

# PERCOLATION PHENOMENA IN DISORDERED TOPOLOGICAL NETWORKS

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## Abstract

Topological polymer networks are networks made of circular polymers that are topologically linked. Topological networks made of small circular DNA or protein molecules are of great interest in biology and nanotechnology because they are found in living organisms and can be constructed in-vitro. The physical factors that determine the topology of a network as well as the pathways that are followed for its formation remain poorly understood. In our previous work we proposed a novel biophysical/computational approach to model the formation of planar DNA minicircle networks in trypanosomatid parasites. This model suggests that minicircle networks in trypanosomatid parasites emerged from topologically free minicircles upon space confinement through a percolation pathway. This model however is somewhat idealized because it assumes that the centers of the minicircles in the network are regularly positioned across a planar lattice. Here we propose an extension of the model by allowing the centers of the minicircles to be randomly placed in a planar surface. We numerically show that upon increasing minicircle density, networks form, following a percolation pathway. Our model suggests that the critical percolation density increases as  $D^{perc} = 0.8357 - 1.4297 \exp(0.6439x)$  with  $x$  is the maximum displacement. Our results therefore show that minicircle positioning does not dramatically affect the process of network formation through percolation supporting therefore that networks made of circular polymers may follow this pathway during their formation.