Gran Sasso Hands-on -PhD summer school on experimental and astroparticle physics

Summary of the 2023 and 2025 editions

Edition	Dates	Participants
2023	25 September – 6 October	40
2025	8 – 19 September	47

Two weeks of lectures and experimental research in small groups, ending with presentations of the results.

GSSI, LNGS and the University of L’Aquila

Lecture topics

2023

Dark matter: theory and experiments

Neutrinos: theory and experiments

Cosmic-ray astrophysics and UHECRs

Nuclear astrophysics and space detectors

Statistics and low-background techniques

2025

Dark matter: theory and experiments

Neutrinos: theory and experiments

Cosmic rays: theory and experiments

Nuclear astrophysics and gravitational waves

Statistics for rare events

Electronics, DAQ and signal processing

List of lecturers

Pierre-André Amaudruz, TRIUMF (Electronics, DAQ and signal processing techniques)
Tomasz Bulik, NCAC (Gravitational waves)
Marco Cirelli, LPTHE (Dark matter theory)
Glen Cowan, RHUL (Statistics for rare event searches)
Rosanna Depalo, UniMI (Nuclear astrophysics)
Martin Lemoine, APC (Cosmic rays theory)
Kimberly Palladino, Oxford (Dark matter experiments)
Marco Pallavicini, INFN-Ge (Neutrino experiments)
Lorenzo Perrone, INFN-Le (Cosmic ray experiments)
Francesco Vissani, INFN-LNGS (Neutrino theory)

Experimental activities in 2023

Projects presented

DARWIN, XENONnT and NEWSdm
PTOLEMY and LEGEND
GINGER
SiPMs and bolometric detectors
CUORE/CUPID, RESNOVA and COSINUS
MANGO and MANGO-KEG
AUGER, HERD and NUSES
LUNA and STELLA

Learning value

Working with technologies and data from real experiments.

Applying lecture content to a project with support from tutors.

Discussing measurement and analysis choices within the group.

Presenting the work at the closing session.

Experimental activities in 2025: detectors

COSINUS: assembling a calorimeter and cooling it to 10 mK.
CRESST: characterising prototypes with TES sensors.

CUORE/CUPID: cryogenic calorimeters and cryocooler performance.
CYGNO: characterising and optimising an optically read out TPC.

DarkSide-20k: SiPM arrays, data acquisition and synchronisation.
LEGEND: monitoring liquid-argon purity.

Hands-on value: relating detector response to operating conditions and signal quality.

Experimental activities in 2025: measurements and analysis

AUGER: analysing and interpreting ultra-high-energy cosmic rays.
GEMINI: controlling seismic-isolation platforms.
LUNA: measuring nuclear cross sections.
NUSES: performance and particle detection for space missions.
PTOLEMY: testing high-frequency electronics.
SABRE: measurements with ultra-pure sodium iodide crystals.
XENONnT: energy reconstruction and signal corrections.
Neutron detectors: characterising GAGG-based sensors.

Hands-on value: working with data, noise and instrumental limits to support a physics conclusion.

Why hands-on work is central to the school

Lectures provide the physics background and tools needed for the project.

Laboratory work requires practical decisions: how to measure, control backgrounds and assess uncertainty.

The group tests ideas against data and revisits its choices with the tutors.

Students experience research: an open problem, a result to verify and a scientific discussion.

Two weeks for almost €1,000

Accommodation in L’Aquila and daily transport to and from LNGS.

Lectures and laboratory research with dedicated tutors.

Group work and preparation of the final presentations.

A social excursion, a city tour and a social dinner.

Staying together encourages discussion beyond the laboratory and helps young researchers build connections.

Fee also covered lunches and coffee breaks. Travel and regular dinners were excluded.

Group work and final presentations

Small groups supervised by researchers from LNGS, GSSI and the University of L'Aquila.

Students share experimental tasks and discuss how to interpret their results.

At the end, they present their project, methods and results.

The final presentation completes the process: students explain the evidence and practise answering scientific questions.

Official Indico pages

Edition 2023

https://agenda.infn.it/event/33718/

Edition 2025

https://agenda.infn.it/event/44808/

Edition 2027

https://agenda.infn.it/e/hands-on-2027

Timetables, lecture materials and project presentations are available on the respective pages.