Dynamic regulation of higher-order chromatin structures in gene regulation

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Eukaryotic DNA is hierarchically packaged into chromatin to fit inside the nucleus, in which the accessibility of DNA is dependent on the packing density of chromatin. Dynamics of chromatin structures plays a critical role in transcriptional regulation and all other DNA related biological processes. However, the dynamic organization of chromatin fibers and its regulation mechanisms remain poorly understood. Recently, we have reported the 11 Å resolution cryo-electron microscopy (cryo-EM) structures of 30 nm chromatin fibers, which reveals a left-handed double helix twisted by the repeating tetra-nucleosomal structural units. Using single-molecule force spectroscopy, we further demonstrated that the tetranucleosome is a novel regulatory structural unit of chromatin fibers beyond the nucleosome, whose stability is negatively regulated by the histone chaperone FACT (Facilitates Chromatin Transcription). Interestingly, we also revealed that FACT has dual functions in breaking nucleosome and maintaining its integrity during DNA replication and transcription.