WWTF Project LS19-001

Elucidating the mechanics of mitotic chromosome assembly by light-, electron-, and atomic force microscopy

Abstract

During mitosis, chromosomes form compact bodies to transport one genome copy to each daughter cell. The assembly of mitotic chromosome involves longitudinal DNA shortening by loop formation, and chromatin volume compaction by weak interactions within the chromatin fiber. DNA looping is mediated by condensin and confers mechanical rigidity to chromosomes. The molecular control and functional relevance of condensin-independent mitotic chromatin compaction have remained elusive. We postulate that chromatin volume compaction forms a sharp surface boundary on mitotic chromosomes to prevent entanglements of DNA loops with spindle microtubules, which would be deleterious for chromosome segregation. We will test this hypothesis by multi-modal microscopy of cells and in vitro reconstituted chromatin. In preliminary studies, we found that global deacetylation of histones is essential for mitotic chromosome compaction in human cells. Here, we aim to elucidate material properties and functions emerging from deacetylation-dependent compaction of mitotic chromosomes. We will use light- and electron microscopy to study chromosome organization and dynamics from the near-molecular to the cellular scale and apply atomic force microscopy to probe surface mechanics of chromosomes isolated from cells and reconstituted synthetic chromatin droplets. Our research will provide insights into the soft matter physics of chromosomes and advance integrated imaging technology for cellular biophysics.

Scientific disciplines:
106052 - Cell biology (70%) | 106006 - Biophysics (30%)

Keywords:
Chromosomes, mitosis, cell division, microscopy, biophysics

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Status: Ongoing (01.06.2020 - 31.05.2024) 48 months

Funding volume: EUR 700,000

Further links about the involved persons and regarding the project you can find at
https://archiv.wwtf.at/programmes/life_sciences/LS19-001