The growth of minicircle networks on regular lattices

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Abstract

The mitochondrial DNA of trypanosomes is organized into a network of topologically linked minicircles. In order to investigate how key topological properties of the network change with minicircle density the authors introduced, in an earlier study, a mathematical model in which randomly oriented minicircles were placed on the vertices of the simple square lattice. Using this model the authors rigorously showed that when the density of minicircles increases, percolation clusters form. For higher densities these percolation clusters are the backbones for networks of minicircles that saturate the entire lattice. An important relevant question is whether these findings are generally true. That is, whether these results are independent of the choice of the lattices on which the model is based. In this paper, we study two additional lattices (namely the honeycomb and the triangular lattices). These regular lattices are selected because they have been proposed for trypanosomes before and after replication. We compare our findings with our earlier results on the square lattice and show that the mathematical statements derived for the square lattice can be extended to these other lattices qualitatively. This finding suggests the universality of these properties. Furthermore, we performed a numerical study which provided data that are consistent with our theoretical analysis, and show that the effect of the choice of lattices on the key network topological characteristics is rather small.

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