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Functional self-similarity, scaling and a renormalization group calculation of the partition function for a non-ideal chain

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Abstract

The hypothesis of asymptotic self-similarity for non-ideal polymer chains is used to derive the functional and differential equations of a new renormalization group. The equations are used to calculate the partition functions of randomly jointed chains with hard-sphere excluded-volume interactions. Theoretical predictions are compared with Monte Carlo calculations based on the *same* microscopic chain model. The excess partition function converges very slowly to its true asymptotic form $\delta Q(N \to \infty) \propto \kappa^{N-1}$. The conventional asymptotic formula, $\delta Q(N \to \infty) \propto \kappa^{N-1} N^{\gamma-1}$, is found to be applicable for chains of moderate length and for the subclass of flexible self-avoiding chains.