[P6] RNA polymerase transcription through di-nucleosomes: Single-molecule experiments and stochastic model

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RNA polymerase II (Pol II) is an enzyme that catalyzes messenger RNA from DNA templates as the first step in gene expression. In eukaryotic cells, a large fraction of the DNA molecules is wrapped around nucleosomes, which interfere with the transcription process. Here we study Pol II transcription along DNA templates with two nucleosomes by using the optical tweezers setup to understand how the neighboring nucleosome affects the transcription process. We found that the Pol II transcription through the first nucleosome depends on the length of the linker DNA in a non-monotonous way. To better understand the experimental results, we develop a stochastic model accounting the nucleosomal barrier, backtracking, and the assisting force acting on Pol II. The model reproduces the dynamics of Pol II transcription in agreement with the experimental data without any fitting parameter. Our model shows that the relative strength of the nucleosomal barrier and the assisting force dramatically change the elongation dynamics.

[1] V. Fitz, J. Shin, C. Ehrlich, L. Farnung, P. Cramer, V. Zaburdaev, and S. W. Grill. Proc. Natl. Acad. Sci. U.S.A. 113, 12733 (2016).