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Torque and buckling in stretched intertwined double-helix DNAs[1]

SUMITABHA BRAHMACHARI, JOHN F. MARKO, Northwestern Univ — We present a statistical mechanical model for the mechanical behavior of two intertwined DNAs under applied force, with a focus on their torque and extension as a function of their linking number (catenation). Our model agrees favorably with available experimental data and predicts a torque that grows non-linearly with linking number, distinct from what is observed in individual twisted double-helix DNA. We find that buckling occurs near the catenation where experiments have observed a change in the slope of the extension versus catenation curves and that the buckled state corresponds to a coexistence of many small plectoneme domains. We predict a discontinuity in extension at the buckling transition corresponding to nucleation of the first plectoneme domain. We also find that buckling occurs for lower catenation at lower salt; the opposite trend is observed for single supercoiled double helices.

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