

---

# Get Free The Toolkit For Multivariate Data Analysis Tmva 4

---

Thank you very much for reading **The Toolkit For Multivariate Data Analysis Tmva 4**. As you may know, people have search numerous times for their chosen novels like this The Toolkit For Multivariate Data Analysis Tmva 4, but end up in harmful downloads.

Rather than enjoying a good book with a cup of coffee in the afternoon, instead they are facing with some harmful bugs inside their desktop computer.

The Toolkit For Multivariate Data Analysis Tmva 4 is available in our book collection an online access to it is set as public so you can get it instantly.

Our digital library spans in multiple locations, allowing you to get the most less latency time to download any of our books like this one.

Kindly say, the The Toolkit For Multivariate Data Analysis Tmva 4 is universally compatible with any devices to read

---

**KEY=TOOLKIT - NICHOLSON LIZETH**

---

## The Digital Journey of Banking and Insurance, Volume III

## Data Storage, Data Processing and Data Analysis

**Springer Nature** This book, the third one of three volumes, focuses on data and the actions around data, like storage and processing. The angle shifts over the volumes from a business-driven approach in “Disruption and DNA” to a strong technical focus in “Data Storage, Processing and Analysis”, leaving “Digitalization and Machine Learning Applications” with the business and technical aspects in-between. In the last volume of the series, “Data Storage, Processing and Analysis”, the shifts in the way we deal with data are addressed.

## Supersymmetric Beasts and Where

# to Find Them

## From Novel Hadronic Reconstruction Methods to Search Results in Large Jet Multiplicity Final States at the ATLAS Experiment

**Springer Nature** After an extensive overview of the Standard Model and of the theory and phenomenology of Supersymmetry, this book describes the recent development of the ATLAS Particle Flow algorithm, a hadronic reconstruction technique aiming at enhancing the sensitivity of the experiment to new physics through the combination of the information from different ATLAS sub-detectors. The first ever ATLAS strong SUSY search exploiting this technique is also described, reporting the results and exclusion limits obtained using the complete proton-proton collision dataset recorded by the ATLAS experiment during the second Run of the Large Hadron Collider (LHC).

## Study of Double Charm B Decays with the LHCb Experiment at CERN and Track Reconstruction for the LHCb Upgrade

**Springer** This book discusses the study of double charm B decays and the first observation of  $B^0 \rightarrow D^0 D^0 K^* S^0$  decay using Run I data from the LHCb experiment. It also describes in detail the upgrade for the Run III of the LHCb tracking system and the trigger and tracking strategy for the LHCb upgrade, as well as the development and performance studies of a novel standalone tracking algorithm for the scintillating fibre tracker that will be used for the LHCb upgrade. This algorithm alone allows the LHCb upgrade physics program to achieve incredibly high sensitivity to decays containing long-lived particles as final states as well as to boost the physics capabilities for the reconstruction of low momentum particles.

# Searches for the Supersymmetric Partner of the Top Quark, Dark Matter and Dark Energy at the ATLAS Experiment

**Springer Nature Astrophysical observations implying the existence of Dark Matter and Dark Energy, which are not described by the Standard Model (SM) of particle physics, have led to extensions of the SM predicting new particles that could be directly produced at the Large Hadron Collider (LHC) at CERN. Based on 2015 and 2016 ATLAS proton-proton collision data, this thesis presents searches for the supersymmetric partner of the top quark, for Dark Matter, and for DarkEnergy, in signatures with jets and missing transverse energy. Muon detection is key to some of the most important LHC physics results, including the discovery of the Higgs boson and the measurement of its properties. The efficiency with which muons can be detected with the ATLAS detector is measured using Z boson decays. The performance of high-precision Monitored Drift Tube muon chambers under background rates similar to the ones expected for the High Luminosity-LHC is studied.**

## Physics with Photons Using the ATLAS Run 2 Data

## Calibration and Identification, Measurement of the Higgs Boson Mass and Search for Supersymmetry in Di-Photon Final State

**Springer The work presented in this book is based on the proton-proton collision data from the Large Hadron Collider at a centre-of-mass energy of 13 TeV recorded by the ATLAS detector in 2015 and 2016. The research program of the ATLAS experiment includes the precise measurement of the**

parameters of the Standard Model, and the search for signals of physics beyond the SM. Both these approaches are pursued in this thesis, which presents two different analyses: the measurement of the Higgs boson mass in the di-photon decay channel, and the search for production of supersymmetric particles (gluinos, squarks or winos) in a final state containing two photons and missing transverse momentum. Finally, ATLAS detector performance studies, which are key ingredients for the two analyses outlined before, are also carried out and described.

## Data Analysis in High Energy Physics

### A Practical Guide to Statistical Methods

**John Wiley & Sons** This practical guide covers the essential tasks in statistical data analysis encountered in high energy physics and provides comprehensive advice for typical questions and problems. The basic methods for inferring results from data are presented as well as tools for advanced tasks such as improving the signal-to-background ratio, correcting detector effects, determining systematics and many others. Concrete applications are discussed in analysis walkthroughs. Each chapter is supplemented by numerous examples and exercises and by a list of literature and relevant links. The book targets a broad readership at all career levels - from students to senior researchers. An accompanying website provides more algorithms as well as up-to-date information and links. \* Free solutions manual available for lecturers at [www.wiley-vch.de/supplements/](http://www.wiley-vch.de/supplements/)

### Statistical Methods for Data Analysis in Particle Physics

**Springer** This concise set of course-based notes provides the reader with the main concepts and tools needed to perform statistical analyses of experimental data, in particular in the field of high-energy physics (HEP). First, the book provides an introduction to probability theory and basic statistics, mainly intended as a refresher from readers' advanced undergraduate studies, but also to help them clearly distinguish between the Frequentist and Bayesian approaches and interpretations in subsequent applications. More advanced concepts and applications are gradually introduced, culminating in the chapter on both discoveries and

upper limits, as many applications in HEP concern hypothesis testing, where the main goal is often to provide better and better limits so as to eventually be able to distinguish between competing hypotheses, or to rule out some of them altogether. Many worked-out examples will help newcomers to the field and graduate students alike understand the pitfalls involved in applying theoretical concepts to actual data. This new second edition significantly expands on the original material, with more background content (e.g. the Markov Chain Monte Carlo method, best linear unbiased estimator), applications (unfolding and regularization procedures, control regions and simultaneous fits, machine learning concepts) and examples (e.g. look-elsewhere effect calculation).

## Searching for Squarks

### in Compressed States and States with Jets from Charm Quarks with the ATLAS Detector

**Springer Nature** This thesis focuses on searches for squarks with the ATLAS detector in "compressed" scenarios where the scalar top is very close in mass to the lightest supersymmetric particle. These models are theoretically appealing because the presence of a quasi-degenerate scalar top enhances the self-annihilation cross-section of the lightest supersymmetric particle, acting therefore as a regulator of the dark matter relic density. Two main analyses are presented: the first is a search for scalar tops decaying to charm quarks. The identification of jets originating from the charm quark is very challenging due to its short lifetime. The calibration of tools for charm-tagging has paved the way to measuring the decay of the Higgs boson to pairs of charm quarks. The second analysis presented is the development of a novel technique for reconstructing low momentum b-hadrons. This tool has enabled the ATLAS collaboration to explore topologies that were previously inaccessible.

## Physics with Electrons in the ATLAS Detector

**Springer** This thesis presents two production cross-section measurements of pairs of massive bosons using final states with leptons, made with the ATLAS detector at the Large Hadron Collider. The first measurement, performed using data collected in 2012 at center-of-mass energy  $\sqrt{s} = 8$  TeV, is the first fiducial and differential cross-section measurement of the

production of the Higgs Boson when it decays to four charged leptons (electrons or muons). The second measurement is the first fiducial and inclusive production cross-section measurement of WZ pairs at center-of-mass energy  $\sqrt{s} = 13$  TeV using final states with three charged leptons. A significant portion of the thesis focuses on the methods used to identify electrons from massive boson decay—important for many flagship measurements—and on assessing the efficiency of these particle identification techniques. The chapter discussing the WZ pair cross-section measurement provides a detailed example of an estimate of lepton background in the context of an analysis with three leptons in the final state.

## Progress in Pattern Recognition, Image Analysis, Computer Vision, and Applications

22nd Iberoamerican Congress,  
CIARP 2017, Valparaíso, Chile,  
November 7–10, 2017, Proceedings

**Springer** This book constitutes the refereed post-conference proceedings of the 22nd Iberoamerican Congress on Pattern Recognition, CIARP 2017, held in Valparaíso, Chile, in November 2017. The 87 papers presented were carefully reviewed and selected from 156 submissions. The papers feature research results in the areas of pattern recognition, image processing, computer vision, multimedia and related fields.

## Machine Learning at the Belle II Experiment

The Full Event Interpretation and Its  
Validation on Belle Data

**Springer** This book explores how machine learning can be used to improve the efficiency of expensive fundamental science experiments. The first part introduces the Belle and Belle II experiments, providing a detailed

description of the Belle to Belle II data conversion tool, currently used by many analysts. The second part covers machine learning in high-energy physics, discussing the Belle II machine learning infrastructure and selected algorithms in detail. Furthermore, it examines several machine learning techniques that can be used to control and reduce systematic uncertainties. The third part investigates the important exclusive B tagging technique, unique to physics experiments operating at the Y resonances, and studies in-depth the novel Full Event Interpretation algorithm, which doubles the maximum tag-side efficiency of its predecessor. The fourth part presents a complete measurement of the branching fraction of the rare leptonic B decay “B→tau nu”, which is used to validate the algorithms discussed in previous parts.

## Methodology of Social Research

**K.K. Publications** Social scientists are divided into camps of support for particular research techniques. These disputes relate to the historical core of social theory (positivism and antipositivism; structure and agency). While very different in many aspects, both qualitative and quantitative approaches involve a systematic interaction between theory and data. The choice of method often depends largely on what the researcher intends to investigate. For example, a researcher concerned with drawing a statistical generalization across an entire population may administer a survey questionnaire to a representative sample population. There are no laws in social science that parallel the laws in natural science. Law in social science is a universal generalization about a class of facts. A fact is an observed phenomenon, and observation means it has been seen, heard or otherwise experienced by the researcher. A theory is a systematic explanation for the observations that relate to a particular aspect of social life. Concepts are the basic building blocks of theory and are abstract elements representing classes of phenomena. Axioms or postulates are basic assertions assumed to be true. Propositions are conclusions drawn about the relationships among concepts, based on analysis of axioms. This book is designed for students at the beginning of their journey in social research. It aims to provide an accessible, practically oriented introduction to social research methods. The research methods included in this book are selected on the basis of their relevance to contemporary social research practice. Contents: • Survey Methodology • Multimethodology • Observational Field Research • Scientific Methods in Social Work Research • Critical Action Research in Social Work • Evaluation Design and Methods • Ethics and the Ruling Relations of Research Production • Multivariate Statistics • Statistical Power • Descriptive Research

# Measurement of Higgs Boson Production Cross Sections in the Diphoton Channel with the full ATLAS Run-2 Data and Constraints on Anomalous Higgs Boson Interactions

**Springer Nature** This thesis presents the measurement of the Higgs boson cross section in the diphoton decay channel. The measurement relies on proton-proton collision data at a center-of-mass energy  $\sqrt{s} = 13$  TeV recorded by the ATLAS experiment at the Large Hadron Collider (LHC). The collected data correspond to the full Run-2 dataset with an integrated luminosity of 139 fb<sup>-1</sup>. The measured cross sections are used to constrain anomalous Higgs boson interactions in the Effective Field Theory (EFT) framework. The results presented in this thesis represent a reduction by a factor 2 of the different photon and jet energy scale and resolution systematic uncertainties with respect to the previous ATLAS publication. The thesis details the calibration of electron and photon energies in ATLAS, in particular the measurement of the presampler energy scale and the estimation of its systematic uncertainty. This calibration was used to perform a measurement of the Higgs boson mass in the  $H \rightarrow \gamma\gamma$  and  $H \rightarrow 4l$  channels using the 36 fb<sup>-1</sup> dataset.

# Technology Meets Research - 60 Years Of Cern Technology: Selected Highlights

**World Scientific** 'The contributions from leading scientists of the day collected in this relatively slim book document CERN's 60-year voyage of innovation and discovery, the repercussions of which vindicate the vision of those who drove the foundation of the laboratory — European in constitution, but global in impact. The spirit of inclusive collaboration, which was a key element of the original vision for the laboratory, together with the aim of technical innovation and scientific excellence, are reflected in each of the articles in this unique volume.' CERN Courier 'Big' science and

advanced technology are known to cross-fertilize. This book emphasizes the interplay between particle physics and technology at CERN that has led to breakthroughs in both research and technology over the laboratory's first 60 years. The innovations, often the work of individuals or by small teams, are illustrated with highlights describing selected technologies from the domains of accelerators and detectors. The book also presents the framework and conditions prevailing at CERN that enabled spectacular advances in technology and contributed to propel the European organization into the league of leading research laboratories in the world. While the book is specifically aimed at providing information for the technically interested general public, more expert readers may also appreciate the broad variety of subjects presented. Ample references are given for those who wish to further explore a given topic.

## Higgs Boson Decays into a Pair of Bottom Quarks

## Observation with the ATLAS Detector and Machine Learning Applications

Springer Nature

## Top Quark Pair Production

## Precision Measurements of the Top Quark Pair Production Cross Section in the Single Lepton Channel with the ATLAS Experiment

Springer Science & Business Media Before any kind of new physics discovery could be made at the LHC, a precise understanding and measurement of the Standard Model of particle physics' processes was necessary. The book provides an introduction to top quark production in the context of the Standard Model and presents two such precise measurements of the production of top quark pairs in proton-proton

collisions at a center-of-mass energy of 7 TeV that were observed with the ATLAS Experiment at the LHC. The presented measurements focus on events with one charged lepton, missing transverse energy and jets. Using novel and advanced analysis techniques as well as a good understanding of the detector, they constitute the most precise measurements of the quantity at that time.

## Search for Higgs Boson Pair Production in the $b\bar{b} \tau^+ \tau^-$ Decay Channel with the CMS detector at the LHC

**Springer** This thesis presents innovative contributions to the CMS experiment in the new trigger system for the restart of the LHC collisions in Run II, as well as original analysis methods and important results that led to official publications of the Collaboration. The author's novel reconstruction algorithms, deployed on the Field-Programmable Gate Arrays of the new CMS trigger architecture, have brought a gain of over a factor 2 in efficiency for the identification of tau leptons, with a very significant impact on important H boson measurements, such as its decays to tau lepton pairs and the search for H boson pair production. He also describes a novel analysis of  $HH \rightarrow b\bar{b} \tau\tau$ , a high priority physics topic in a difficult channel. The original strategy, optimisation of event categories, and the control of the background have made the result one of the most sensitive concerning the self-coupling of the Higgs boson among all possible channels at the LHC.

## Observation of a New State in the Search for the Higgs Boson at CMS

**Springer** This book describes the searches that lead to the discovery of a Higgs boson performed at CMS, one of the two main experiments at the CERN LHC. After an overview of the theory and of the CMS experiment, all search channels are described, with emphasis on the ones with the best sensitivity. The statistical methodology used to analyse and the outcomes of the searches and the discovery results are then presented in detail.

# Scalar Boson Decays to Tau Leptons in the Standard Model and Beyond

**Springer** This thesis presents a study of the scalar sector in the standard model (SM), as well as various searches for an extended scalar sector in theories beyond the SM (BSM). The first part of the thesis details the search for an SM Higgs boson decaying to taus, and produced by gluon fusion, vector boson fusion, or associated production with a vector boson, leading to evidence for decays of the Higgs boson to taus. In turn, the second part highlights several searches for an extended scalar sector, with scalar boson decays to taus. In all of the analyses presented, at least one scalar boson decays to a pair of taus. The results draw on data collected by the Compact Muon Solenoid (CMS) detector during proton-proton collisions with a center-of-mass energy of 7 or 8 TeV.

# Search for the Higgs Boson Produced in Association with Top Quarks with the CMS Detector at the LHC

**Springer Nature** In this book, the interaction between the Higgs boson and the top quark is studied with the CMS detector at the LHC via the search for the associate production of the Higgs boson with one (tH) or two (ttH) top quarks. These processes are very rare and thus a high particle selection efficiency by the trigger system is essential. The selection of hadronically decaying tau leptons, expected from the Higgs boson decays, is tackled in the first part, where the trigger is optimized for Run 2 and Run 3 and a novel machine-learning based trigger for the High-Luminosity LHC is developed. The second part presents the analysis of tH and ttH where the Higgs boson decays into tau leptons, W or Z bosons with Run 2 data. The presence of multiple particles in the final state leads to the use of multivariant discriminants based on machine learning and the Matrix Element Method. The sophisticated methods used and the unprecedented amount of data result in the most precise cross section measurements to date.

# Neutrino Physics in Present and Future Kamioka Water-Čerenkov Detectors with Neutron Tagging

**Springer** This book discusses the upgrade of the Super-Kamiokande (SK) detector, which consists in the addition of a salt of gadolinium into the detector's water, the goal being to endow it with a very high-efficiency ability to detect neutrons: the SuperK-Gd project. This will substantially improve the scientific value of the SK detector because, among others, neutron production is related to the matter-antimatter character of the interacting neutrino. In this book the authors develop several procedures for maximizing the impact of neutron tagging in various physics analyses involving a broad range of neutrino energy. They thoroughly study the impact of new backgrounds introduced by Gd in key physics analyses, most remarkably including the search for the Diffuse Supernova Neutrino Background. At GeV energies, the neutron tagging improvements are evaluated by performing a complete neutrino oscillation sensitivity study using atmospheric and long baseline neutrinos, with a focus on the neutrino mass hierarchy and the leptonic CP violation. In order to prove the relevance of neutron tagging with the available data, the authors apply the neutron-tagging tools developed here to the 4th phase of the SK detector, which is already capable of detecting a low fraction of the neutrons produced through hydrogen-neutron captures. A global oscillation analysis of the SK's atmospheric neutrino data is also conducted.

## Astroparticle, Particle, Space Physics and Detectors for Physics Applications Proceedings of the 13th ICATPP Conference

**World Scientific** The exploration of the subnuclear world is done through increasingly complex experiments covering a wide range of energy and performed in a large variety of environments ranging from particle accelerators, underground detectors to satellites and the space laboratory. Among recent advances one has to indicate, for instance, first results

obtained from space and LHC experiments and progress done in preparation of the latter experiments upgrades, including plans for the LHC machine upgrade. The achievement of these research programs calls for novel techniques, new materials and instrumentation to be used in detectors, often of large scale. Therefore, fundamental physics is at the forefront of technological advance and also leads to many applications. Among these, medical applications have a particular importance due to health and social benefits they bring to the public. **Sample Chapter(s).** Science highlights from the Fenni Observatory (5,046 KB). Contents: Space Experiments and Cosmic Rays Observations; Production and Propagation of Cosmic Rays in the Galaxy and Heliosphere; Dark Matter Searches, Underwater and Underground Experiments; High Energy Physics Experiments; Tracker and Position Sensitive Detectors; Calorimetry; Advanced Detectors, Particles Identification, Devices and Materials in Radiation; Broader Impact Activities, Treatments and Software Application. Readership: Post-graduate students, researchers and engineers.

## Astroparticle, Particle, Space Physics and Detectors for Physics Applications

**World Scientific** The exploration of the subnuclear world is done through increasingly complex experiments covering a wide range of energy and performed in a large variety of environments ranging from particle accelerators, underground detectors to satellites and the space laboratory. Among recent advances one has to indicate, for instance, first results obtained from space and LHC experiments and progress done in preparation of the latter experiments upgrades, including plans for the LHC machine upgrade. The achievement of these research programs calls for novel techniques, new materials and instrumentation to be used in detectors, often of large scale. Therefore, fundamental physics is at the forefront of technological advance and also leads to many applications. Among these, medical applications have a particular importance due to health and social benefits they bring to the public. Contents:Space Experiments and Cosmic Rays ObservationsProduction and Propagation of Cosmic Rays in the Galaxy and HeliosphereDark Matter Searches, Underwater and Underground ExperimentsHigh Energy Physics ExperimentsTracker and Position Sensitive Detectors CalorimetryAdvanced Detectors, Particles Identification, Devices and Materials in RadiationBroader Impact Activities, Treatments and Software Application Readership: Post-graduate students, researchers and engineers. Keywords:Astroparticle;Particle;Space Physics;Cosmic Ray Physics;Heliosphere;Dark Matter;Double-Beta Decay

## The Road to Discovery

Detector Alignment, Electron  
Identification, Particle

Misidentification, WW Physics, and  
the Discovery of the Higgs Boson

**Springer** The research presented here includes important contributions on the commissioning of the ATLAS experiment and the discovery of the Higgs boson. The thesis describes essential work on the alignment of the inner tracker during the commissioning of the experiment and development of the electron identification algorithm. The subsequent analysis focuses on the search for the Higgs boson in the WW channel, including the development of a method to model the critical W+jet background. In addition, the thesis provides excellent introductions, suitable for non-specialists, to Higgs physics, to the LHC, and to the ATLAS experiment.

## Artificial Intelligence For High Energy Physics

**World Scientific** The Higgs boson discovery at the Large Hadron Collider in 2012 relied on boosted decision trees. Since then, high energy physics (HEP) has applied modern machine learning (ML) techniques to all stages of the data analysis pipeline, from raw data processing to statistical analysis. The unique requirements of HEP data analysis, the availability of high-quality simulators, the complexity of the data structures (which rarely are image-like), the control of uncertainties expected from scientific measurements, and the exabyte-scale datasets require the development of HEP-specific ML techniques. While these developments proceed at full speed along many paths, the nineteen reviews in this book offer a self-contained, pedagogical introduction to ML models' real-life applications in HEP, written by some of the foremost experts in their area.

## QCD Radiation in Top-Antitop and

# Z+Jets Final States

## Precision Measurements at ATLAS

**Springer** This thesis contains new research in both experimental and theoretical particle physics, making important contributions in each. Two analyses of collision data from the ATLAS experiment at the LHC are presented, as well as two phenomenological studies of heavy coloured resonances that could be produced at the LHC. The first data analysis was the measurement of top quark-antiquark production with a veto on additional jet activity. As the first detector-corrected measurement of jet activity in top-antitop events it played an important role in constraining the theoretical modelling, and ultimately reduced these uncertainties for ATLAS's other top-quark measurements by a factor of two. The second data analysis was the measurement of Z+2jet production and the observation of the electroweak vector boson fusion (VBF) component. As the first observation of VBF at a hadron collider, this measurement demonstrated new techniques to reliably extract VBF processes and paved the way for future VBF Higgs measurements. The first phenomenological study developed a new technique for identifying the colour of heavy resonances produced in proton-proton collisions. As a by-product of this study an unexpected and previously unnoticed correlation was discovered between the probability of correctly identifying a high-energy top and the colour structure of the event it was produced in. The second phenomenological study explored this relationship in more detail, and could have important consequences for the identification of new particles that decay to top quarks.

## Advances in Jet Substructure at the LHC

## Algorithms, Measurements and Searches for New Physical Phenomena

**Springer Nature** This book introduces the reader to the field of jet substructure, starting from the basic considerations for capturing decays of boosted particles in individual jets, to explaining state-of-the-art techniques. Jet substructure methods have become ubiquitous in data

analyses at the LHC, with diverse applications stemming from the abundance of jets in proton-proton collisions, the presence of pileup and multiple interactions, and the need to reconstruct and identify decays of highly-Lorentz boosted particles. The last decade has seen a vast increase in our knowledge of all aspects of the field, with a proliferation of new jet substructure algorithms, calculations and measurements which are presented in this book. Recent developments and algorithms are described and put into the larger experimental context. Their usefulness and application are shown in many demonstrative examples and the phenomenological and experimental effects influencing their performance are discussed. A comprehensive overview is given of measurements and searches for new phenomena performed by the ATLAS and CMS Collaborations. This book shows the impressive versatility of jet substructure methods at the LHC.

## XXIII DAE High Energy Physics Symposium Select Proceedings

**Springer Nature** This volume presents the peer-reviewed proceedings of the XXIII DAE-BRNS High Energy Physics Symposium 2018, which was held at the Indian Institute of Technology Madras, India, on 10-15 December 2018. Gathering selected contributions, the book highlights the latest developments and research trends in physics, detectors and instrumentation relevant to all branches of particle physics, astroparticle physics and closely related fields. The major topics covered include Standard Model physics, beyond Standard Model physics, neutrino physics, cosmology, formal theory, heavy ion physics & quantum chromodynamics (QCD), particle detectors and future experiments. Given the range of topics discussed, the book will be useful for beginners as well as advanced researchers in the field.

## The Search for Supersymmetry in Hadronic Final States Using Boosted Object Reconstruction

**Springer Nature** This thesis represents one of the most comprehensive and in-depth studies of the use of Lorentz-boosted hadronic final state systems in the search for signals of Supersymmetry conducted to date at the Large Hadron Collider. A thorough assessment is performed of the observables

that provide enhanced sensitivity to new physics signals otherwise hidden under an enormous background of top quark pairs produced by Standard Model processes. This is complemented by an ingenious analysis optimization procedure that allowed for extending the reach of this analysis by hundreds of GeV in mass of these hypothetical new particles. Lastly, the combination of both deep, thoughtful physics analysis with the development of high-speed electronics for identifying and selecting these same objects is not only unique, but also revolutionary. The Global Feature Extraction system that the author played a critical role in bringing to fruition represents the first dedicated hardware device for selecting these Lorentz-boosted hadronic systems in real-time using state-of-the-art processing chips and embedded systems.

## Discovery of the Higgs Boson

**World Scientific** The recent observation of the Higgs boson has been hailed as the scientific discovery of the century and led to the 2013 Nobel Prize in physics. This book describes the detailed science behind the decades-long search for this elusive particle at the Large Electron Positron Collider at CERN and at the Tevatron at Fermilab and its subsequent discovery and characterization at the Large Hadron Collider at CERN. Written by physicists who played leading roles in this epic search and discovery, this book is an authoritative and pedagogical exposition of the portrait of the Higgs boson that has emerged from a large number of experimental measurements. As the first of its kind, this book should be of interest to graduate students and researchers in particle physics.

## Emerging Trends in Computing and Expert Technology

**Springer Nature** This book presents high-quality research papers that demonstrate how emerging technologies in the field of intelligent systems can be used to effectively meet global needs. The respective papers highlight a wealth of innovations and experimental results, while also addressing proven IT governance, standards and practices, and new designs and tools that facilitate rapid information flows to the user. The book is divided into five major sections, namely: "Advances in High Performance Computing", "Advances in Machine and Deep Learning", "Advances in Networking and Communication", "Advances in Circuits and Systems in Computing" and "Advances in Control and Soft Computing".

## Calorimetry

# Energy Measurement in Particle Physics

**Oxford University Press Particle physics is the science that pursues the age-old quest for the innermost structure of matter and the fundamental interactions between its constituents. Modern experiments in this field rely increasingly on calorimetry, a detection technique in which the particles of interest are absorbed in the detector. Calorimeters are very intricate instruments. Their performance characteristics depend on subtle, sometimes counter-intuitive design details. Written by one of the world's foremost experts, Calorimetry is the first comprehensive text on this topic. It provides a fundamental and systematic introduction to calorimetry. It describes the state of the art in terms of both the fundamental understanding of calorimetric particle detection, and the actual detectors that have been or are being built and operated in experiments. The last chapter discusses landmark scientific discoveries in which calorimetry has played an important role. This book summarizes and puts into perspective the work described in some 900 scientific papers, listed in the bibliography. This second edition emphasizes new developments that have taken place since the first edition appeared in 2000.**

## The XVIII International Conference on Strangeness in Quark Matter (SQM 2019)

**Springer Nature This book focuses on new experimental and theoretical advances concerning the role of strange and heavy-flavour quarks in high-energy heavy-ion collisions and in astrophysical phenomena. The topics covered include • Strangeness and heavy-quark production in nuclear collisions and hadronic interactions, • Hadron resonances in the strongly-coupled partonic and hadronic medium, • Bulk matter phenomena associated with strange and heavy quarks, • QCD phase structure, • Collectivity in small systems, • Strangeness in astrophysics, • Open questions and new developments.**

## Higgs boson potential at colliders:

## status and perspectives

**Roma TrE-Press** Questo documento riassume lo stato attuale degli ricerche studi, teorici e sperimentali, sulla produzione di coppie di bosoni di Higgs, e sui vincoli, sia diretti che indiretti, al valore del termine di auto-interazione del bosone di Higgs, con l'intento di servire da referenza per i prossimi anni. Il documento discute lo stato degli studi teorici, includendo le più recenti stime della sezione di produzione di coppie di bosoni di Higgs, sviluppi sulle teorie di campo efficaci, e studi su specifici scenari di nuova fisica che possono contribuire alla produzione di due bosoni di Higgs. Sono presentati i più recenti risultati sperimentali sulle ricerche di coppie di bosoni di Higgs e sui limiti diretti e indiretti al termine di auto-interazione, ottenuti al Large Hadron Collider di Ginevra, con una panoramica delle tecniche sperimentali. Infine, sono discusse le capacità dei collisionatori futuri di determinare il termine di auto-interazione del bosone di Higgs. Questo lavoro è iniziato come raccolta di contributi della conferenza "Di-Higgs ai Colliders", che ha avuto luogo a Fermilab dal 4 al 9 settembre 2018, ma gli argomenti discussi vanno al di là di quelli presentati alla conferenza, includendo ulteriori sviluppi.

## Discovery and Measurement of the Higgs Boson in the WW Decay Channel

**Springer** This thesis describes the stand-alone discovery and measurement of the Higgs boson in its decays to two W bosons using the Run-I ATLAS dataset. This is the most precise measurement of gluon-fusion Higgs boson production and is among the most significant results attained at the LHC. The thesis provides an exceptionally clear exposition on a complicated analysis performed by a large team of researchers. Aspects of the analysis performed by the author are explained in detail; these include new methods for evaluating uncertainties on the jet binning used in the analysis and for estimating the background due to associated production of a W boson and an off-shell photon. The thesis also describes a measurement of the WW cross section, an essential background to Higgs boson production. The primary motivation of the LHC was to prove or disprove the existence of the Higgs boson. In 2012, CERN announced this discovery and the resultant ATLAS publication contained three decay channels: gg, ZZ, and WW.

## Dark Photon Search at BABAR.

Presented is the current progress of a search for the signature of a dark photon or new particle using the BaBar data set. We search for the processes  $ee^- \rightarrow \gamma_{ISR} A'$ ,  $A' \rightarrow e+e^-$  and  $e+e^- \rightarrow \gamma_{ISR} \gamma, \gamma \rightarrow A', A' \rightarrow e+e^-$ , where  $\gamma_{ISR}$  is an initial state radiated photon of energy  $E_{\gamma} \geq 1$  GeV. Twenty-five sets of Monte Carlo, simulating  $e+e^-$  collisions at an energy of 10.58 GeV, were produced with different values of the  $A'$  mass ranging from 100 MeV to 9.5 GeV. The mass resolution is calculated based on Monte Carlo simulations. We implement ROOT's Toolkit for Multivariate Analysis (TMVA), a machine learning tool that allows us to evaluate the signal character of events based on many of discriminating variables. TMVA training is conducted with samples of Monte Carlo as signal and a small portion of Run 6 as background. The multivariate analysis produces additional cuts to separate signal and background. The signal efficiency and sensitivity are calculated. The analysis will move forward to fit the background and scan the residuals for the narrow resonance peak of a new particle.

## Combinatorial Kalman Filter and High Level Trigger Reconstruction for the Belle II Experiment

Springer Combinatorial Kalman filters are a standard tool today for pattern recognition and charged particle reconstruction in high energy physics. In this thesis the implementation of the track finding software for the Belle II experiment and first studies on early Belle II data are presented. The track finding algorithm exploits novel concepts such as multivariate track quality estimates to form charged trajectory hypotheses combining information from the Belle II central drift chamber with the inner vertex sub-detectors. The eventual track candidates show an improvement in resolution on the parameters describing their spatial and momentum properties by up to a factor of seven over the former legacy implementation. The second part of the thesis documents a novel way to determine the collision event null time  $T_0$  and the implementation of optimisation steps in the online reconstruction code, which proved crucial in overcoming the high level trigger limitations.

## Searches for CP Violation in

# Charmed Meson Decays

## A Study of $D^+ \rightarrow K^- K^+ \pi^+$ at the LHCb Experiment

Springer Our current understanding of the fundamental building blocks of the Universe, summarised by the Standard Model of particle physics, is incomplete. For example, it fails to explain why we do not see equal, or almost equal, numbers of particles and their antiparticle partners. To explain this asymmetry requires, among other effects, a mechanism known as charge-parity (CP) violation that causes differences between the rates at which particles and antiparticles decay. CP violation is seen in systems containing bottom and strange quarks, but not in those with up, charm or top quarks. This thesis describes searches for particle-antiparticle asymmetries in the decay rates of charmed mesons. No evidence of CP violation is found. With current sensitivities, an asymmetry large enough to observe probably could not be explained by the Standard Model. Instead an explanation could come from new physics, for example contributions from supersymmetric or other undiscovered heavy particles. In the thesis, the development of new techniques to search for these asymmetries is described. They are applied to data from the LHCb experiment at CERN to make precise measurements of asymmetries in the  $D^{+-} \rightarrow K^- K^+ \pi^+$  decay channel. This is the most promising charged D decay for CP violation searches.

## Annales Universitatis Mariae Curie-Skłodowska

### Informatica. Sectio AI

## First Evidence for Atmospheric Neutrino-induced Cascades with the IceCube Detector

IceCube is an all-flavor, cubic kilometer neutrino telescope currently under construction in the deep glacial ice at the South Pole. Its embedded optical sensors detect Cherenkov light from charged particles produced in

neutrino interactions in the ice. For several years IceCube has been detecting muon tracks from charged-current muon neutrino interactions. However, IceCube has yet to observe the electromagnetic or hadronic particle showers or "cascades" initiated by charged-current or neutral-current neutrino interactions. The first detection of such an event signature is expected to come from the known flux of atmospheric electron and muon neutrinos. A search for atmospheric neutrino-induced cascades was performed using 275.46 days of data from IceCube's 22-string configuration. Reconstruction and background rejection techniques were developed to reach, for the first time, a signal-to-background ratio  $\sim 1$ . Above a reconstructed energy of 5 TeV, 12 candidate events were observed in the full dataset. The signal expectation from the canonical Bartol atmospheric neutrino flux model is  $5.63 \pm 2.25$  events, while the expectation from the atmospheric neutrino flux as measured by IceCube's predecessor array AMANDA is  $7.48 \pm 1.50$  events. Quoted errors include the uncertainty on the flux only. While a conclusive detection can not yet be claimed because of a lack of background Monte Carlo statistics, the evidence that we are at the level of background suppression needed to see atmospheric neutrino-induced cascades is strong. In addition, one extremely interesting candidate event of energy 133 TeV survives all cuts and shows an intriguing double pulse structure in its waveforms that may signal the "double bang" of a tau neutrino interaction.