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Modifying DNA topology through packing and enzymatic reactions.

Flexible circular chains appear often in nature, from microscopic DNA plasmids to macroscopic loops in solar corona. Such chains entrap rich geometrical and topological complexity which can give insight into the processes underlying their formation or modification. While knotted and interlinked DNA molecules are believed to be undesired in the cellular environment, they have been shown to occur as by-products of enzymatic reactions and of DNA packing. Reconnection processes involving one or two cleavages are used to simplify the topology of DNA. Examples include the action of type II topoisomerases and DNA recombination. We use techniques from knot theory and low-dimensional topology, aided by discrete methods and computational tools to study DNA packing, and the action of enzymes that change the topology of DNA. We are particularly interested in processes of unknotting and unlinking by local reconnection, and in the packing of DNA in bacteriophage capsids. In this talk I will give and overview of some of this research. (Received September 25, 2018)