TANGLE ANALYSIS OF THE MU TRANSPOSOSOME

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(Joint work with Isabel Darcy and John Luecke)

Site-specific recombinases are enzymes that bind two identical DNA segments, introduce a double-stranded break, recombine the loose ends, and reseal the recombined ends together. When acting on circular DNA they may result on knotting or linking of the DNA molecules. A tangle consists of arcs properly embedded in a 3-dimensional ball. In the 80ies Ernst and Sumners used 2-string tangles to model site-specific recombination reactions. In their tangle model the 3-dimensional ball represents the protein (enzyme) complex while the arcs represent DNA segments bound within this protein complex. The recombination mechanism is understood by solving systems of 2-string tangle equations.

Certain protein complexes such as Gin, Hin and Mu bind three arcs instead of two. Based on the experimental results of Pathania, Jayaram, and Harshey (Cell, 2002), we solved 3-string tangle equations modeling the Mu transposase complex bound to three segments of DNA. Pathania et al. used an experimental technique called difference topology to propose one possible 3-string tangle model for the shape of DNA bound within the Mu transposase protein complex. We describe other families of solutions to the same tangle equations and we argue that the model given by Pathania et. al. is the only biologically reasonable one. In particular, we show that the solution they propose is the only rational tangle solution and the only small crossing solution.

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