Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Unbinding of Semi-flexible Bio-polymers from Columnar Traps: An Exactly Solvable Problem of Statistical Mechanics LEONARDO GOLUBOVIC, West Virginia University — We elucidate unbinding of long semi-flexible bio-polymers from long line-like attractive potential wells (columnar traps). This phase transition has been observed in the experiments with DNA molecules adsorbed on micro-structured supported cationic lipid membranes. It provides a new way to stretch (linearize) single DNA coils [Hochrein, Leierseder, Golubovic, and Raedler, Physical Review E (2007)]. We reveal that this phase transition is an exactly solvable problem of statistical mechanics. Our theory is based on mapping this nontrivial problem onto a novel class of directed random walks. This DNA unbinding transition turns out to have a unique thermodynamic character: It is of the second order however with very weakly (logarithmically) diverging correlation length. This feature induces a very strong divergence of the heat capacity at the unbinding transition of a semi-flexible polymer from a columnar trap. Our exact solution of this statistical physics problem opens a new venue in the theory of molecular shape control of bio-polymers such as DNA molecules adsorbed on specially designed biocompatible surfaces.

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Date submitted: 20 Nov 2009 Electronic form version 1.4