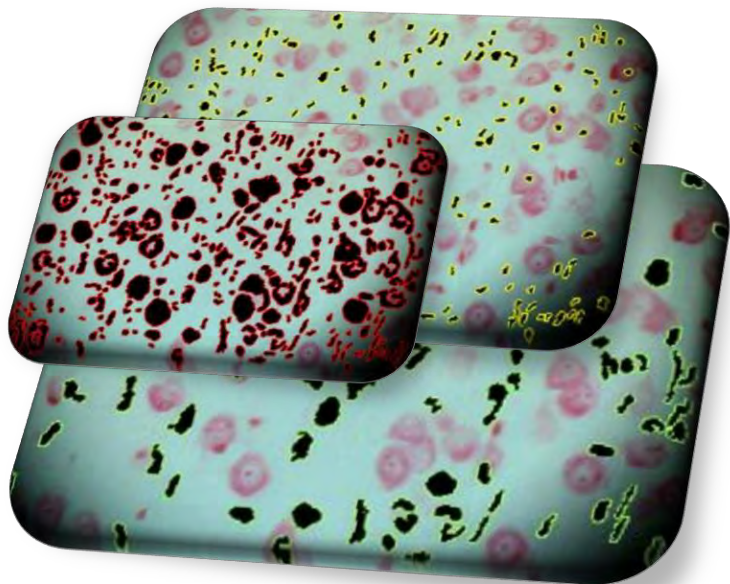# BIOHLIT for automation of biological research at JINR

**MLIT/JINR: Y.A. Butenko, A.V. Nechaevskiy, D.V. Podgainy, A.V. Stadnik, O.I. Streltsova**

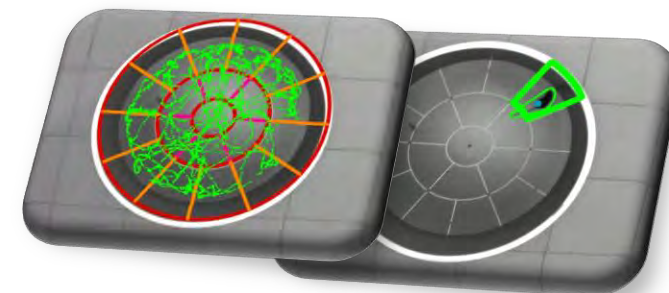# BIOHLIT information system for radiobiological studies

**Joint project of MLIT and LRB:** aims at establishing an information system (IS) for analyzing behavioral and pathomorphological changes in the central nervous system when studying the effects of ionizing radiation and other factors on biological objects.

**IS system is based on:**

- computer vision algorithms based on machine and deep learning technologies;
- modern IT solutions for data storage, processing and visualization.

**IT system will help to:**

- Speed up and simplify work on experimental data for different groups of researchers
- Simplify and accelerate the diagnosis of CNS pathologies, in a particular case to use effective methods of prevention and protection from ionizing radiation.
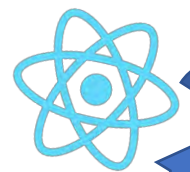
https://bio.jinr.ru/

# BIOHLIT information system for radiobiological studies
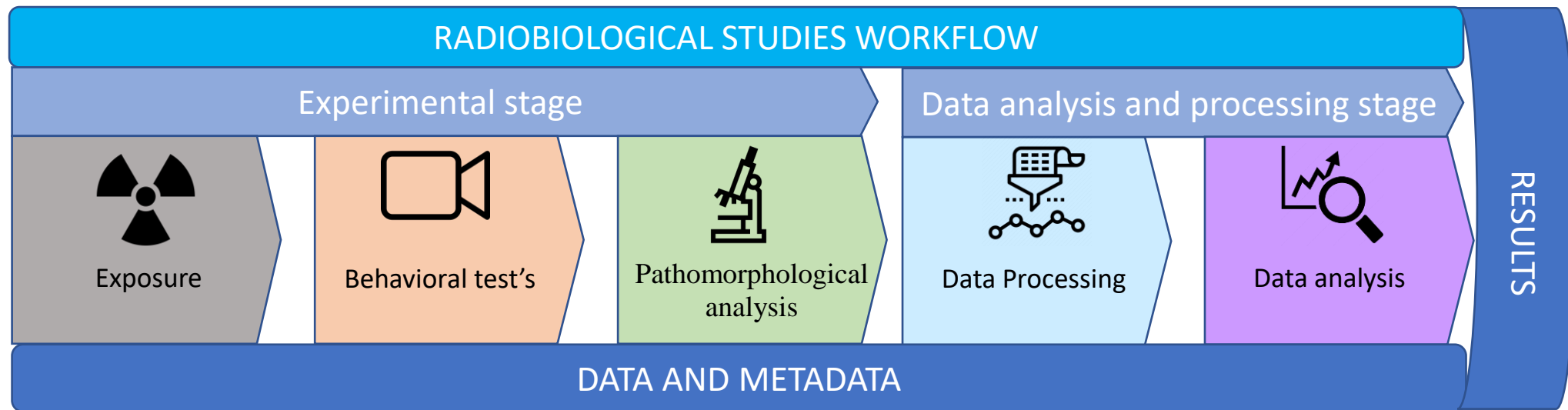
**Webapp**

**Metadata DB**

**Supercomputer "Govorun"**

metadata

**API-Server**

Images, Videos, data

Jobs, resource allocation

Train, Inference, Results

Auth data, credentials

Train, Inference, Dev

**HLIT-storage, JINR EOS**

**Auth**

**Batch-system**

**ML\DL ecosystem**

## Processing conceptual scheme
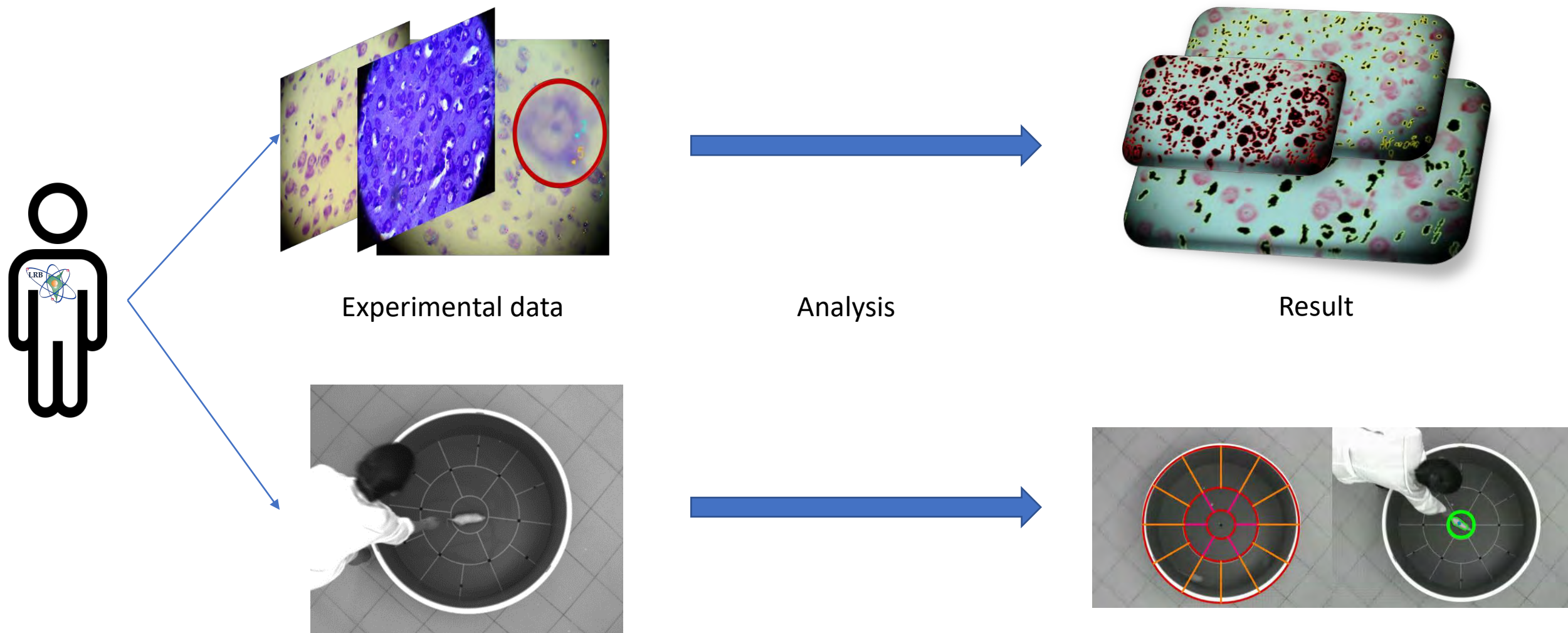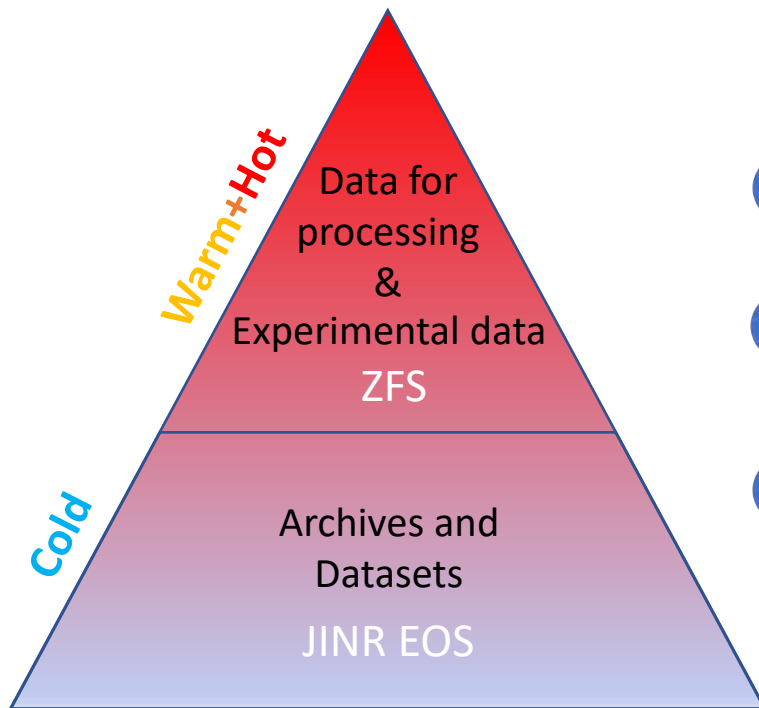


Experimental data
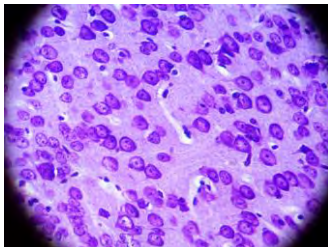
Analysis

Result
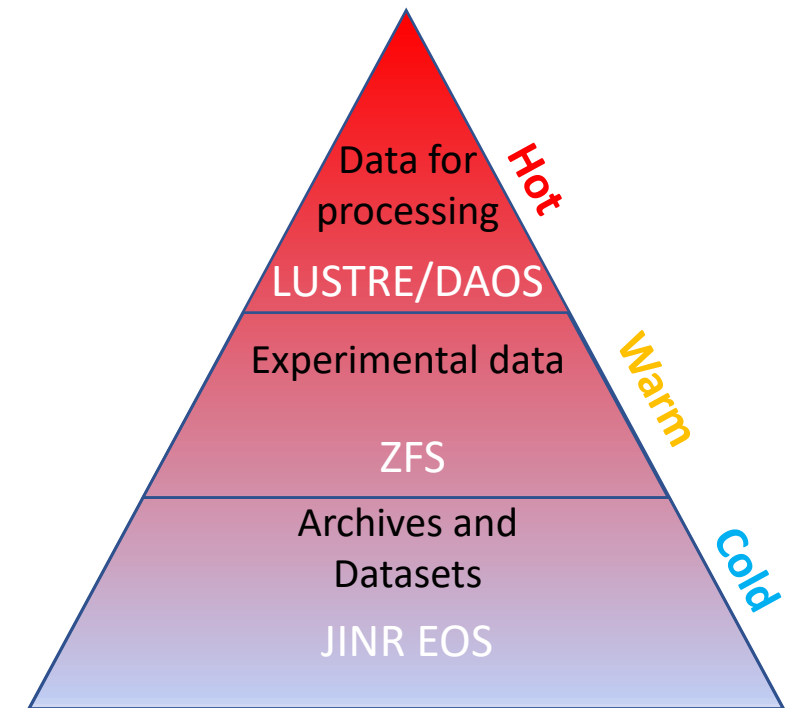
# BIOHLIT STORAGE

# BIOHLIT STORAGE

**Experiment:**

- Experiment name
- Description
- Animals type
- Impact
- Dose
- Date of impact
- Arrival date
- Animal Date of Birth
- Slaughter date
- Gender
- Owner
- Creation date

**Group:**

- Group Name
- Description
- Owner
- Creation date

**Videos**

**Behavioral test**



**Histological slices**



**Objects:**

- Object name
- Owner
- Creation date

**Images**

- Analysis of the experimental field markup
- Tracking the position of the animal as part of the experiment
- Classification and determination of the type of animal activity (grooming, fading, etc)
- Segmentation of neurons in images of histological slices
- Classification of neurons by type and belonging to the layer
- Statistical analysis of behavioral patterns and correlations with pathomorphological analysis
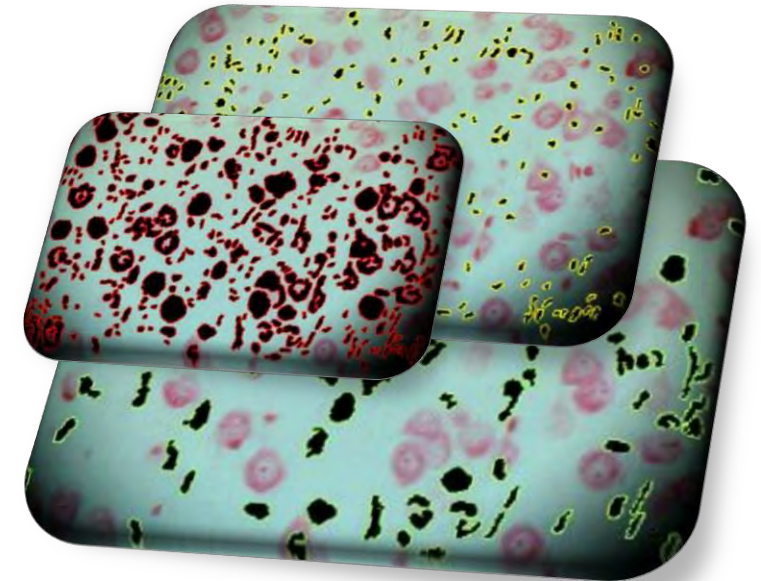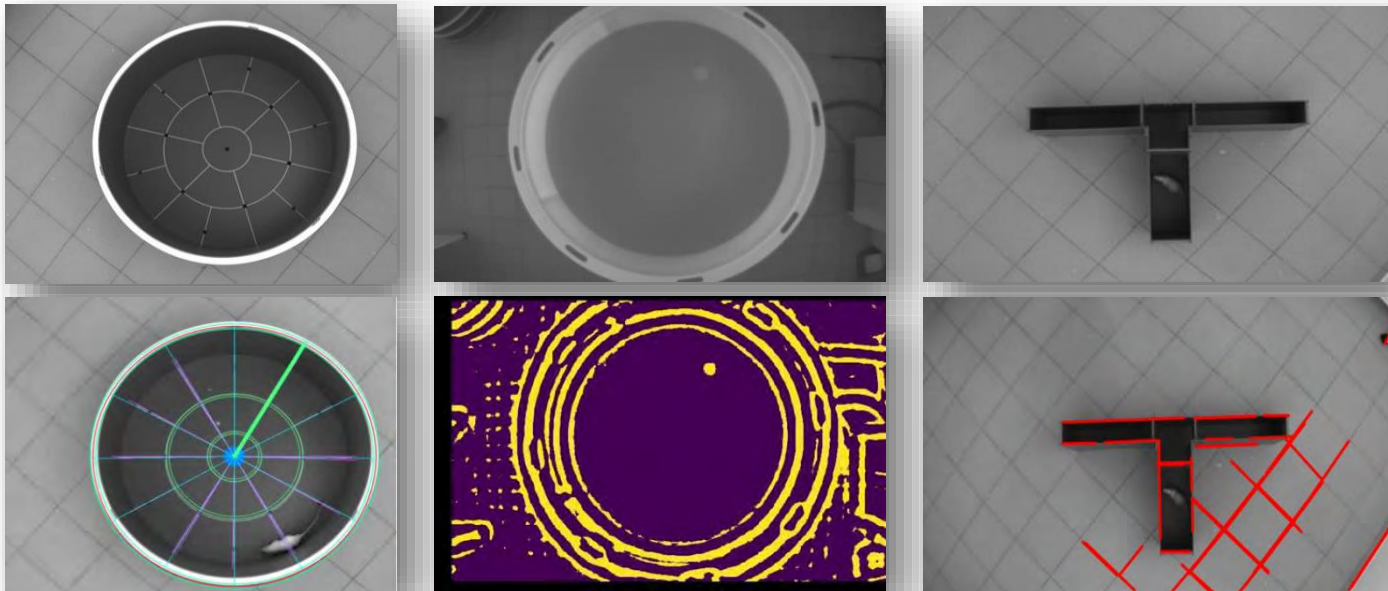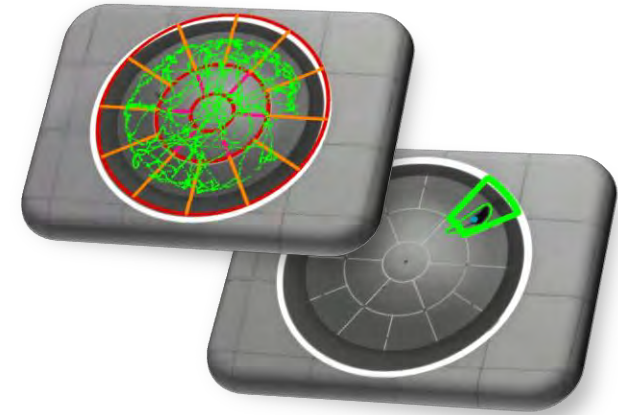
# Behavioral test: Open Field

Open field behavioral test it 's a round arena with marked sectors and bottom holes. The test takes 6 minutes.

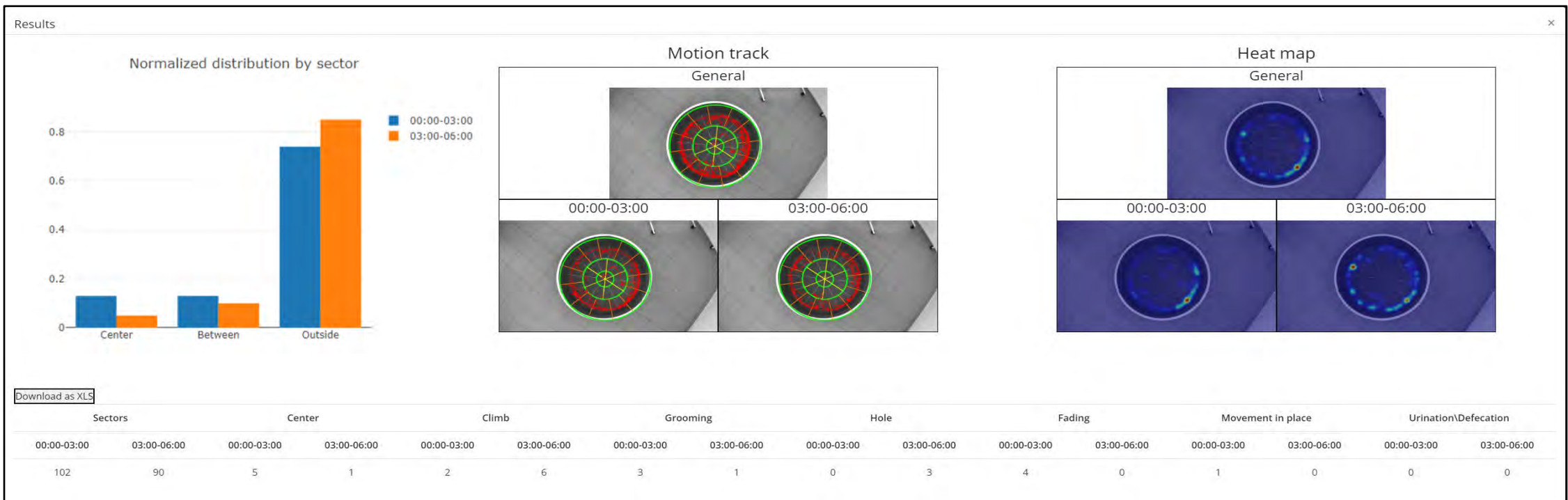The "Open Field" allows to register the general activity of experimental animals. To aim this required to counting number of: sectors passed, intersections of the center, fading's, climbs, movements in place, grooming, urination and defecations.
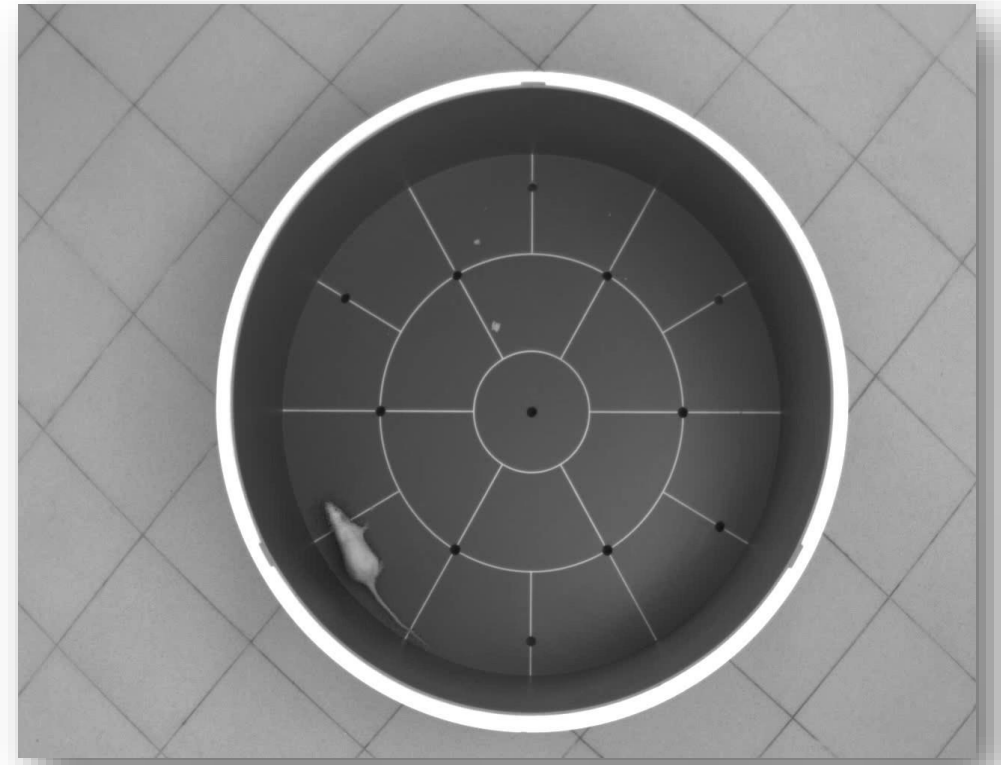
# BIOHLIT information system for radiobiological studies

# ML/DL and data analysis ecosystem + JLabHPC

Easy and fast prototyping of ML/DL algorithms in Jupyter Notebook environment

4x GPU Volta V100 is available for learning of convolutional neural networks

Popular frameworks and software for DL/ML/CV/Data Processing (Tensorflow, Keras, Pytorch, OpenCV, Matlab, etc.) are assembled and ready for use.

Large specter of available Python libraries for data analysis and visualization

**Specifications:**
- GPU: 4x Nvidia Volta V100-SXM2 *NVLink* 32Gb HBM2
- CPU : 2x Intel Xeon Gold 6148 CPU @ 2.40GHz 20 Cores/40 Threads
- RAM: 512 GB DDR4 2666MHz
- SSD: 2*240 GB
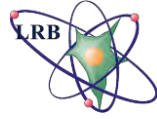
**The Computer-Assisted Identification, Characterization, and Modeling of the Histological Data**

A project within the Cooperation Agreement between the Joint Institute for Nuclear Research (JINR), Dubna, Russian Federation, and the Ministry of Education and Science of the Republic of Serbia.

We plan to develop of the automated information system (AIS), based on the machine learning techniques, for systematic acquisition and preprocessing of experimental data, followed by automated segmentation, identification, and characterization of the biologically relevant structures. This system will enable efficient manipulation and visualization of obtained results, which are necessary prerequisites for advanced statistical analysis and modeling.

AIS will enable the systematization of the accumulated results. identification of hidden patterns in the biological data and characterize the damaging effect of ionizing radiation or any other carcinogen. While modeling the observed patterns could lead to significant advances in diagnosis, prevention, and treatment of cancer.

https://it4bio.jinr.ru/

# MATLAB in ML/DL Ecosystem

Available 6 licenses for Matlab in JupyterHub environment as part of ML/DL Ecosystem

## Conclusions

**Information system has been implemented as a web application and it has a client-server architecture. The server is Node.js and the client is written using the React library.**

- IS takes over all necessary manipulations of the DB (database), file storage, Batch-system and other components of the HybriLIT platform;
- IS provides a convenient interface for: processing, storing, modifying and adding experimental data;

**Web applications advantages:**

- No installation or update required;
- Available on all devices with the Internet (PC's, Pad's);
- All calculations/processing will take place on a remote dedicated server.

**Based on the results and technologies of this project, several another projects have been launched:**

- Virtual Research Environment NanoHLIT for Hybrid Nanostructures Research on the HybriLIT Platform;
- The Computer-Assisted Identification, Characterization, and Modeling of the Histological Data.

# Thanks for your attention!

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https://bio.jinr.ru/          http://hlit.jinr.ru/          https://it4bio.jinr.ru/