The effect of electrostatic interactions in minicircle networks

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The mitochondrial DNA in kinetoplastids, called kinetoplast DNA (kDNA), is partitioned into thousands of maxi and minicircles that are highly confined. Due in part to its high concentration, nearest neighbour minicircles are topologically linked through Hopf links forming a topological network similar to a medieval chainmail. The presence of histone-like proteins suggests that one key contributing factor to the final structure of the kDNA network is the electrostatic interaction of DNA molecules. In this work we use the concept of knot *energy* to study the effects of electrostatic interactions in kDNA networks. Each minicircle is modelled as a rigid circle and the electrostatic interactions between pairs of minicircles is defined by the Mobius energy ($p=2$). Previous works have shown that the Hopf link is a minimizer of two linked minicircles whose interaction is given by the Mobius energy. In this work we show that the energy minimizer for two minicircles is a conformation in which the two minicircles are contained into planes perpendicular to each other and whose centres are a distance of $\sqrt{2}$. Second, we study energy minimizers for entire networks using steepest descent methods. We find that the mean energy values obtained are xxx and the configurations in which linked minicircles tend to be locally orthogonal to each other. We end by estimating the energy required for the minicircles to be parallel to each other and how histone like proteins can decrease this value.

**Abstract for Poster Presentation:**