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Macroscopic loop formation in circular DNA denaturation

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The statistical mechanics of DNA denaturation under fixed linking number is qualitatively different from that of the unconstrained DNA. Quantitatively different melting scenarios are reached from two alternative assumptions, namely, that the denatured loops are formed in expense of 1) overtwist, 2) supercoils. Recent work has shown that the supercoiling mechanism results in a BEC-like picture where a macroscopic loop appears at Tc and grows steadily with temperature, while the nature of the denatured phase for the overtwisting case has not been studied. By extending an earlier result, we show here that a macroscopic loop appears in the overtwisting scenario as well. We calculate its size as a function of temperature and show that the fraction of the total sum of microscopic loops decreases above Tc, with a cusp at the critical point.

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