PREMELTONS IN DNA

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Abstract

Premeltons are examples of emergent-structures (i.e., structural-solitons) that arise spontaneously in DNA due to the presence of nonlinear-excitations in its structure. They are of two kinds.

B-B (or A-A) premeltons form at specific DNA-regions to nucleate site-specific DNA melting. They are stationary and, being globally-nontopological, undergo breather-motions that allow drugs and dyes to intercalate into DNA.

B-A (or A-B) premeltons, on the other hand, are mobile, and being globally-topological, act as phase-boundaries transforming B- into A- DNA during the structural phase-transition. They are not expected to undergo breather-motions.

A key feature of both types of premeltons is the presence of an intermediate structural-form in their central-regions (proposed as being a transition-state intermediate in DNA-melting and in the B- to A- transition), which differs from either A- or B- DNA. Called beta-DNA, this is both metastable and hyperflexible -- and contains an alternating sugar-puckering pattern along the polymer-backbone combined with the partial-unstacking (in its lower-energy forms) of every-other base-pair. Beta-DNA is connected to either B- or to A- DNA on either side by boundaries possessing a gradation of nonlinear structural-change, these being called the kink and antikink regions.

The presence of premeltons in DNA leads to a unifying theory to understand much of DNA physical chemistry and molecular biology. In particular, premeltons are predicted to define the 5’ and 3’ ends of genes in naked-DNA and DNA in active- chromatin, this having important implications for understanding physical-aspects of the initiation, elongation and termination of RNA-synthesis during transcription. For these and other reasons, the model will be of broader interest to the general-audience working in these areas.

The model explains a wide variety of data, and carries with it a number of experimental predictions -- all readily testable – as will be described at the meeting.