Nuclear architecture and gene expression in *Caenorhabditis elegans*

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ABSTRACT

The parental genomes are initially separated in each pronucleus after fertilization. During the first mitosis this spatial distribution is being disintegrated. In my thesis we used green-to-red phoroconversion of Dendra2-H2B-labeled pronuclei to distinguish maternal and paternal chromatin domains and to track their distribution in space in living *Caenorhabditis elegans* embryos starting shortly after fertilization. Both of the parental chromatin domains within the nucleus are separated in the zygote and at the 2-cell stage. Intermingling occurs first after chromatin decondensation at the beginning of the cell cycle at the 4-cell stage. To our knowledge, we report to the first live observation of the separation and subsequent mixing of parental chromatin during embryogenesis. Following of the photoconverted chromatin also allowed us to detect a reproducible 180° rotation of the nuclei during cytokinesis of the zygote. Tracking of fluorescently-labelled P granules and polar bodies showed that the entire embryo rotates during the first cell division. In the second part of the thesis we used the *C. elegans* model to investigate relationship between nuclear architecture and gene expression. We focused on localization of transcriptional activity in cells of the germline. Using techniques for detection of nascent transcription, such as single molecule RNA FISH and fluorescent labelling of 5-ethynyl uridine RNA incorporation, we show that the highest level of mRNA synthesis occurs during the late pachytene and diplotene of the prophase in meiosis I. This is a stage of dramatic chromosome restructuralization, which probably leads to partial chromatin decondensation. The last project is focused on the relationship between nuclear and cytoplasmic volume. Multi-color fluorescence imaging of live germline cells in the gonad and early *C. elegans* embryos allowed us to show that nucleo-cytoplasmic ratio in gametogenesis decreases and vice versa increases in embryogenesis. This may be caused by metabolic and spatial changes during each development.

Key words: *Caenorhabditis elegans*, embryogenesis, parental chromatin, gonad, transcription