17 February 2025 to 28 June 2025
Europe/Lisbon timezone

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This is the 14th edition of a specialized course on the Physics at the Large Hadron Collider. It is organized by LIP in the framework of the International Doctorate Network in Particle Physics, Astrophysics and Cosmology (IDPASC). The course is intended for under-graduate or graduate students with basic training in Particle Physics. The objective of the Course is to introduce the physics, analysis methods and results on the physics areas covered by the LHC experiments.

Lectures will take place in person at LIP (in "sala Seminarios"). A Zoom link may also be provided to connect remotely.

TOPICS

https://indico.lip.pt/event/1952/

Zoom Meeting: https://cern.zoom.us/j/68257258580?pwd=GBHu2RlO4a7m3eJkSqjn6w1cbRbB3v.1

Meeting ID: 682 5725 8580
Passcode: 342458

All lectures will start at 5pm (Lisbon time), unless otherwise stated. Please note that Lisbon is one hour behind CET.

Introduction

- Specialized course on the Physics at the Large Hadron Collider organized by LIP in the framework of IDPASC
- The goal of the Course is to introduce the physics, analysis methods, and results of the LHC experiments
- Emphasis is placed on the search for new physics
- Benchmark channels in proton-proton collisions will be discussed:
  - identification of the objects involved
  - signal and background properties
  - background estimation and S/B discriminants
  - estimation of systematical errors
  - extraction and interpretation of the final results

Introduction (cont.)

- Course intended for under-graduate or graduate students with basic training in Particle Physics

- *Basic concepts*
- Elementary constituents of matter and interactions. Quantum numbers and conservation rules. Spin and symmetry groups. Relativistic kinematics. Cross-section. Natural units. Mass and lifetime. Resonances.

- *Structure of matter*
- Elastic scattering and form factors. Inelastic scattering experiments. Nucleon structure functions. Scale invariance. Quark model. Parton distribution functions. Introduction to QCD.

- *Fundamental interactions*
- Introduction to QED. Fermi interaction. Parity violation. Currents V-A and weak doblets. W and Z bosons. Cabibbo angle. Neutral currents. Electroweak interaction. Gauge symmetries. The Higgs mechanism. Weinberg-Salam model. CP violation.

bibliography

- F. Halzen and A.D.Martin, ' Quarks and Leptons ', John Wiley and Sons (1984)
- D. Griffiths, ' Introduction to Elementary Particles ', John Wiley and Sons (1987)
- B.R.Martin, G. Shaw, ' Particle Physics ', John Wiley and Sons (1999)

Course certification

- Will provide *Certificate of Attendance* to those who attend at least 80% of the lectures

- Recognized as a course at IST (with *credit*) for those:
  - Who will attend at least 80% of the lectures
  - Who will pass a final exam (give a short seminar and Q&A session)
  - Registered on Fenix as ``Topicos em Fisica de Particulas”

Link (Fenix): https://fenix.tecnico.ulisboa.pt/disciplinas/TFParti/2024-2025/2-semestre

- 2-day workshop to introduce ML techniques and algorithms applied to HEP
- A series of introductory classes using dedicated tools are paired with hands-on exercises to familiarize with the needs and applications adopted for the LHC experiments

- Lectures will be in presence
- **Please register!**