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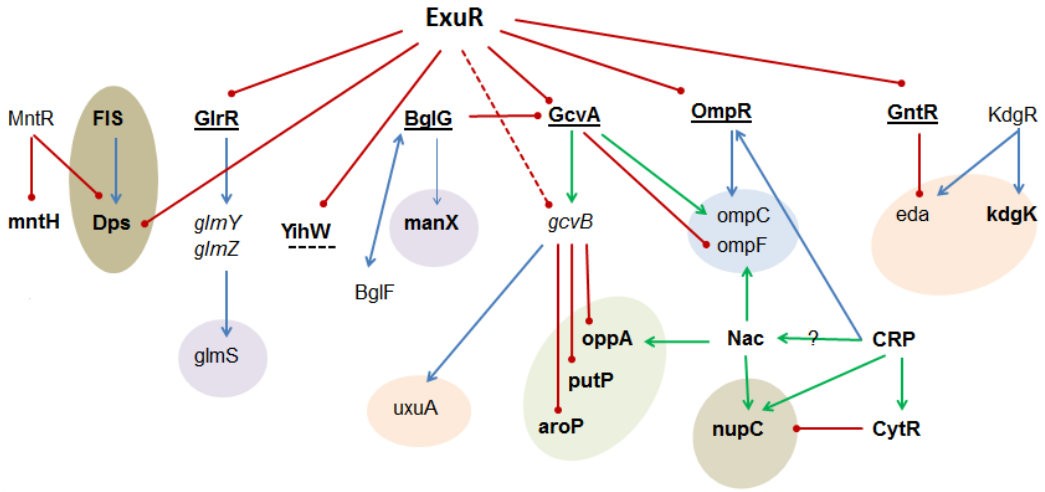
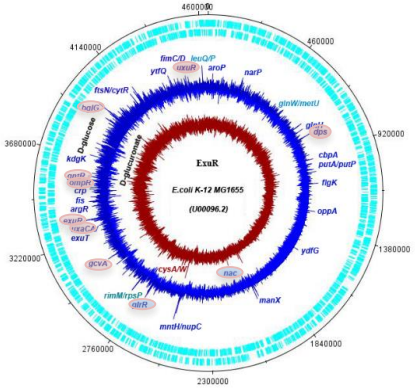
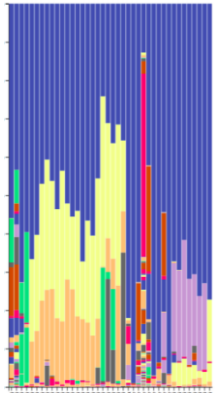
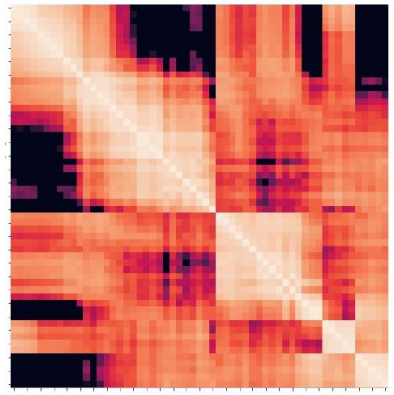
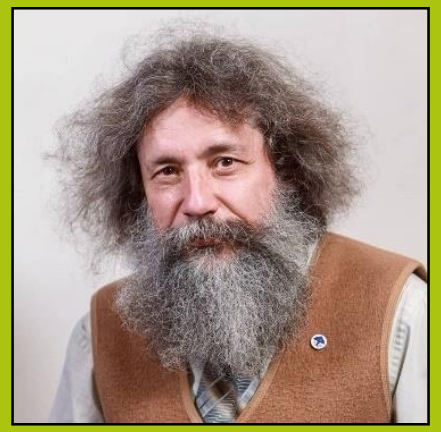
# Evolutionary and functional genomics.









**Mikhail Gelfand**

Professor,
Vice President for
Biomedical Research

- Bacterial genomics
  - New genes, their function and regulation
  - Evolution of regulatory interactions
  - Genome evolution
  - Metagenomics
- Systems biology of eukaryotes
  - Epigenomics
  - Transcriptomics and development

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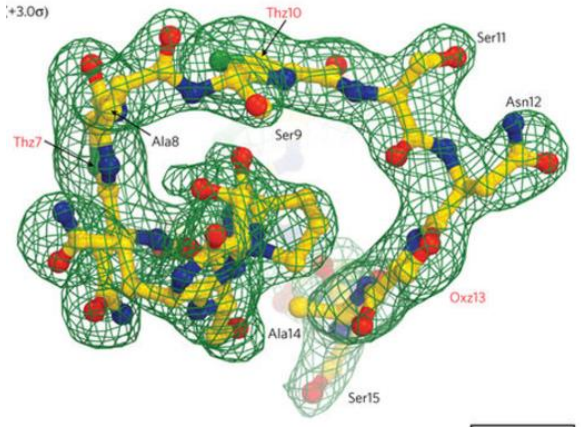
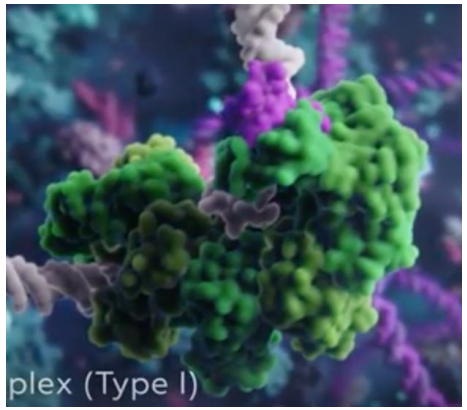
# Molecular, applied, ecological, and medical microbiology



**Konstantin Severinov**

Professor,
Director of Life Sciences PhD program

- Interactions of bacteria with phages and other mobile genetic elements
- Global ecology of prokaryotes and their viruses
- Basic mechanisms of CRISPR-Cas adaptive immunity
- Prediction and validation of phage defence systems
- Prediction and validation of new antibiotics

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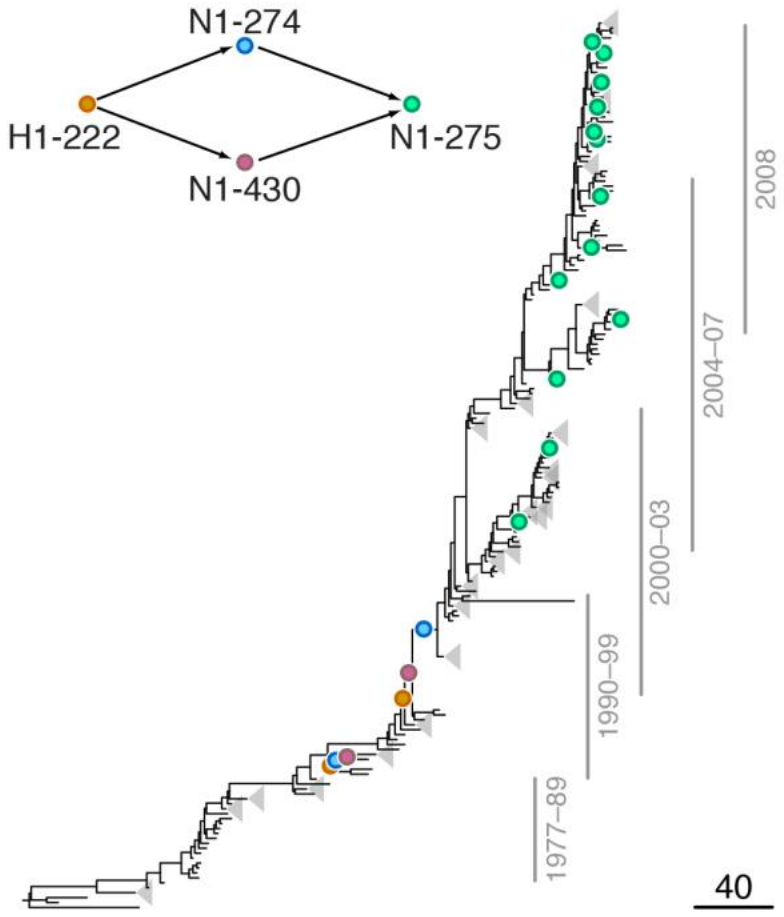
# Evolutionary Genomics



**Georgii ‘Yegor’ Bazykin**

Professor,
Director of Life Sciences MSc program

- Evolutionary dynamics of pathogens
- Mutations in germline and cancer
- Natural selection and genomic interactions

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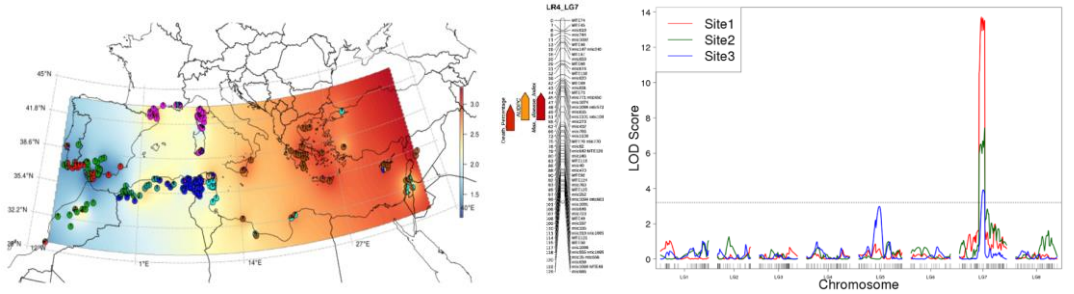
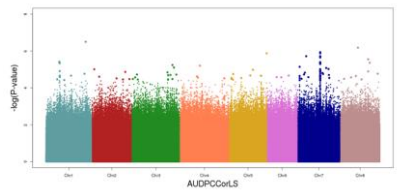
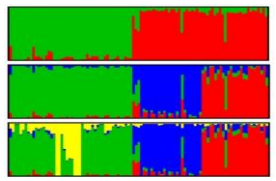
# Whole genome-based analysis of adaptive or agronomic traits

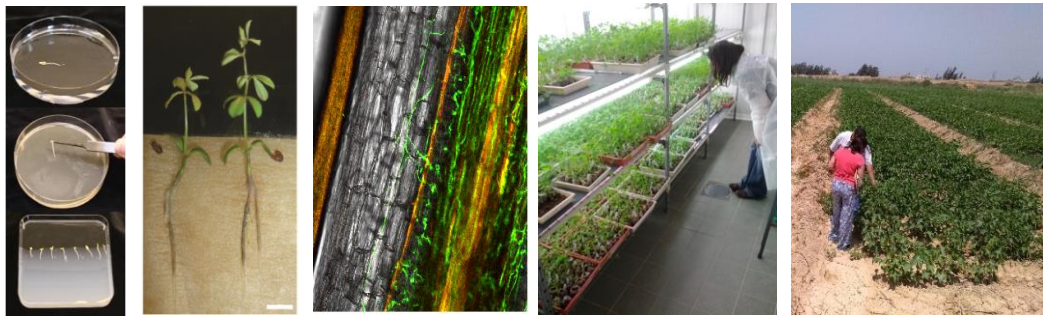


$$y = Xb + Zu + e$$

$$u \sim N(0, A\sigma_a^2), e \sim N(0, I\sigma_e^2),$$



**Laurent Gentzbittel**

Professor,
Head of Digital Agriculture Laboratory

- Quantitative Genetics
- Population Genomics
- Plant biotechnologies
- Plant breeding, Genomic Selection

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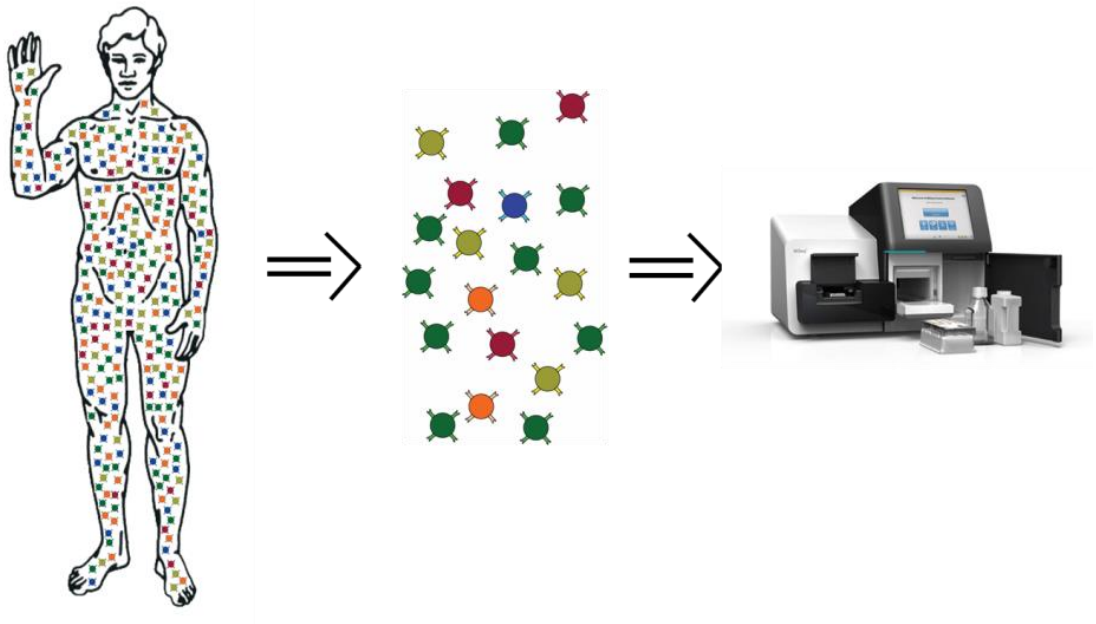
# Adaptive Immunity in health and disease



**Dmitriy Chudakov**

Associate Professor

- Deep profiling of T-cell receptor and B cell/antibody repertoires
- Development and aging of adaptive immunity
- Cancer immunology and immunotherapy
- Autoimmune diseases
- Vaccination
- Blood cell transplantation
- Helper T cell subsets
- Effector and memory B cells
- Gamma-delta T cells
- Single cell transcriptomics

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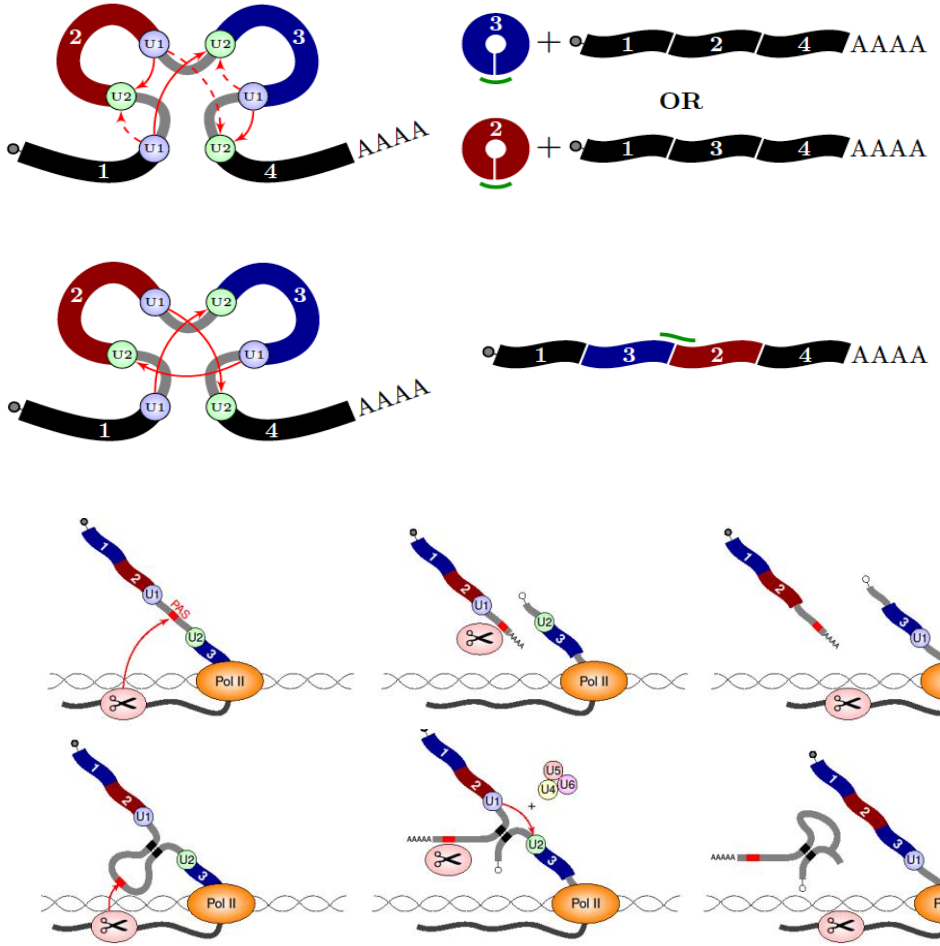
# Comparative & Structural Transcriptomics



**Dmitry Pervouchine**

Associate Professor

- Mechanisms of pre-mRNA splicing and polyadenylation
- Tissue- and tumor-specific alternative splicing
- Long-distance RNA structure and RNA processing
- Auto- and cross-regulatory splicing networks

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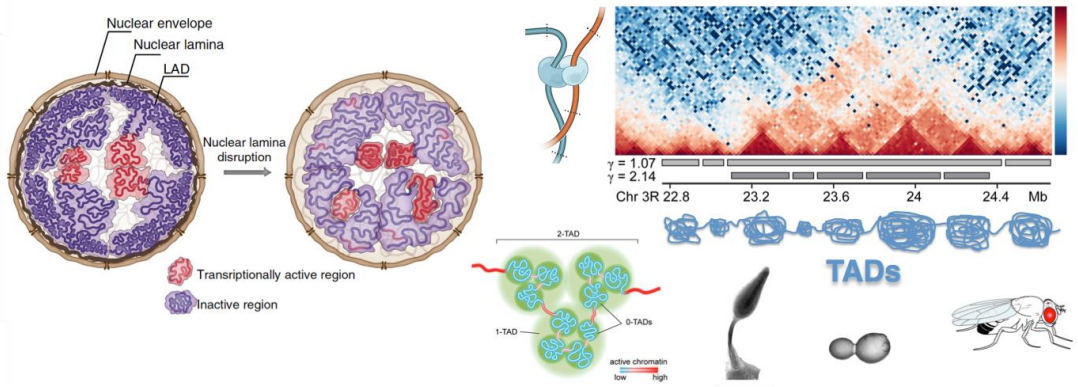
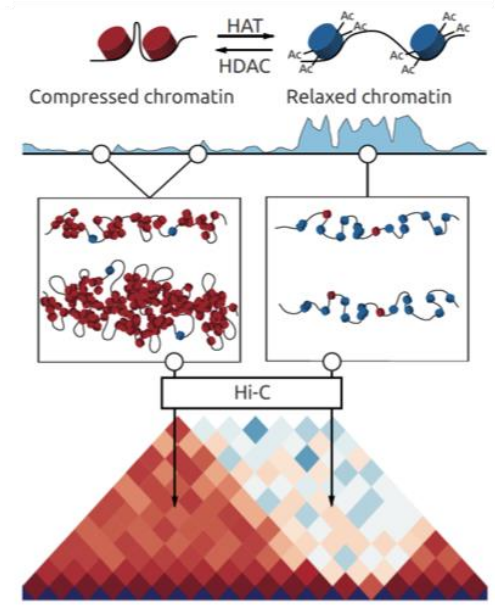
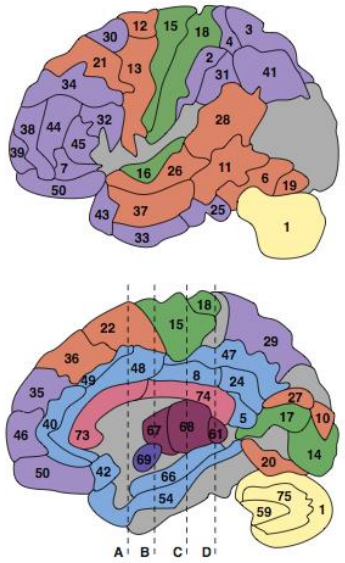
# Multi-omics data analysis



**Ekaterina Khrameeva**

Assistant Professor

**Chromatin architecture:**

- Chromatin organization changes between life stages
- Histone acetylation level vs. formation of TADs
- Chromatin structure changes during spermatogenesis

**Other projects:**

- SIRT6 protein: regulation of gene expression and metabolism
- Evolution of the human brain lipidome

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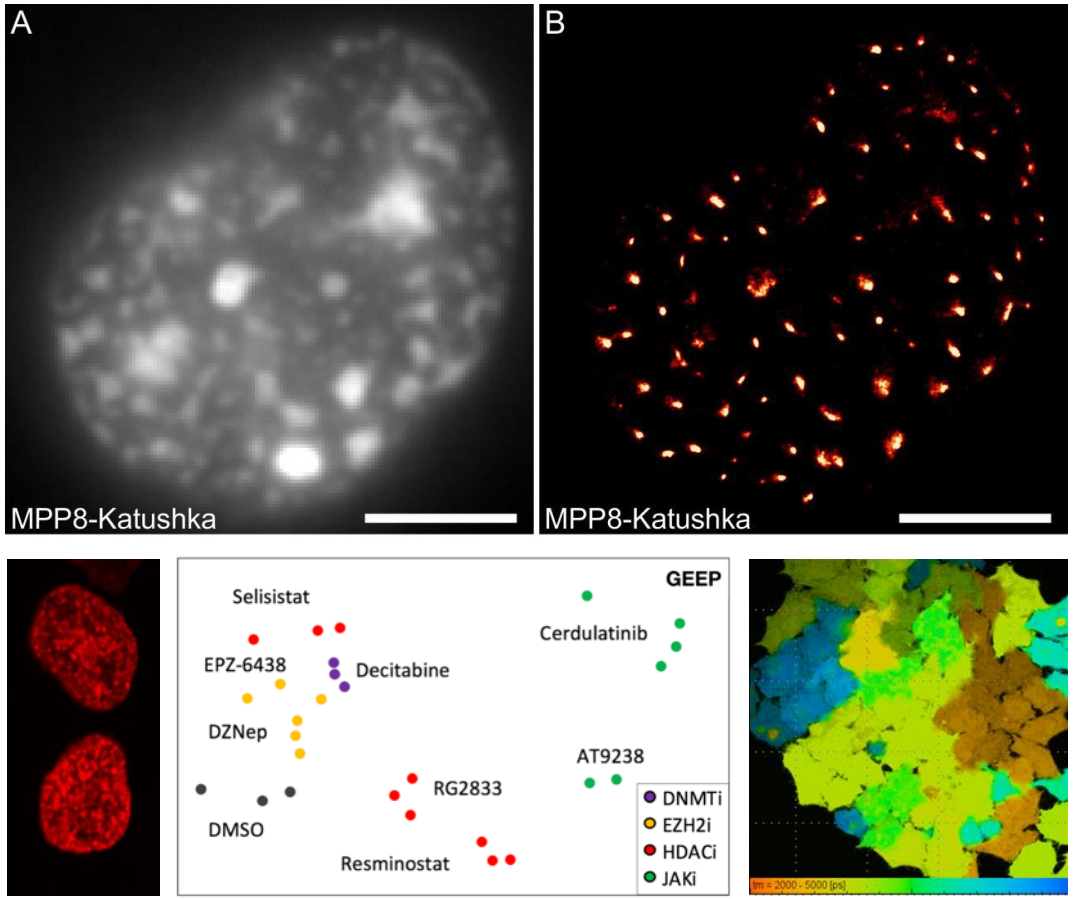
# Fluorescence imaging of live cells and organisms



**Konstantin Lukyanov**

Professor

- Multiparameter and super-resolution fluorescence imaging
- Fluorescence time-resolved imaging
- “Million-color” cell labeling
- Visualization and computer vision-based tracking of epigenetic chromatin state in live cells

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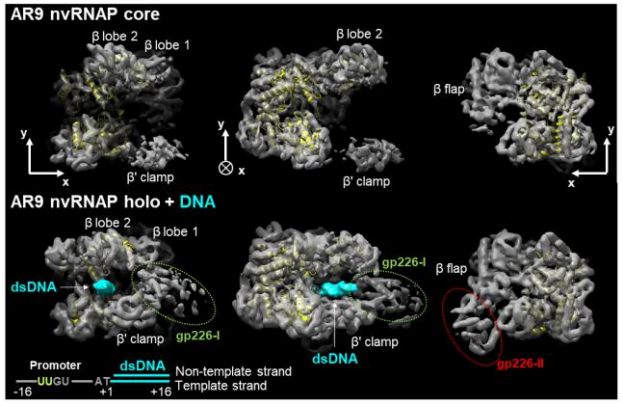
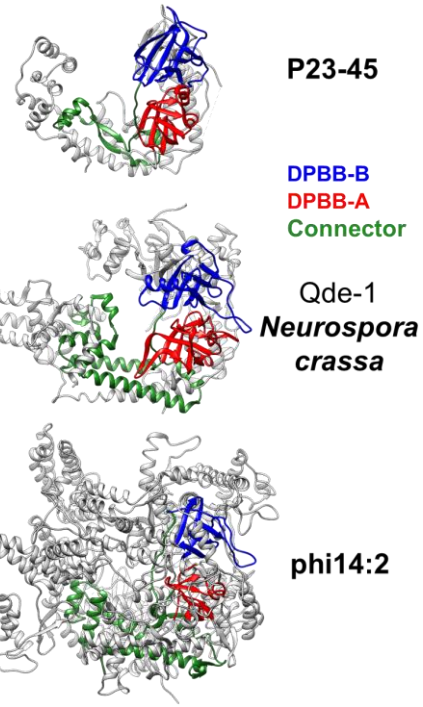
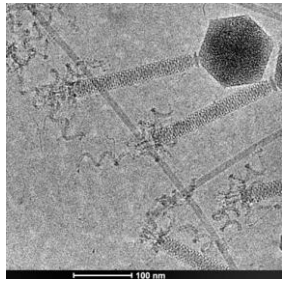
# Mechanisms of transcription




**AR9**



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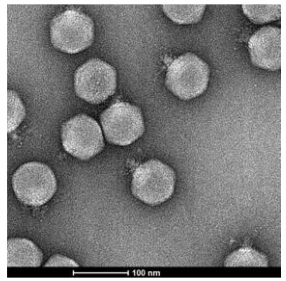

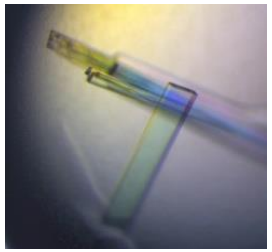

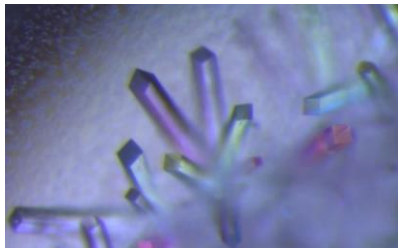

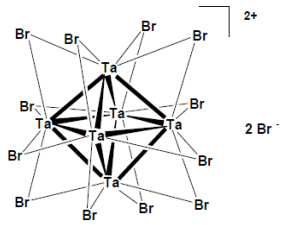

**Maria Sokolova**

Assistant Professor

- Transcriptional strategies of bacteriophages:
  - crAssphages, the most abundant viruses in human gut
  - Phages of thermophilic bacteria
  - Phages with uracil-containing DNA genomes
- Function and structure of unusual RNA polymerases
- Pseudo-nucleus of Jumbo phages (new topic!)

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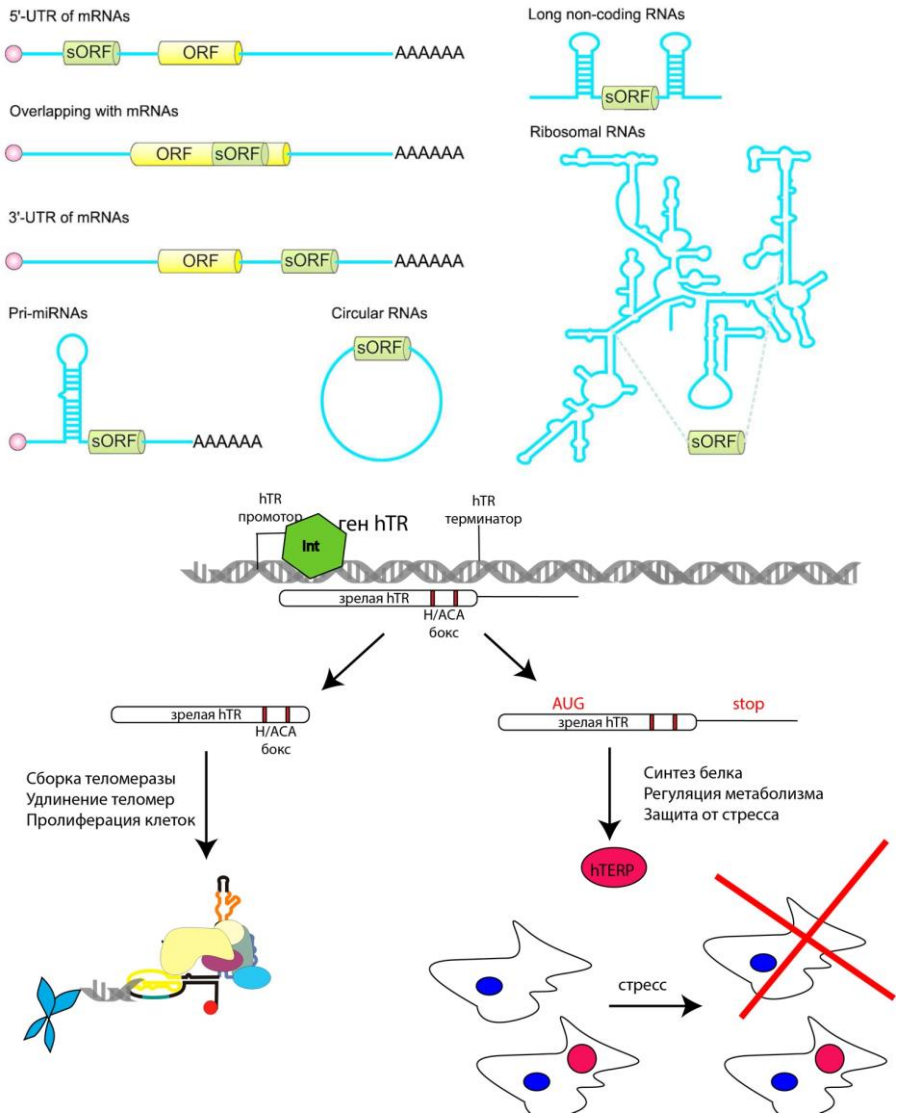
# Biogenesis and functions of RNA



**Olga Dontsova**

Professor

- Novel long noncoding RNAs (lncRNAs) for diagnostics of different liver cancers
- Search for functional noncanonical small Open Reading Frames
- Human telomerase RNA biogenesis
- Function of hTERP protein encoded in human telomerase RNA

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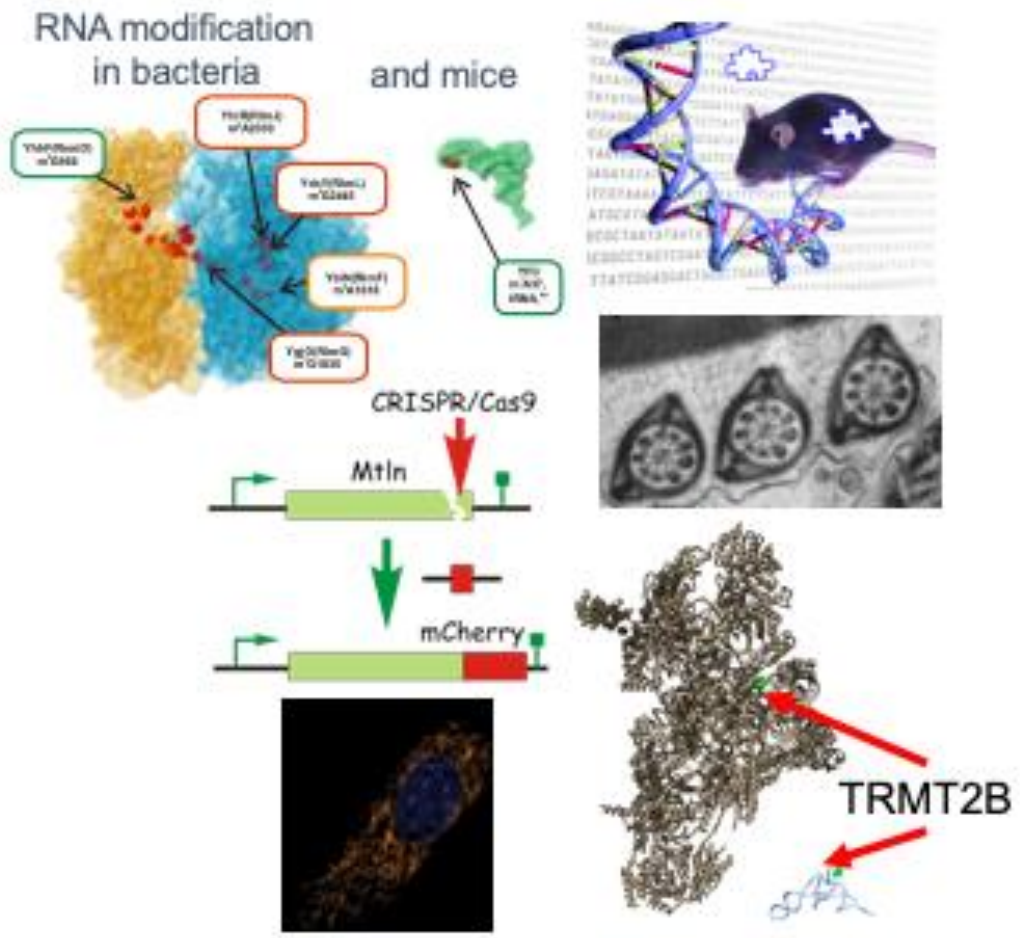
# RNA modification in bacteria and mice



**Petr Sergiev**

Associate Professor

The lab uses genome engineering for studying the function of genes in bacteria and mice with the emphasis on genes of previously unknown function related to RNA modification and translation apparatus

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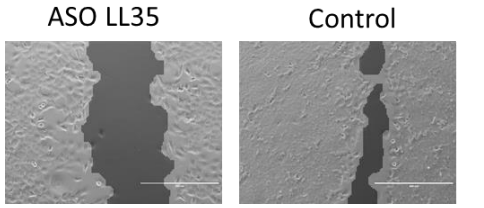
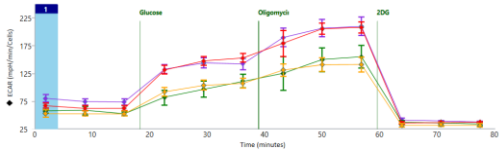
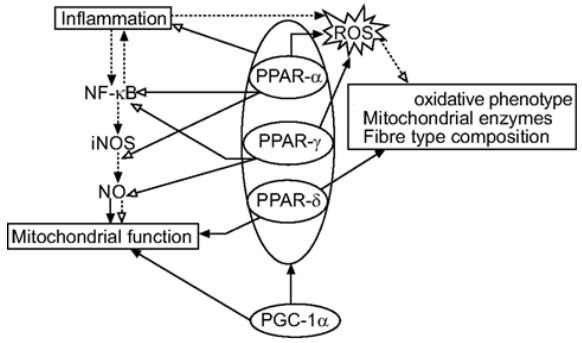
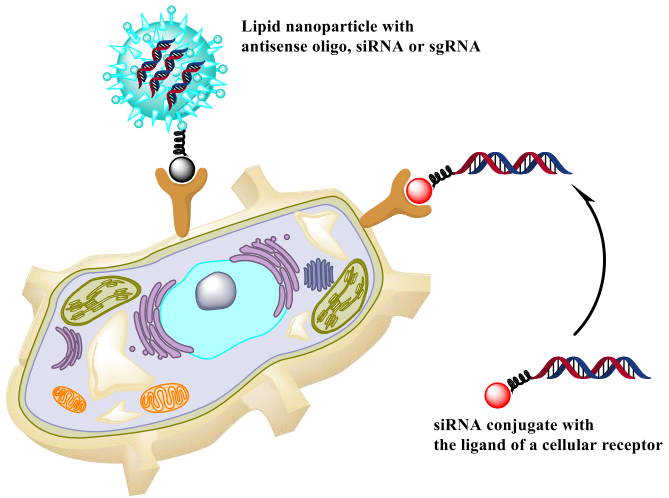
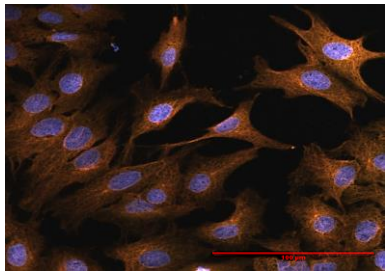
# Modified nucleic acids
## *in vitro* **and** *in vivo*







**Timofei Zatsepin**

Associate Professor

- Roles of lncRNA in the liver and beyond
- Targeted delivery of modified antisense/siRNA/sgRNA *in vitro* and *in vivo*

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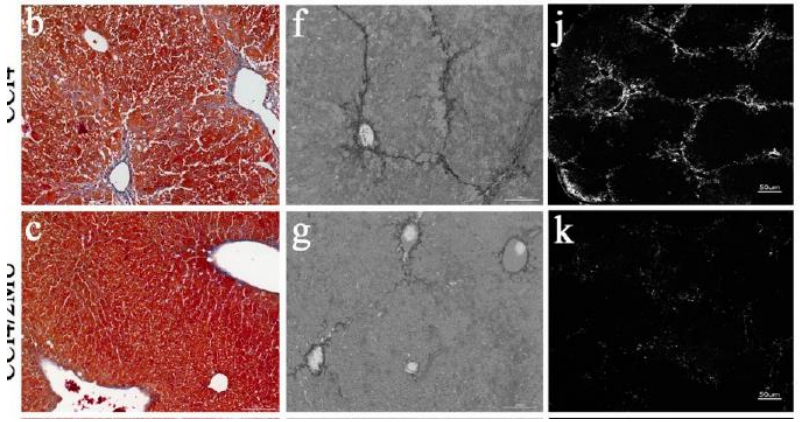
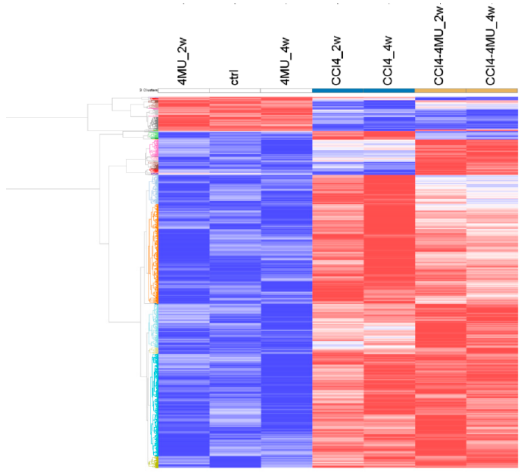
# Extracellular matrix in inflammation and tissue repair



**Yuri Kotelevtsev**

Professor

- Hyaluronan synthases: the key catabolic enzymes in extracellular matrix homeostasis
- Coumarins as chemoprotective agents in liver fibrosis and hepatocellular carcinoma
- Reprogramming macrophage pro inflammatory and regenerative phenotypes using RNAi
- Hyaluronan homeostasis in brain trauma and cerebral hypoxia

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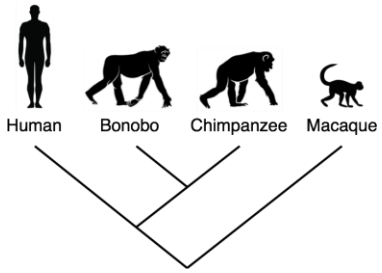
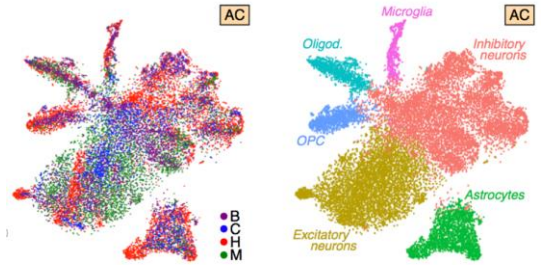
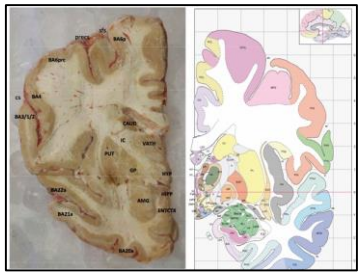
# Molecular mechanisms of human brain evolution and function

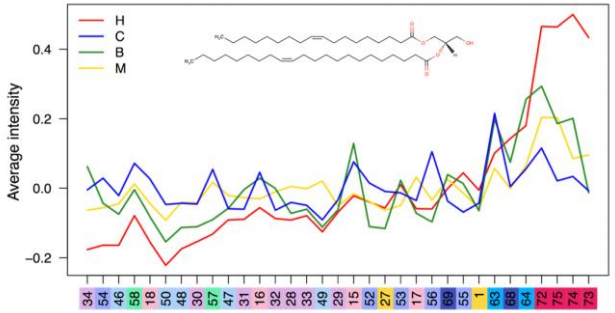


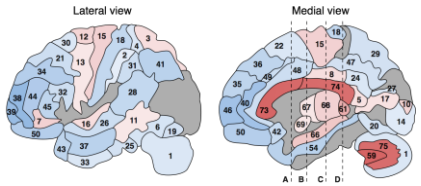







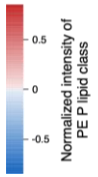


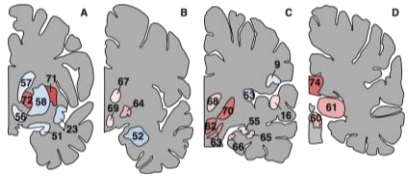








**Philipp Khaitovich**

Professor

- Cellular organization of the human brain
- Molecular mechanisms of schizophrenia, depression, and autism
- Molecular evolution of the human brain
- Molecular mechanisms of brain development and aging
- Brain metabolism in humans and mammals

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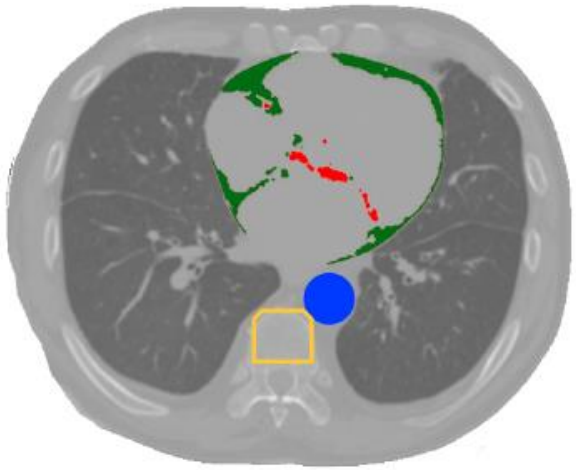
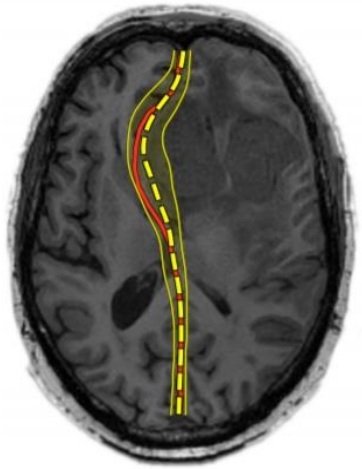
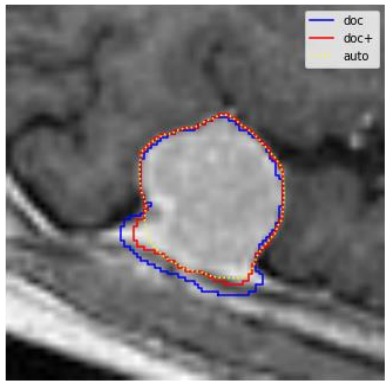
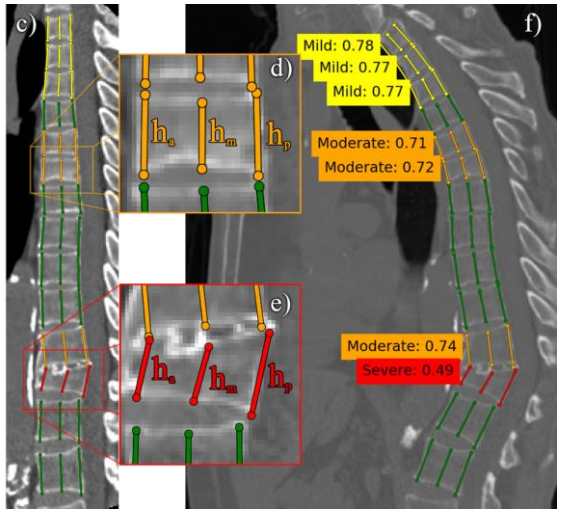
# Computer vision for medical imaging







**Mikhail Belyaev**

Assistant Professor

- Computer vision for Computed tomography, Magnetic Resonance Imaging:
  - Estimation of various biomarkers
  - Medical decision support systems
- Machine learning for neuroimaging
  - macro-connectomics
  - nonlinear image coregistration

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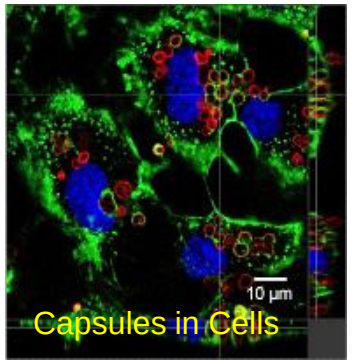
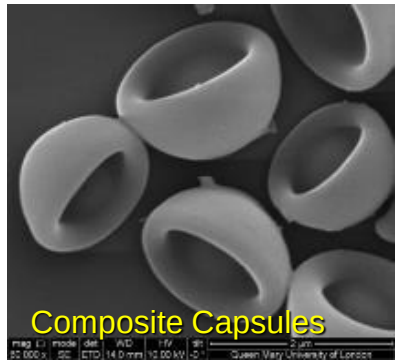
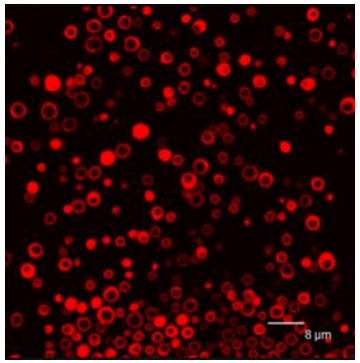
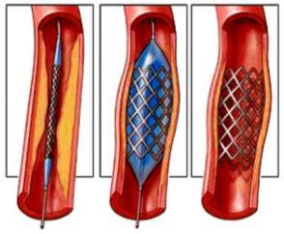
# Remote Controlled Biomaterials

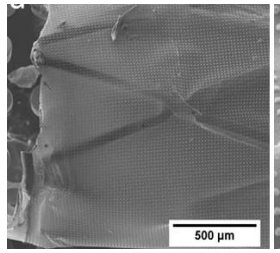


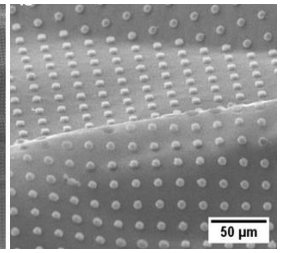
Capsules in Cells

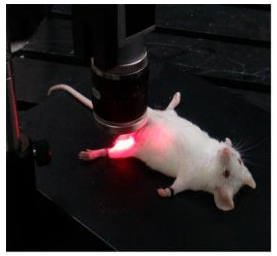

Composite Capsules



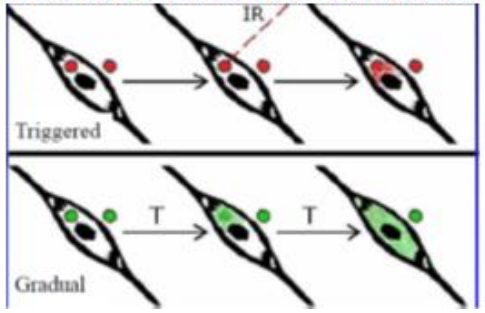





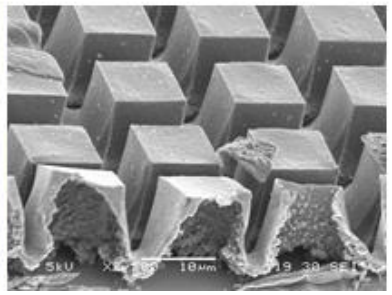



Intracellular controlled release




Microchamber arrays



**Gleb Sukhorukov**

Professor

**Biomaterials and Drug Delivery**

- Encapsulation of wide class of bioactives
- Storage, Protection and On-demand release
- Intracellular delivery and imaging tools
- Multifunctional coatings and micropackaging
- Light, Magnetic and Ultrasound Controlled Biomaterials

**Applications:**

- Drug delivery Systems, Cell Delivery
- Microencapsulated sensors inside cells
- Remote-controlled release
- Programmed release from stents and coatings
- Marking and Tracking of individual cells
- Functional thin films and surfaces

Skoltech