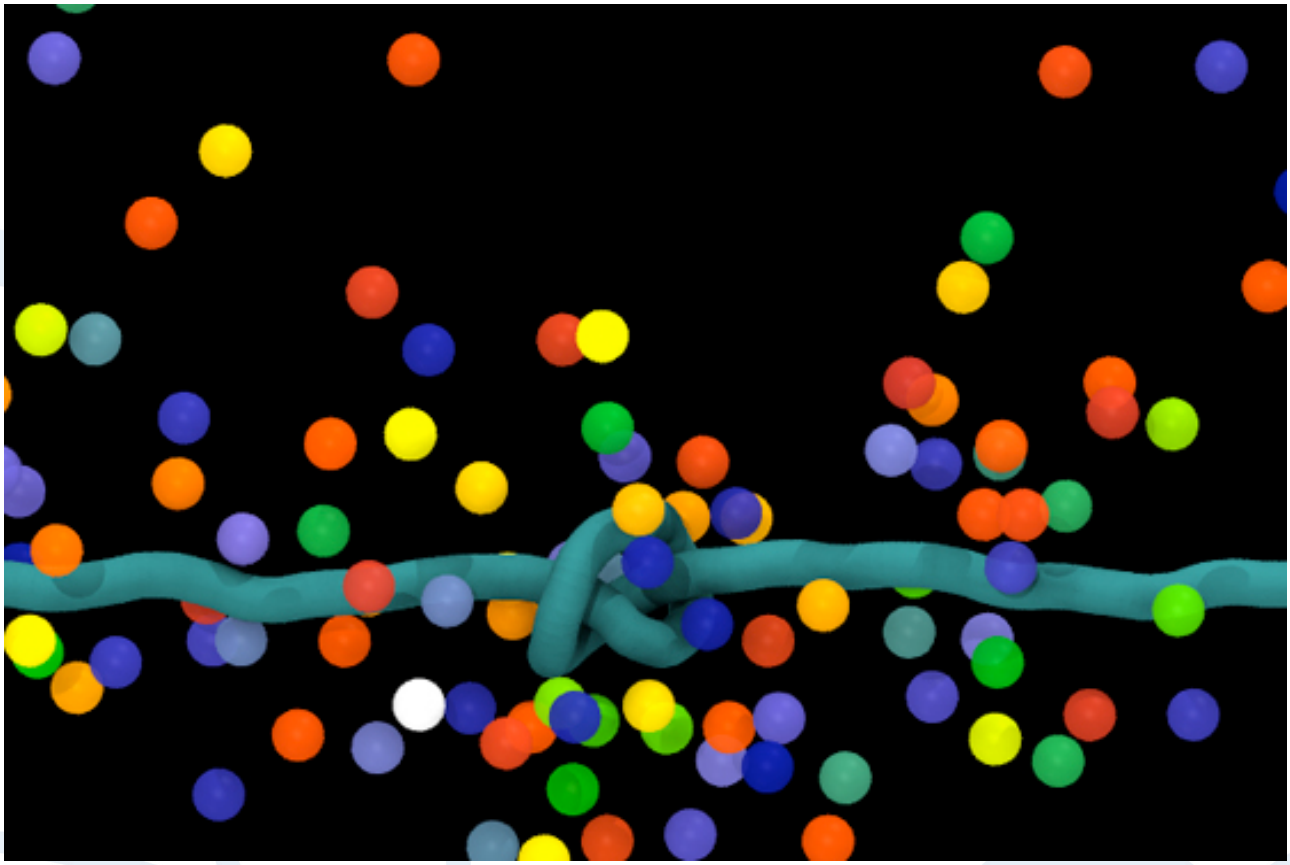
The electric slide dance of DNA knots



How to drive DNA knots with an electric potential

July 23, 2014

DNA is an electrically charged molecule, and for this reason the knots that form spontaneously along the strand can be manipulated by applying electric fields, as done by Cristian Micheletti, professor at SISSA, and his team. The research paper has just been published in *Soft Matter* and is the first example of a technique allowing DNA knots to be driven from the outside.

DNA has the nasty habit of getting tangled and forming knots. Scientists study these knots to understand their function and learn how to disentangle them (e.g. useful for gene sequencing techniques). Cristian Micheletti, professor at the International School for Advanced Studies (SISSA) in Trieste and his team have been carrying out research in which they simulate these

knots and their dynamics. In their latest paper, just published in the journal *Soft Matter*, Micheletti together with Marco Di Stefano, first author and PhD student at SISSA, and colleagues from Ljubljana and San Diego devised and tested a method based on the application of electric fields and "optical tweezers".

DNA is in fact an electrically charged molecule which reacts to the presence of opposing charges. "In our theoretical-computational study we took into account a "stretched-out" strand of DNA, with its ends secured by two optical tweezers that serve as anchors to keep them apart. We succeeded in moving the knot, inserted into the configuration, by applying an electric field", explains Micheletti. "Try to imagine holding one end of a knotted rope so that the rope is suspended above the ground: by shaking it gently you can make the knot slide down with the help of gravity. Something like that takes place in our experiments".

"Our work", concludes Micheletti, "provides useful information for setting up new experiments where the movement of the DNA knots can be controlled from the outside". In fact, in studies of this kind carried out to date the movement of the knot was "stochastic", that is, produced by thermal noise, the random movement of atoms caused by the rise in temperature of the system, and never directly controlled by the investigator.

USEFUL LINK:

Original paper:
http://pubs.rsc.org/en/Content/ArticleLanding/2014/SM/C4SM00160E#!divAbstract

PICTURE:

Simulation of a knotted DNA chain under mechanical tension. The coloured "confetti" are positive ions that counterbalance the negative charge of DNA, maintaining the system electrically neutral
Credits: SISSA (Micheletti/Di Stefano)
(gallery on Flickr: http://bit.ly/1A4vkQe**).**

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