MAR15-2014-020290

Abstract for an Invited Paper
for the MAR15 Meeting of
the American Physical Society

Dynamics of the Competition Between Nucleosome Unwrapping and DNA Binding Proteins[1]

RALF BUNDSCHUH, Ohio State Univ - Columbus

In eukaryotic organisms DNA is tightly wrapped into nucleosomes. This bears the question how this DNA can be accessed in order to be copied, transcribed, or repaired. A process that allows access to the DNA is transient unwrapping of the DNA from the histone proteins. We have developed a quantitative model of this unwrapping process which we calibrate by comparison to nucleosome unzipping experiments by the Wang group. We then apply this model to quantitatively explain the dynamics of transcription factor binding within nucleosomal DNA. In this context, it has been well known that nucleosomes reduce the affinity for transcription factors to binding sites covered by the nucleosome. It has been assumed that this is due to a reduction in on-rate since a transcription factor can only bind when a rare thermal fluctuation of the nucleosome makes the DNA accessible. However, recent experimental data surprisingly shows that the off-rate of transcription factors is also strongly affected in the presence of a nucleosome. The application of our nucleosome unwrapping free energy landscape demonstrates that this increase in off-rate by several orders of magnitude is a consequence of a competition between partial binding events of dimeric transcription factors and the nucleosome.

[1]This material is based upon work supported by the National Science Foundation under Grant Nos. 1105458 and 1410172.