Entropy of trails on the square lattice in the full lattice limit

Lucas R. Rodrigues, Thomas Prellberg, Jürgen F. Stilck

[1] IF-Universidade Federal Fluminense,
[2] School of Mathemathical Sciences, Queen Mary University of London,
[3] IF-Universidade Federal Fluminense

Trails are lattice walks which are constrained to pass through each edge of the lattice at most once [1], they may be seen as a generalization of the self-avoiding walks (SAW's), which visit each *site* of the lattice not more than once. On the square lattice, the trail at each site, when the four incident edges are occupied, may have three possible configurations: two *collisions*, where pairs of perpendicular edges are connected, and a *crossing*, where pairs of parallel edges connect. We study the model of semi-flexible trails on the square lattice in the compact limit, that is, when the walk passes through all the edges of the lattice and crossings have a statistical weight ω. To obtain estimates for the entropy, we solve the model model numerically on strips of finite widths m using transfer matrices and extrapolate our results to the two-dimensional limit $m \to \infty$. When crossings are forbidden ($\omega = 0$), the model is known as VISAW in the literature and many exact results are known [2]. Another particular limit is $\omega = 1$, where the entropy reaches a maximum, and finally $\omega \to \infty$, where no collisions appear and the entropy vanishes. Besides obtaining precise estimates for the entropy as a function of the density of crossings ρ_x, we also solve the model in a simple mean-field approximation, where loops are allowed, and on the Husimi lattice built with squares [3], comparing the results.

References

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