BP 32: Posters - DNA/RNA

Time: Tuesday 14:00–16:00 Location: P2-OG1

BP 32.1 Tue 14:00 P2-OG1

Condensation of DNA Brush Networks — •Günther Pardatscher[1], Dan Bracha[2], Shirley S. Daube[2], Ohad Vonshak[2], Roy H. Bar-Ziv[2], and Friedrich C. Simmel[1,3] — [1]TU München, Garching, Germany — [2]Weizmann Institute of Science, Rehovot, Israel — [3]Nanosystems Initiative Munich, München, Germany

DNA condensation via interaction with multivalent salts or histones is known for the regulation of genes and metabolism, and for the generation of self-assembling rod-like, spheroidal or toroidal DNA nanostructures. We here investigated the condensation of e-beam patterned, surface-bound DNA brushes into arbitrarily shaped DNA bundles. DNA molecules of 1 micron length (3 kbp) were immobilized on lines as thin as 100 nm in width, before condensation was induced by addition of spermidine. Starting at a nucleation site, DNA condensates grew via an inverted domino effect by adsorbing neighboring DNA chains.

The confinement of DNA brushes to widths below the contour length of the DNA resulted in changes in condensation dynamics and condensate morphology from two-dimensional dendritic to a single, straight one-dimensional DNA bundle. In contrast to condensation from solution or extended 2D brushes, 1D DNA bundles can be guided along predesigned, arbitrary pathways, while persisting over tens of micrometers. We further applied the process in unconventional approaches to computational problems, e.g. in determining possible solutions for a maze.

BP 32.2 Tue 14:00 P2-OG1

Transcription by RNA polymerase II establishes DNA microstructure — •Lennart Hilbert[1,2,3], Yuko Sato[4], Alf Honigmann[2], Frank Jülicher[3], Hiroshi Kimura[4], Nadine L Vastenhouw[2], and Vasily Zaburdaev[3,1] — [1]Center for Systems Biology Dresden — [2]MPI Molecular Cell Biology and Genetics — [3]MPI Physics of Complex Systems — [4]Tokyo Institute of Technology

In interphase cell nuclei, DNA forms a microstructure of interspersed high concentration and low concentration regions. Transcription of DNA is carried out by RNA Polymerase II (Pol II) in low DNA density regions. While this organization reflects a need to unfold DNA for Pol II access, the causal origin of this spatial organization remains unclear. Here, we investigate if and how transcribing Pol II organizes DNA. Using zebrafish embryo cells, we found that Pol II needs to fill nuclei with RNA to induce segregation of DNA and RNA into a fine microstructure of mutually exclusive regions. We observed that the global DNA/RNA microstructure collapsed into a coarse pattern upon transcription inhibition. The microstructure originated from individual transcription sites, which locally displaced DNA by an RNA-rich region upon transcription activation. Our experimental results can be recapitulated in a simulated microemulsion. Here, the accumulation of nuclear RNA induces a global phase separation of DNA and RNA. Transcribing Pol II - tethered to both DNA and RNA - acted as a bivalent copolymer, locally dispersing DNA in the RNA phase. In summary, transcription by Pol II appears as a major driver of nuclear organization, which can be understood in the framework of phase separation.