

XIII International Conference on New Frontiers in Physics 2024



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on New Frontiers in Physics
25 Aug - 4 Sep 2024, OAC, Kolymbari, Crete, Greece

Sunday 25 August 2024 - Wednesday 4 September 2024

Orthodox Academy of Crete, Kolymbari, Crete, Greece

Scientific Program

The conference series "New Frontiers in Physics" aims to promote interdisciplinarity and cross-fertilization of ideas between different disciplines addressing fundamental physics. While different fields each face a distinct set of field-specific challenges in the coming decade, a significant set of commonalities has emerged in the technical nature of some of these challenges, or are underlying the fundamental concepts involved. A Grand Unified Theory should in principle reveal this underlying relationship.

For instance, techniques from string theory have become relevant in recent years for improving perturbative techniques in high-energy physics or identifying material properties of non-abelian plasmas that share essential features with the systems studied in heavy-ion collisions. Fluctuation analyses of the cosmic microwave background involve techniques and concepts that are becoming increasingly relevant for the study of the quickly expanding little bangs in heavy-ion collisions. Cosmological models are developed in close interplay with searches for new physics at the LHC. There is a multitude of examples illustrating that crosstalk between neighbouring fields is relevant or even crucial for progress in either field.

The conference series "New Frontiers in Physics" aims at identifying interdisciplinary topics on which crosstalk between different disciplines of fundamental physics can contribute to further progress. The conference series aims at bringing together key scientists of different fields to discuss the state of the art and the nature of open questions in a language suitable for a physics-educated interdisciplinary audience and to discuss avenues for further progress.

Main topics

While the main body of the conference builds mainly on the below-mentioned topics, presentations on yet different disciplines are invited and vary every year. Such topics can be for example nuclear structure, atomic physics, plasma physics, physics applications (biophysics, medical science), biology, mathematics, computing science, etc.

High Energy Particle Physics

Searches for new particles and new phenomena (Higgs boson, SUSY, top quarks, extra dimensions, flavour physics, precision electroweak measurements and others), hadron physics, and neutrino physics.

Heavy Ion Collisions and Critical Phenomena

The properties of QCD matter under extreme conditions and the QCD phase diagram. Branching out to neighbouring disciplines: Superconductivity, Neutron Stars, Quark Stars, Exotics.

Quantum Physics, Quantum Optics and Quantum Information

Quantum Optics, Quantum Information, Foundations of Quantum Mechanics, Quantum information; Entanglement and the Universe: Black Holes and Cosmology, Quantum Non-Locality, Cold Atoms.

Cosmology, Astrophysics, Gravity, Mathematical Physics

Cosmic Microwave Background, Dark Energy, Gravitational waves, Dark Matter, Astroparticle Physics, Quantum Gravity, String Theory, Non-Commutative Geometry, Holography.

Workshops & Special Sessions

Workshops, mini-workshops and special sessions will be also organized during the conference. The full list of scientific topics will be published soon.

Workshop on Laser Fusion, a spin-off from heavy-ion collisions

Convener: Prof. Laszlo Pal Csernai, University of Bergen, Norway (laszlo@csernai.no)

Dates: September 2-4, 2024

If you are interested to participate in the workshop, please choose this topic in the abstract submission form. In case of questions please contact the convener.

Special Session on Quantum Information and Quantum Optics

(TBC)

Workshop on Ultrarelativistic Heavy Ion Collisions at high energy

Workshop on Physics of Heavy Ion Collisions at low energy

Convenors: Dr. Peter Senger, Dr. Alexander Sorin.

Workshop on Instruments and Methods

Workshop on " Half a Century of QCD "

28-30 August 2024.

Convener: Prof. Willibald Plessas, University of Graz, Austria.

Workshop on Astro-Cosmo-Gravity

Convener: Dr. Armen Sedrakian, Frankfurt Institute for Advanced Studies, J W Goethe University of Frankfurt, Germany

School on Machine Learning

Convener: Pietro Vischia, Universidad de Oviedo and ICTEA.

The school will include theory lectures and practice hours.
There will be a challenge leading to a price for the best team.

For interested people that will participate in the school, a certificate of attendance will be given.

The dates will be announced soon.

For potential lecturers:

You can submit an abstract if you wish to present a lecture within the school.

For students:

You can select the option to participate in the school as a student, in your registration data.

The school is aimed at giving a wide view of modern machine learning, from theoretical foundations to state-of-the-art applications. The school will consist of lectures mixing the theoretical aspect and hands-on examples. Furthermore, there will be exercise sessions where participants will go through longer exercises at their own pace, with the assistance of the lecturer and of facilitators.

Covered topics:

1. Mathematical foundations of ML | Vapnik's theory of statistical learning | Early methods from statistics to ML: PCA, SVM, decision trees
2. Supervised learning: neural networks, gradient descent | Technical foundations: automatic differentiation | Hardware foundations: from CPUs to GPUs, TPUs, FPGAs, ASIC, neuromorphic circuits | Practical techniques (e.g. hyperparameters optimization, regularization)
3. Transformers, large language models | Spiking networks | Unsupervised learning | Quantum machine learning

Special session on Machine Learning

Convenors: Pietro Vischia, Universidad de Oviedo and ICTEA and Tommaso Dorigo, INFN, Sezione di Padova.

Special session on neutrino physics

Session on other topics and interdisciplinary topics

Outreach

Extended session