

Centro de Investigação em Matemática e Aplicações
Departamento de Matemática
Programa de Doutoramento em Matemática

Seminário

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Rare Signals from Big Data

Nuno Leonardo
LIP & IST

Abstract: The Large Hadron Collider and its detectors are among the largest and most complex scientific apparatuses ever built. The goal is that of probing Nature at the smallest scales and most fundamental level. The strategy is to accumulate large datasets at the highest energies to search for tiny signals. CERN's LHC has started operations a decade ago, and has facilitated a wealth of precious physics results. Following the discovery of the only known scalar elementary particle, the Higgs boson, the overarching goal is to detect signals from New Physics (NP), beyond the standard model of particle physics. Such expected signals of interest are extraordinarily rare. High-energy physics has thus long been a driver in managing and processing enormous scientific datasets. The LHC produces about 800 million collisions, generating about 75TB worth of data - each second. A hierarchical sequence of steps is employed to extract the tiny signals from the enormous background of known processes. Machine learning techniques are increasingly employed ubiquitously at each of these stages. I will present an overview of recent LHC results with focus on the ongoing search effort for NP through rare processes. Summarize the tantalizing pattern of deviations that are emerging from the data (which forms the most significant indication of NP in collider data to date, and illustrates how NP may be first revealed at the LHC). Illustrate how multivariate techniques are employed in the endeavour of detecting rarer signals in increasingly large and precise datasets — specially in view of the high-luminosity phase of the LHC towards the middle of the decade.

Short Bio: Nuno Leonardo's current research focuses on the acquisition and physics exploration of LHC data with the CMS detector at CERN. He is a principal researcher at LIP-Lisbon and invited faculty at IST. Previously he held researcher positions at MIT, CERN and Purdue University, and studied at IST (Licenciatura), Cambridge (MSc) and MIT (PhD). At CMS he has served in the Trigger and Physics coordination of the experiment, and at LIP he serves as coordinator for advanced training.



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