

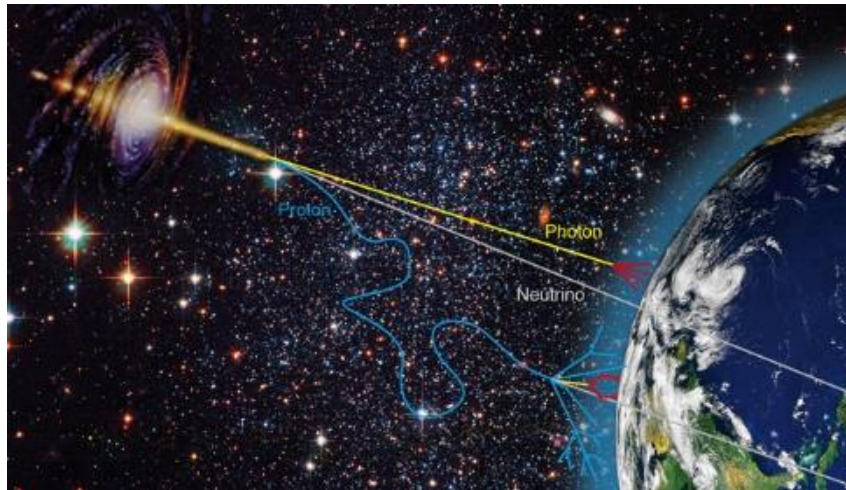
Educational and outreach resource for astroparticle physics

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Motivation

- Consolidation and integration of instruments aimed at the detection of different messengers from high-energy astrophysical processes.
- Experiments should operate during several decades, which means that the data will be obtained and analyzed by several generations of physicists.
- It is necessary to properly support the data life cycle, as well as the human aspects, for example, attracting, learning and continuity.



Baikal Region Experiments

The world-known actively developing astroparticle experiments in Baikal region, which in turn require the involvement of new members:

- TAIGA gamma observatory (**cosmic rays, gamma quanta**)
- Baikal-GVD deep underwater neutrino telescope (**neutrino**)
- MASTER robotic wide field telescope (**optical** range)



Baikal Multimessenger Lab

Mission

- Creation of common framework for experiments in Baikal region (Baikal-GVD, TAIGA and MASTER)
- Integration of these facilities into full-stack multimessenger astrophysics
- Creation a competitive school for astroparticle physics at Irkutsk State University (ISU)

Departments

- Science (Focus on multimessenger astrophysics)
- Computing (High-speed communication, Computing cluster, Real-time analysis)
- Hardware (Technical support for operation, Developing and testing of new technologies)
- Education (Lectures, seminars and laboratory practicum on astroparticle physics, Program for invited speakers, PhD and postdoc programs)

Outreach

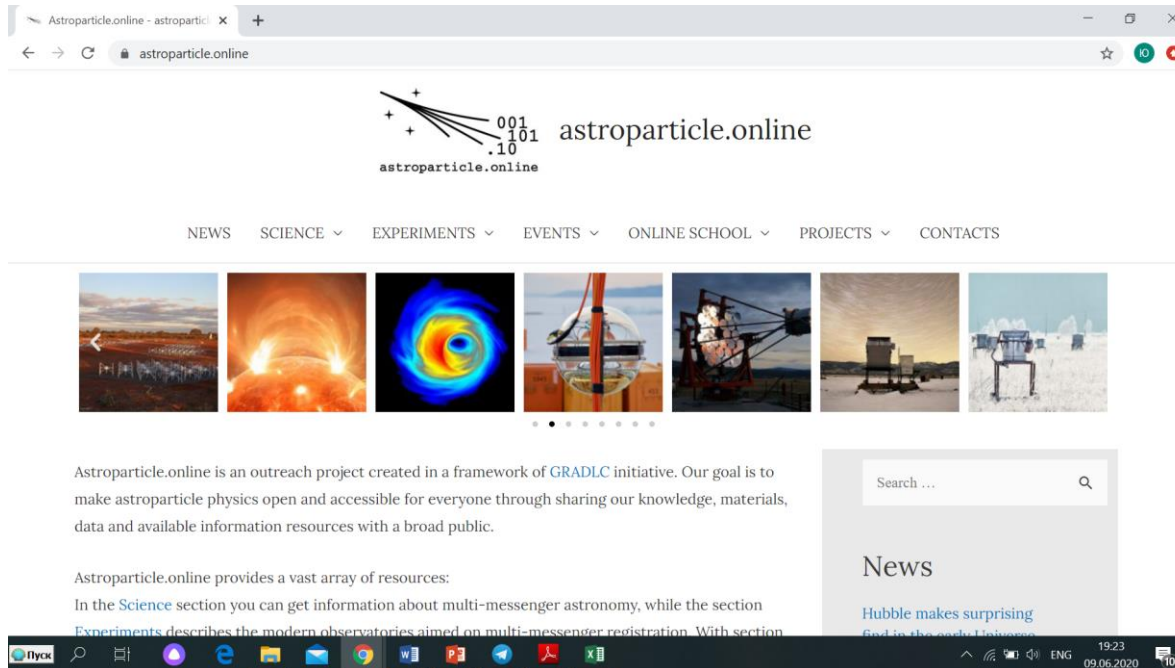
- Activity with Irkutsk Planetarium
- Excursions to Tunka and Baikal
- Promotion of the Laboratory activities with social nets
- Using the educational and outreach resource ***astroparticle.online***

astroparticle.online

- In 2018 educational and outreach activities in the frame of German-Russian Astroparticle Data Life Cycle Initiative (GRADLCI) has been started
- The servers of the platform have been deployed at the Matrosov Institute for System Dynamics and Control Theory, the resource based on CMS WordPress
- The main target audience – ISU students, whom we want to attract to work with our experiments

Structure and Content

- News on astronomy and astrophysics (updated weekly)
- Theory of messengers and particle physics
- Links on astroparticle experiments and projects



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Choose the characteristic that does not describe the quark:

- nuclei formation
- participation in the strong interaction
- fractional charge
- existence of the corresponding neutrino

Prev

Next

Online school

- Data analysis (interactive service)
- Lectures (video + quizzes)
- Seminars (video + quizzes)
- Labs (Laboratory telescope for studying the secondary component of cosmic rays developed in ISU)
- Popular Science (video + quizzes)
- Tasks (hints, solutions)

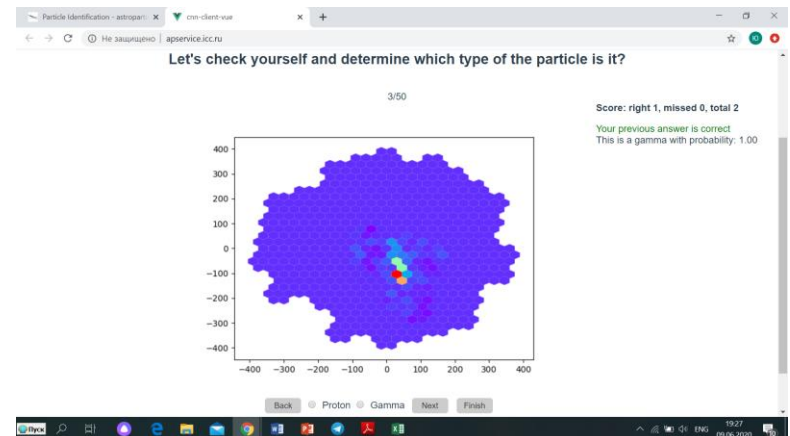
The content for the scientific and educational portal *astroparticle.online* particularly based on the new course in astrophysics launched at the ISU in 2019.

Interactive service

- On-line analysis of the gamma/hadron separation using convolutional neural networks developed as part of the GRADLCL project
- Monte Carlo events of the TAIGA-IACT telescope

The service contains:

- Guessing game on gamma/hadron separation
- Instruction how to define gamma-event using telescope image
- Prepared datasets ready for downloading
- Application for processing your own dataset
- Tools:
 - Script for data visualization + instruction
 - Script for file structure + instruction



Structure of Astroparticle CNN client

- Server part is deployed in the Docker container
(written in python and based on the Django framework)
- SQLite is used as the DBMS (only information about preloaded datasets)
- The database includes two tables: a dataset table and an event table.
- The database structure is defined by the model described using the Django framework
- Tables are populated from HDF5 files with data sets during system deployment
- .png event image files are generated during the deployment

- appds-cnn-micro
 - |— api
 - | |— admin.py
 - | |— apps.py
 - | |— models.py
 - | |— serializers.py
 - | |— tests.py
 - | |— views.py
- |— build_docker.sh
- |— cnnmicro
 - | |— settings.py
 - | |— urls.py
 - | |— wsgi.py
- |— DATAFORMAT.md
- |— datasets
 - | |— pub1.h5
 - | |— pub2.h5
 - | |— pub3.h5
 - | |— pub4.h5
 - | |— pub5.h5
- |— datasets_to_db.py
- |— Dockerfile
- |— manage.py
- |— model.h5
- |— README.md
- |— requirements.txt
- |— static

Conclusion

- The resource *astroparticle.online* can be the education and outreach instrument for the new Baikal Multimessenger Lab as well as the advertising for experiments of Baikal region
- The resource is filled with materials and tasks in astroparticle physics and the content is being constantly updated
- Interactive service based on using CNN for gamma-hadron separation is developed