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Fast Chromatin Assembly facilitated by Nucleosome Breathing and Replication-Guided Packing JOHANNES NUEBLER, BRENDAN OSBERG, Theory of Complex Biosystems, Physik-Department, Technische Universität München, James-Franck-Str. 1, 85748 Garching, Germany, PHILIPP KORBER, Adolf-Butenandt-Institut, University of Munich, Schillerstrasse 44, 80336 Munich, Germany, ULRICH GERLAND, Theory of Complex Biosystems, Physik-Department, Technische Universität München, James-Franck-Str. 1, 85748 Garching, Germany — The condensation of eukaryotic DNA into chromatin entails the formation of nucleosome arrays with high density at species-dependent nucleosome spacing. These arrays are frequently destroyed by transcription and replication, such that reassembly is required. Due to a well-known jamming effect in the random adsorption of mutually exclusive objects (aka the "car parking problem"), the question was raised how in vivo nucleosome densities, and patterns, can be reached in the biologically relevant timescale of minutes [1]. We show that the "softness" of nucleosomes alleviates this kinetic challenge [2]. Nucleosome softness arises due to transient DNA unwrapping (breathing) and stepwise nucleosome assembly. From a physics perspective, the "soft car parking problem" differs fundamentally from its hard counterpart by exhibiting non-monotonic density and rapid equilibration. We also discuss scenarios how the progression of the replication fork can promote rapid reassembly in its wake. For example, tight packing arises naturally if the fork progresses slowly compared to the reassembly rate.

[1] R. Padinhateeri, J.F. Marko, PNAS 108, 7799 (2011).
[2] B. Osberg, J. Nuebler, P. Korber, U. Gerland, Nucl. Acids Res., in press.

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