IT Services

Case Study

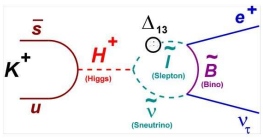
BlueBEAR provides a substantial computing resource that properly supports the research work of research staff and students at Birmingham. It provides a cost effective facility that optimises the effectiveness of research and ensures the University continues to be a world-class academic learning and research environment.

Test of Lepton Flavour Universality at the CERN high-energy particle experiment NA62

Challenges

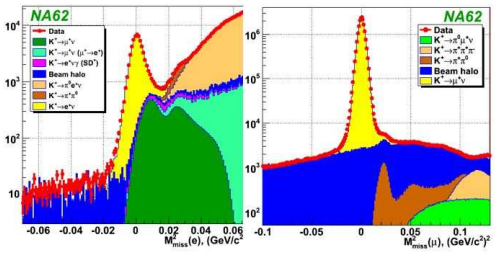
The first phase of the NA62 experiment at CERN is dedicated to a very precise test of Lepton Flavour Universality (LFU), a cornerstone of the Standard Model of particle physics postulating that lepton coupling to gauge bosons is independent of lepton type ("flavour"), as opposed to flavour-dependence of quark interactions. The origin of the observed LFU is a fundamental problem of modern physics. Precision tests of LFU with the aim of finding evidences for its violation can shed light on the question of whether the supersymmetry or any other Standard Model extensions are realized in nature. This is in turn closely related to the astrophysical problems of the composition of the Universe and Dark Matter.

Using a data set collected in 2007, the ratio of the two leptonic decays of the charged kaon decays (Ke2/Km2), which is sensitive to possible manifestations of LFU violation, has been measured precisely to search for deviation from the Standard Model predictions. As it is usual for precision measurements in particle physics, CPU-intensive Monte Carlo simulations are instrumental for achieving the proposed accuracy, extracting the signal out of the large background, and estimating all the background sources and all the experimental effects that could limit the precision.



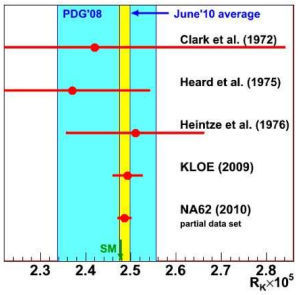
Solution

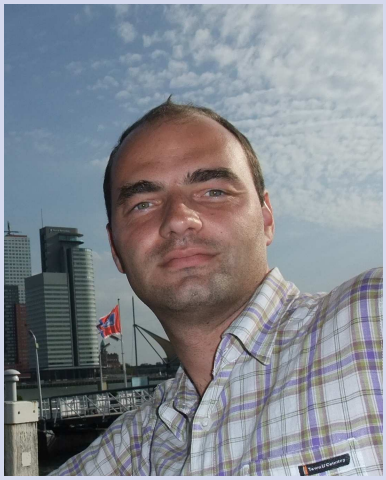
All the Monte Carlo simulations required for the physics analysis have been carried out at the BlueBEAR cluster. A total of about 10 billion events have been simulated, using a custom programme based on the Geant toolkit that simulates kaon decays and traces the decay products in the detector. The simulation also takes care of the energy release of particles in the detector and their interaction with matter, and finally of their detection. All background sources and all relevant detector effects such as muon interactions in the liquid krypton calorimeter were simulated in detail.



Results

The simulation of muon interaction in lead has been crucial in order to achieve a precise background rejection. Overall, the various background components are reproduced extremely well. This makes us confident that the extracted signal is pure and all the detector effects are under control. Therefore the measurement achieved a world record 0.5% precision.





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Product Used
Custom packages based on Geant3 and Geant4 simulation tools

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