



Laboratory of Biology of the Cell Nucleus

Cell nucleus, gene expression, nucleoskeleton, nuclear actin, myosins and lipids, microscopy, ultrastructural methods

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In diploid mammalian cells, some 6×10^9 base pairs of DNA fold as a nucleoprotein complex [i.e. chromatin] into higher-order arrays so as to fit in a nucleus measuring only $10 \mu\text{m}$. The nucleus also contains machineries for transcription of genes and processing of RNA products, and for precise DNA replication, repair and recombination. Nuclear interior is therefore functionally highly compartmentalized, and the recent evidence points strongly to structure-related regulation of nuclear functions – however, the mechanisms forming the 3D-structure of the nucleus are still mostly obscure. We therefore employ a multi-disciplinary approach in order to study nuclear functions in relation to the higher-order nuclear structures, e.g. nuclear bodies, the nucleolus, and the nucleoskeleton. Our research concentrates on: [1] the relationship between nuclear compartmentalization and regulation of gene expression, [2] structure, dynamics, and function of the nucleoskeleton, which contributes to the nuclear compartmentalization, [3] functions of nuclear myosins and actin in transcription and gene expression, [4] functions of nuclear lipids, [5] development of new microscopy methods for ultrastructural studies.

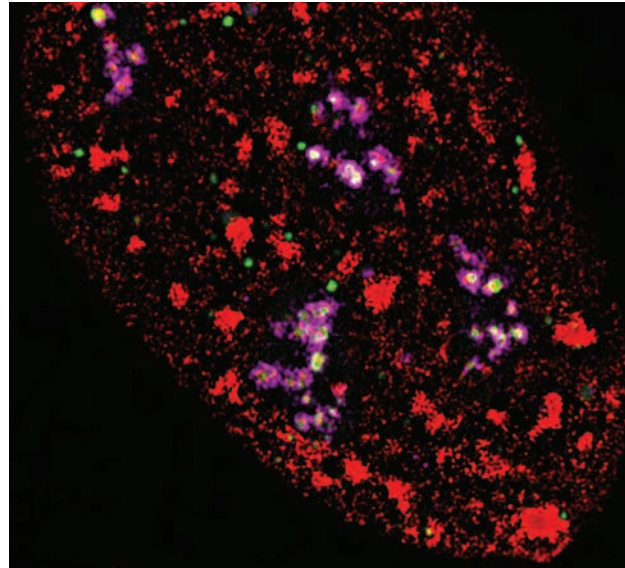


Fig. 1. Super-resolution image of nuclear interior documents yet undiscovered relationships of nuclear components [green: nucleolar protein UBF, red: phospholipid PIP2, magenta: nucleolar protein fibrillar]

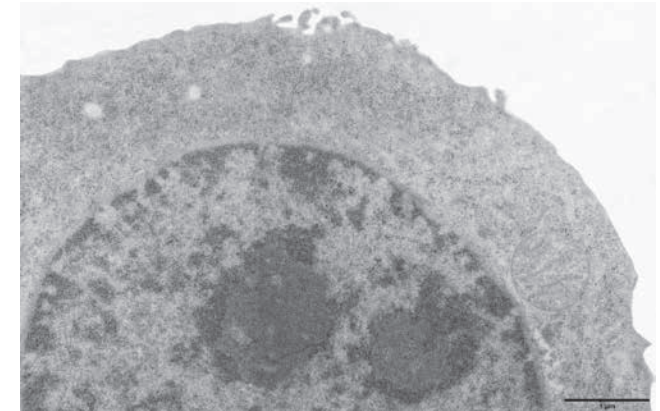


Fig. 2. Combinations of novel sample preparation techniques allows visualization of cells in electron microscopy even without chemical fixation. This human cancer cell was prepared using high-pressure freezing, freeze substitution and embedding in LR White resin.

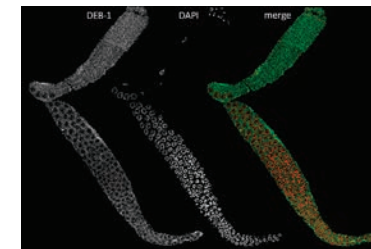


Fig. 3. Actin-binding protein vinculin might play an important role in gametogenesis: immunofluorescence localization of vinculin homologue DEB-1 in a gonad of *C. elegans*.



- Ministry of Education, Youth and Sports of the Czech Republic, LC545 - Functional organisation of the cell, 2005–2011, P. Hozák
- Ministry of Education, Youth and Sports of the Czech Republic, 2B06063 - Structure and irregularities of the nucleoskeleton: identification and diagnostics, 2006–2011, P. Hozák
- Ministry of Education, Youth and Sports of the Czech Republic, LC06063 - Fluorescence microscopy in biological and medical research, 2006–2011, M.Hof/P. Hozák
- AS CR, KAN200520704 - New nanoparticles for ultrastructural diagnostics, 2007–2011, P. Hozák
- GA CR, GD204/D9/H084 - Molecular biology of a differentiating cell, 2009–2012, P. Hozák
- FP7 EU, 262023 EURO-BIOMAGING - Euro-Biolmaging - Research infrastructure for imaging technologies in biological and biomedical sciences, 2010–2013, P. Hozák
- GA CR, GAP305/11/2232 - Functions of myosin I and its binding partners in the cell nucleus, 2011–2015, P. Hozák
- Ministry of Industry and Trade of the Czech Republic, FR-TI3/588 - Development of a kit for detection of mutations in structural proteins of a cell, 2011–2015, P. Hozák



1. [Dzijak R, Yildirim S, Kahle M, Novák P, Hnilicová J, Venit T, Hozák P.](#) Specific nuclear localizing sequence directs two myosin isoforms to the cell nucleus in calmodulin-sensitive manner. **PLoS One** 2012 7(1): e30529.
2. [Maruyama EO, Hori T, Tanabe H, Kitamura H, Matsuda R, Tone S, Hozák P, Habermann FA, von Hase J, Cremer C, Fukagawa T, Harata M.](#) The actin family member Arp6 and the histone variant H2A.Z are required for spatial positioning of chromatin in chicken cell nuclei. **J Cell Sci** 2012 125(Pt 16): 3739–3743.
3. [Sobol MA, Philimonenko VV, Philimonenko AA, Hozák P.](#) Quantitative evaluation of freeze-substitution effects on preservation of nuclear antigens during preparation of biological samples for immunoelectron microscopy. **Histochem Cell Biol** 2012 138(1): 167–177.
4. [Philimonenko AA, Janacek J, Snyers L, Almeder M, Berger W, Schmidt W, Schöfer C, Hozák P, Weipoltshammer K.](#) Chromosomal dynamics of cell cycle regulator gene p21 during transcriptional activation. **J Struct Biol** 2011 173(2): 382–390.
5. [Sobol M, Nebesářová J, Hozák P.](#) A method for preserving ultrastructural properties of mitotic cells for subsequent immunogold labeling using low-temperature embedding in LR White resin. **Histochem Cell Biol** 2011 135(1): 103–110.



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