Journal of Statistical Mechanics: Theory and Experiment
An IOP and SISSA journal

Statistics of semiflexible self-avoiding trails on a family of two-dimensional compact fractals

I Živić[1], S Elezović-Hadžić[2] and S Milošević[2]

[1] Faculty of Natural Sciences and Mathematics, University of Kragujevac, 34000 Kragujevac, Serbia
[2] Faculty of Physics, University of Belgrade, PO Box 44, 11001 Belgrade, Serbia
E-mail: ivanz@kg.ac.rs, suki@ff.bg.ac.rs and emilosev@etf.rs

Received 1 August 2011
Accepted 17 September 2011
Published 17 October 2011

Online at stacks.iop.org/JSTAT/2011/P10015
doi:10.1088/1742-5468/2011/10/P10015

Abstract. We have applied the exact and Monte Carlo renormalization group (MCRG) method to study the statistics of semiflexible self-avoiding trails (SATs) on the family of plane-filling (PF) fractals. Each fractal of the family is compact, that is, the fractal dimension d_f is equal to 2 for all members of the PF family, which are enumerated by an odd integer b, $3 \leq b < \infty$. Varying values of the stiffness parameter s of trails from 1 to 0 (so that when s decreases the trail stiffness increases) we calculate exactly (for $3 \leq b \leq 7$) and through the MCRG approach (for $b \leq 201$) the sets of the critical exponents ν (associated with the mean squared end-to-end distances of SATs) and γ (associated with the total number of different SATs). Our results show that critical exponents are stiffness dependent functions, so that $\nu(s)$ is a monotonically decreasing function of s, for each studied b, whereas $\gamma(s)$ displays a non-monotonic behavior for some values of b. On the other hand, by fixing the stiffness parameter s, our results show clearly that for highly flexible trails (with $s = 1$ and 0.9) ν is a non-monotonic function of b, while for stiffer SATs (with $s \leq 0.7$) ν monotonically decreases with b. We also show that $\gamma(b)$ increases with increasing b, independently of s. Finally, we compare the obtained SAT data with those obtained for the semiflexible self-avoiding walk (SAW) model on the same fractal family, and for both models we discuss behavior of the studied exponents in the fractal-to-Euclidean crossover region $b \to \infty$.

Keywords: classical Monte Carlo simulations, critical exponents and amplitudes (theory), renormalization group, polymers, copolymers, polyelectrolytes and biomolecular solutions

1742-5468/11/P10015+16$33.00