PHYSTAT-nu 2019

Report of Abstracts

Abstract ID : **1**

Treatment of material radioassay measurements in projecting sensitivity for low-background experiments

Content

Low-background experiments typically perform radioassay on detector construction materials, and use the resulting radioimpurity estimates to project experiment sensitivity. However, as the radiopurity of the materials improves and approaches the detection limit of the radioassay techniques, the radioimpurity concentration of the materials cannot be conclusively determined. Instead, only an upper limit can be placed on the radioimpurity concentrations. This presents a problem as the values cannot be trivially incorporated into sensitivity projections. The most straightforward approach is to treat the upper limit as if it is the determined radioimpurity concentration. This is often considered "conservative" as the resulting sensitivity is likely to be worse than the *true* sensitivity. Another approach is to transform the upper limit into a distribution. Depending on the choice of the distribution, this may or may not provide a more accurate estimate of the *true* sensitivity. By analyzing sensitivity projections as a statistical estimation problem, we evaluated different ways of treating radioassay measurement results (values and upper limits) when projecting sensitivity for low-background experiments. We developed a figure of merit that incorporates a notion of conservativeness to quantitatively explore the consequences of attempts to bias sensitivity projections, and proposed a method to report sensitivity.

Primary author(s) : TSANG, Raymond Hei-Man (Pacific Northwest National Laboratory); Dr ARNQUIST, Isaac (Pacific Northwest National Laboratory); Dr HOPPE, Eric (Pacific Northwest National Laboratory); Dr ORRELL, John (Pacific Northwest National Laboratory); Dr SALDANHA, Richard (Pacific Northwest National Laboratory)

Presenter(s) : TSANG, Raymond Hei-Man (Pacific Northwest National Laboratory)

Comments:

https://arxiv.org/abs/1808.05307

Status: ACCEPTED

Submitted by **TSANG, Raymond Hei-Man** on **Friday 17 August 2018**

Abstract ID : **37**

Status of the MicroBooNE low-energy excess search and systematic uncertainties evaluation

Content

MicroBooNE (the Micro Booster Neutrino Experiment) is a liquid argon time-projection chamber (LArTPC) experiment currently running at Fermilab, and is designed to study short-baseline neutrino physics. It aims to address the nature of the anomalous excess of low-energy electron-neutrino-like events observed by the previous MiniBooNE experiment. We will present the status of the low-energy excess search and will discuss the evaluation of the systematic uncertainties.

Primary author(s) : Mr SOLETI, Stefano Roberto

Presenter(s) : Mr SOLETI, Stefano Roberto

Comments:

On behalf of the MicroBooNE collaboration

Status: ACCEPTED

Submitted by **ROBERTO SOLETI, Stefano** on **Monday 24 September 2018**

Abstract ID : **41**

ReSyst: a novel technique to Reduce the Systematic uncertainty for precision measurementsReSyst: a novel technique to Reduce the Systematic uncertainty for precision measurements

Content

We are in an era of precision measurements at the Large Hadron Collider. The precision that can be achieved on some of the measurements is limited however due to large systematic uncertainties. This paper introduces a new technique to reduce the systematic uncertainty by quantifying the systematic impact of single events and correlating it with event observables to identify parts of the phase space that are more sensitive to systematic effects. A proof of concept is presented by means of a simplified top quark mass estimator applied on simulated events. Even without a thorough optimization, it is shown that the total systematic uncertainty can be reduced by a factor of at least two.

Primary author(s) : VAN MULDERS, Petra (Vrije Universiteit Brussel (BE))

Presenter(s) : VAN MULDERS, Petra (Vrije Universiteit Brussel (BE))

Comments:

I am happy to present my technique to reduce systematic uncertainties at the PHYSTAT-nu 2019 conference, either in a talk or poster.

Status: ACCEPTED

Submitted by **VAN MULDERS, Petra** on **Thursday 27 September 2018**

Abstract ID : **42**

Bayesian analysis of multichannel measurements

Content

A typical experiment in high energy physics is considered. The result of the experiment is assumed to be a histogram consisting of bins or channels with numbers of corresponding registered events. The expected background and expected signal shape or acceptance are measured in separate auxiliary experiments, or calculated by the Monte Carlo method with finite sample size, and hence with finite precision. An especially complex situation occurs when the expected background in some of the channels (usually at the right end of the physical histograms, where the expected signal to background ratio is maximal) happens to be zero due to either a fluctuation of the auxiliary measurement (or simulation) or because it is truly zero. Different statistical methods give different confidence intervals for the full signal rate and different significance of the signal+background hypothesis versus the pure background hypothesis. The Bayesian method is discussed in this report. Detailed analysis and numerical tests are presented. A simple modification of central intervals and a simple empirical rule for choosing priors for nuisance parameters allow the user to obtain credible intervals with the frequentist coverage. There is a method to find an optimal number of channels and to retain the claimed coverage.

Primary author(s) : Dr SMIRNOV, Igor (Petersburg Nuclear Physics Institute (Russia))

Presenter(s) : Dr SMIRNOV, Igor (Petersburg Nuclear Physics Institute (Russia))

Status: ACCEPTED

Submitted by **SMIRNOV, Igor** on **Wednesday 03 October 2018**

Abstract ID : **51**

ReMU – Data sharing in a forward-folding framework

Content

The canonical way to make experimental neutrino-cross-section data available for comparison with different theories and other experiments is to unfold it.
The aim of this is to remove the detector effects and efficiencies from the data to release distributions of variables of interest in "truth space".
Depending on the available data, the detector properties, and the variables of interest, it is not always possible to do this though.
For example, the detector response might depend on variables that are not measurable by the detector.
If the distribution of events in those variables is not constrained by external measurements,
it is impossible to predict the actual detector response without depending on a theoretical model.
The unfolded results would thus become dependent on said model, introducing a theoretical bias in what is supposed to be an objective measurement.

In these (and other) cases it would be preferable to calculate the expected measured distributions for each model separately,
and compare those predictions to the real data in the smeared (i.e. reconstructed) space.
This should always be possible as the different models will have to predict some sort of distribution in all variables that could affect the detector,
even if those distributions are poorly motivated.
The act of bringing the model predictions in truth space to expected distributions of reconstructed (i.e. measured) quantities is called "forward-folding".

This is done on a regular basis within the experimental collaborations using detailed simulations of the detectors.
Events are generated according to a specific model and these events are then propagated through the detector one-by-one.
It requires a large amount of computing power and expert knowledge of the detectors.
Also, the simulation software is usually integrated closely in the software stack of the experiments.
All this makes it impractical or impossible to do a full detector simulation outside the collaborations.
To make the data usable by external interested parties, e.g. model builders or other experiments,
it would be necessary to provide a simpler way of forward-folding.

ReMU (Response Matrix Utilities) tries to solve this problem by modelling the detector with a response matrix that describes both the detector efficiency and smearing.
Expectation values in reconstructed space are generated by simply multiplying this matrix with the truth space distributions provided by the different models.
It offers all necessary machinery to build the response matrix from simulations and test arbitrary models against the data.
Both Frequentist and Bayesian methods for model testing and parameter estimation are available.
Systematic detector uncertainties, statistical uncertainties, and model nuisance parameters can all be handled with a few lines of code.

The main design goal of ReMU is ease of use.
Users are not required to be a Python, statistics, or detector experts to use a provided response matrix and compare their models to data.
It is implemented as a pure Python package and requires only standard scientific Python packages.
It supports Python 2.6, 2.7, and 3.x.

Official releases are distributed via the Python Package Index, so installing it is as easy as “pip install remu”.

Primary author(s) : KOCH, Lukas (Science and Technology Facilities Council)

Presenter(s) : KOCH, Lukas (Science and Technology Facilities Council)

Status: ACCEPTED

Submitted by **KOCH, Lukas** on **Thursday 25 October 2018**

Abstract ID : **52**

Non-Parametric Bayesian Event Reconstruction in Super-Kamiokande

Content

We present an update to a method for non-parametric, Bayesian neutrino event reconstruction for the Super-Kamiokande detector with the existing fiTQun event reconstruction framework, first reported at PhyStat-nu 2016 at the IPMU. Particle properties are determined in a way where the number of Cherenkov rings to be reconstructed, and therefore the number of parameters, is one of the unknowns. We discuss Bayesian model selection with Markov Chain Monte Carlo, future scalability and the issues surrounding non-parametric Bayesian reconstruction with fiTQun.

Primary author(s) : Mr SZTUC, Artur (Imperial College London)

Presenter(s) : Mr SZTUC, Artur (Imperial College London)

Status: ACCEPTED

Submitted by **SZTUC, Artur** on **Saturday 27 October 2018**

Abstract ID : **53**

Analysis review of JUNO Experiment

Content

After three neutrino mixing angles and two independent neutrino mass squared differences have been measured, neutrino physics has entered the precision era. Neutrino mass hierarchy and CP violation phase are the two remaining important unknown properties which could be measured by next generation neutrino oscillation experiments. Jiangmen Underground Neutrino Observatory (JUNO) is constructing a 20 kton multi-purpose liquid scintillator detector with unprecedented 3\% energy resolution at 1 MeV. The main physics goal is to determine neutrino mass hierarchy with reactor antineutrino oscillation at baseline of 52.5 km with 3-4 sigma statistical significance. Besides, JUNO is also able to perform many other important neutrino physics measurements, including precision measurements of three neutrino oscillation parameters (θ_{12}, Δm^2_{21} and Δm^2_{32}), supernova neutrino detection, solar neutrinos, etc. In this talk, I will review the analysis techniques in the JUNO experiment.

Primary author(s) : Dr LING, Jiajie (Sun Yat-sen University)

Presenter(s) : Dr LING, Jiajie (Sun Yat-sen University)

Status: ACCEPTED

Submitted by **Dr LING, Jiajie** on **Saturday 27 October 2018**

Abstract ID : **54**

Implementation of a Feldman-Cousins Framework on Supercomputers and the Impact on NOvA Oscillation Results

Content

The NOvA long-baseline neutrino and anti-neutrino oscillation results, by the nature of the measurements, feature low event counts in both the appearance and disappearance channels. When the low event counts are combined with the form of the fits that are needed to describe PMNS mixing, physical boundaries develop and have the potential to skew the statistical behavior of extracted parameters away from typical Gaussian behavior.

To determine the statistical significance of our results and account for the non-Gaussian nature of the statistics, the NOvA collaboration performs a procedure involving the empirical determination of the confidence interval. This procedure referred to as the "Feldman-Cousins" prescription, is an empirical, multi-universe approach that accounts for all the statistical correlations in our fits and includes the effects of the systematics and nuisance parameters.

We present here the implementation of the Feldman-Cousins calculations that was designed to run on High Performance "Super" Computers (HPC) and which was run on the NERSC facility's Cori-1, Cori-2 and Edison supercomputer in May 2018 to obtain the latest NOvA oscillation results. This implementation was able to perform the Feldman-Cousins corrections, that were projected to more than 5 months of dedicated computing on conventional HEP facilities, in 16 hours using the largest dedicated computing pool ever used in High Energy Physics. We also present the evolution of this approach that leverages the Theta supercomputer at the Argon Leadership Computing Facility (ALCF) and expands to the calculations to use an adaptive MPI based approach.

Primary author(s) : CALVEZ, Steven (Colorado State University)

Co-author(s) : NORMAN, Andrew (Fermilab)

Presenter(s) : CALVEZ, Steven (Colorado State University)

Status: ACCEPTED

Submitted by **CALVEZ, Steven** on **Monday 29 October 2018**

Abstract ID : **55**

Searches for New Physics in the Short Baseline Neutrino Program at Fermilab with SBNfit

Content

SBNFit is a software framework designed for the purpose of performing simultaneous fits across data from multiple, correlated distributions. Although extremely modular and generic, an ideal application is the searches for new physics at the Short Baseline Neutrino (SBN) experimental program at Fermilab. SBN comprises three experiments: MicroBooNE, SBND, and ICARUS, each of which can perform measurements of neutrino event rates at a distinct distance from the neutrino source in the Fermilab Booster Neutrino Beamline. Since each detector shares the same neutrino flux and argon cross-sections, these measurements are highly correlated. These correlations can be further exploited to reduce systematic uncertainties by performing multiple side-by-side channel fits, allowing us to ask deeper questions about the underlying physics behind our observations. We explore this with a case study of how a muon neutrino sample can be used to constrain backgrounds in electron neutrino appearance studies.

Primary author(s) : CIANCI, Davio (Columbia University)

Presenter(s) : CIANCI, Davio (Columbia University)

Comments:

Presented on behalf of the MicroBooNE collaboration

Status: ACCEPTED

Submitted by **CIANCI, Davio** on **Tuesday 30 October 2018**

Abstract ID : **58**

Analytical Multivariate Fit and Sensitivity Studies in the Borexino Solar Neutrino Analysis

Content

The Borexino detector, located at the Laboratori Nazionali del Gran Sasso in Italy, is a liquid scintillator detector with a primary goal to measure solar neutrinos. The spectral fit of the energy spectrum has been performed for the first time in the whole energy range from 0.19 up to 2.93 MeV. This approach made it possible to obtain the fluxes of 7Be, pp, and pep solar neutrinos simultaneously. To increase the sensitivity for pep and CNO neutrinos, the multivariate fit technique has been developed, which takes into account additional information of the radial and pulse shape distributions of events. The current limit on CNO neutrinos was obtained by fixing the theoretically well-known ratio of the expected rates between pp and pep neutrinos, as obtained from the standard solar models. In addition to this approach, sensitivity to CNO neutrinos using other methods are under study. The talk shows the analytical multivariate fitting strategy used to obtain the new Borexino results for the 7Be, pp, and pep rates and the sensitivity of the Borexino detector to measure CNO neutrinos. This talk is presented in the name of the Borexino Collaboration.

Primary author(s) : Mr PENEK, Omer (IKP-2 Forschungszentrum Juelich)

Co-author(s) : Prof. LUDHOVA, Livia (IKP-2 Forschungszentrum Juelich)

Presenter(s) : Mr PENEK, Omer (IKP-2 Forschungszentrum Juelich)

Status: ACCEPTED

Submitted by **PENEK, Ömer** on **Monday 05 November 2018**

Abstract ID : **65**

Statistical methods and issues in sterile neutrino searches

Content

The statistical issues related to the search for sterile neutrinos are reviewed with focus on short-baseline appearance and disappearance experiments. The sensitivities for limit setting and signal discovery are discussed along with their dependency on the experimental parameters, including the signal rate and the spectral shape. Our baseline analysis is built on a profile-likelihood test statistic that extends the unified approach of Feldman and Cousins by introducing nuisance parameters for the signal and background rate. We examine the differences between methods based on a local and global p-value, and explore the limitations of approaches relying on a Gaussian approximation and the Asimov data set. Our work is particularly relevant given that a large number of sterile neutrino experiments is currently running and in the process of releasing new results.

Primary author(s) : NEUMAIR, Birgit (Technical University of Munich (TUM))

Co-author(s) : AGOSTINI, Matteo (Technical University Munich)

Presenter(s) : NEUMAIR, Birgit (Technical University of Munich (TUM))

Comments:

This work is based on a paper currently in preparation and to be submitted to PRD by the end of the year.

Status: ACCEPTED

Submitted by **NEUMAIR, Birgit** on **Thursday 15 November 2018**

Abstract ID : **66**

ESSnuSB, a new facility to discover CP violation in leptonic sector in Europe.

Content

The large value of the last mixing angle of the PMNS mixing matrix measured by reactor experiments enable the search for CP violation in leptonic sector with a new generation of neutrino super beams. The ESSnuSB project proposes to use the European Spallation Source (ESS) based in Sweden to elaborate a high intensity neutrino super beam. The LINAC of this facility, under construction, will produce 5 MW proton beam with 2 GeV energy by 2023 and will be upgraded hereafter to produce in addition a neutrino super beam. This will require in addition an accumulator located at the end of the LINAC to reduce the initial time width of the proton pulses. The combination of the high beam intensity and these low energy protons allows the neutrino measurements to be made with a megaton Water Cherenkov detector installed 1000 m down in a mine at about 500 km from the neutrino source which is near the position of the second neutrino oscillation maximum. The use of this type of detector will extent the physics program to proton−decay, atmospheric neutrinos and astrophysics searches.

This project is now supported by the COST Action CA15139 "Combining forces for a novel European facility for neutrino-antineutrino symmetry-violation discovery" (EuroNuNet). It has also received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 777419.

Primary author(s) : Dr BAUSSAN, Eric (IPHC)

Presenter(s) : Dr BAUSSAN, Eric (IPHC)

Comments:

Poster Contribution

Status: ACCEPTED

Submitted by **BAUSSAN, Eric** on **Friday 16 November 2018**

Abstract ID : **67**

Updated Results for the Search for $\bar{\nu}_\mu \rightarrow \bar{\nu}_e$ Oscillations from T2K in the 3-flavour Framework

Content

I report the results of a search for $\bar{\nu}_\mu \rightarrow \bar{\nu}_e$ oscillations at the T2K experiment in a 3-flavour framework. An exposure of 1.49×10^{21} Protons On Target (POT) is used in ν mode and 1.63×10^{21} POT in $\bar{\nu}$ mode; an increase of 46% in the $\bar{\nu}$ exposure compared to results reported in June 2018.

Results are reported for a joint analysis where candidate events are selected from the e-like events observed in $\bar{\nu}$ running mode. In order to obtain the best possible constraint on $\bar{\nu}_e$ appearance, observations from four other far detector event samples (across both ν and $\bar{\nu}$ modes) are used in conjunction with near-detector data. These observations constrain the values of the oscillation and systematic parameters, including the mass-hierarchy.

Two hypotheses are tested: a) no appearance and b) $\bar{\nu}_e$ appearance according to the current best knowledge of the PMNS matrix. Both rate-only and rate+shape analyses are performed, producing p-values for each hypothesis. A description is given of the method used to constrain the parameters and the treatment of priors used to generate distributions of the rate-only and rate+shape test statistics.

Primary author(s) : Mr BENCH, Francis (The University of Liverpool); ANDREOPOULOS, Costas (University of Liverpool & STFC Rutherford Appleton Laboratory); Mr BARRY, Chistopher (The University of Liverpool); CHAPPELL, Andrew (University of Warwick); DEALTRY, Thomas (RAL & University of Oxford); DENNIS, Stephen Robert (University of Liverpool); SGALABERNA, Davide (CERN); SHAH, Raj (Oxford University)

Presenter(s) : Mr BENCH, Francis (The University of Liverpool)

Comments:

Poster

Status: ACCEPTED

Submitted by **Mr BENCH, Francis** on **Friday 23 November 2018**

Abstract ID : **70**

CPT test with the NOvA experiment

Content

NOvA is a long-baseline neutrino oscillation experiment that looks for oscillations within Fermilab's NuMI beam in ν and $\bar{\nu}$ modes. Having the longest baseline of any past or present accelerator experiment, the experiment observes ν_μ disappearance and ν_e appearance using a 300 ton Near Detector (ND) and a 14 kiloton Far Detector (FD) placed 810 km away from each other.

The disappearance search in NOvA is particularly sensitive to constraining the $\sin^2\theta_{23} - \Delta m^2_{23}$ space. Any difference between the ν_μ and $\bar{\nu}_\mu$ disappearance rates and their preferred parameter values would be an indication of the combination of Charge Conjugation, Parity and Time reversal (CPT) not being conserved. In this poster I present NOvA' sensitivities to a separated analysis of ν_μ and $\bar{\nu}_\mu$ disappearance for a CPT symmetry test in the neutrino sector.

Primary author(s) : MENDEZ, Diana Patricia (Univeristy of Sussex)

Presenter(s) : MENDEZ, Diana Patricia (Univeristy of Sussex)

Comments:

Submitting abstract only for a poster.

Status: WITHDRAWN

Submitted by **MENDEZ, Diana Patricia** on **Tuesday 27 November 2018**

Abstract ID : **71**

NOvA's $\nu_e + \nu_\mu$ oscillation analysis

Content

NOvA is an experiment devoted to studying neutrino oscillations in the NuMI neutrino beam from FNAL (USA). It is a long-baseline experiment consisting of two functionally identical, finely granulated detectors which are separated by 810 km of Earth crust and sited at 14 mrad off the beam axis. By measuring the transition probabilities P($\nu_\mu \rightarrow \nu_e$) and P($\nu_\mu \rightarrow \nu_\mu$) NOvA is able to extract oscillation parameters: Δm^2_{32}, mixing angle θ_{23}, CP violating phase δ_{CP} and neutrino mass hierarchy.

The most recent analysis was the first to include both neutrino ($9 \cdot 10^{20}$ POT) and antineutrino ($7 \cdot 10^{20}$ POT) data, which helps to resolve the "octant θ_{23} - hierarchy - δ_{CP}" degeneracies in the oscillation probability. NOvA performed a joint analysis of ν_e appearance and ν_μ disappearance channels in both neutrino and antineutrino modes, with systematic uncertainties included as pull terms. This procedure helped to set new restrictions on the oscillation parameters.

This talk will discuss the NOvA joint $\nu_e + \nu_\mu$ analysis chain, systematic treatment, and details of the fit for oscillations.

Primary author(s) : KOLUPAEVA, Liudmila

Presenter(s) : KOLUPAEVA, Liudmila

Status: ACCEPTED

Submitted by **KOLUPAEVA, Liudmila** on **Wednesday 28 November 2018**

Abstract ID : **76**

Tuning the pion production on free nuclei with GENIEv3

Content

GENIE (http://www.genie-mc.org/) is one of the most used event generator for neutrino experiments. The collaboration has a continuous effort to improve its prediction by adding new models and tune them against data. For the future experiments, the description of single and double pion production is fundamental and yet there is not a single model that describes simultaneously resonant, non-resonant and DIS interactions. The modelling of this transition region is left to the generators and a number empirical models are used to achieve this goal. GENIE has addressed the modelling of pion production at the free nucleon level with a new tune using deuterium data from ANL-12ft, BNL-7ft, BEBC and FNAL 15-ft bubble chamber experiments. The shallow inelastic scattering region has been tuned against ν_μ and $\bar{\nu}_\mu$ CC inclusive, one pion and two pion integrated cross sections. The global fit describes both inclusive and exclusive cross sections simultaneously, improving the agreement for ν_μCC pπ^+, nπ^+, pπ^0 and p$\pi^+\pi^-$ cross sections on free nucleon.

Primary author(s) : TENA VIDAL, Julia (University of Liverpool)

Presenter(s) : TENA VIDAL, Julia (University of Liverpool)

Comments:

I believe that it is not said anywhere explicitly but this is my abstract for the poster session

Status: ACCEPTED

Submitted by **TENA VIDAL, Julia** on **Friday 30 November 2018**

Abstract ID : **77**

GNA – high performance fitter for large-scale analyses.

Content

Statistical data analysis of modern experiments deals with large-scale models with hundreds of nuisance parameters. Direct application on statistical methods such as likelihood profiling, Bayesian methods and especially Feldman-Cousins procedure can lead to extensive numerical computations. In order to facilitate the growing need for flexible and high-performance analysis tools to deal with complex models we have developed the GNA framework. Models of experiments are defined in runtime in terms of directed acyclic graph that describes a flow of computations. Each node of the graph represents independent physical part of the model such as oscillation probability, cross section and etc. It provides transparent and flexible configuration of the models. Each node is implemented in C++ using Eigen, Boost and ROOT to achieve high performance.
The current status of the framework, overview of multithreading and GPU computing support in the framework and first results of analysis of reactor antineutrino experiments are provided in this talk.

Primary author(s) : Mr TRESKOV, Konstantin (Joint Institute for Nuclear Research)

Co-author(s) : Dr GONCHAR, Maxim (Joint Institute for Nuclear Research); Ms FATKINA, Anna (Joint Institute for Nuclear Research); NAUMOV, Dmitri (Joint Inst. for Nuclear Research (RU))

Presenter(s) : Mr TRESKOV, Konstantin (Joint Institute for Nuclear Research)

Status: ACCEPTED

Submitted by **TRESKOV, Konstantin** on **Friday 30 November 2018**

Abstract ID : **79**

Model-Assisted GANs for the optimisation of simulation parameters

Content

We propose and demonstrate the use of a Model-Assisted Generative Adversarial Network to produce simulated images that accurately match true images through the variation of underlying model parameters that describe the image generation process. The generator learns the parameter values that give images that best match the true images. The best match parameter values that produce the most accurate simulated images can be extracted and used to re-tune the default simulation to minimise any bias when applying image recognition techniques to simulated and true images. In the case of a real-world experiment, the true data is replaced by experimental data with unknown true parameter values. The Model-Assisted Generative Adversarial Network uses a convolutional neural network to emulate the simulation for all parameter values that, when trained, can be used as a conditional generator for fast image production.

Primary author(s) : ALONSO MONSALVE, Saul (University Carlos III (ES)); WHITEHEAD, Leigh Howard (CERN)

Presenter(s) : ALONSO MONSALVE, Saul (University Carlos III (ES))

Status: SUBMITTED

Submitted by **SGALABERNA, Davide** on **Wednesday 12 December 2018**

Abstract ID : **98**

Limitations of Asimov Sensitivities

Content

The median sensitivity of an analysis is derived from an ensemble of confidence intervals, each constructed from a statistically and systematically fluctuated null-hypothesis simulated experiment. This provides both an estimate of the expected sensitivity and an uncertainty band which together show the range of limits potentially observable in data if the null-hypothesis is true and the systematic uncertainties are well characterized. However, this is a computationally intensive procedure. Instead, many analyses construct a confidence interval using simulated data derived from a large-sample-size null-hypothesis prediction with nominal values of systematic parameters, scaled to the expected number of events of the data sample. This simulated data is known as the Asimov sample and it represents the median experiment of a set of statistically and systematically fluctuated simulated experiments. The resulting sensitivity is known as an Asimov sensitivity and is assumed to be an approximation of the median sensitivity. The Asimov sensitivity is a good approximation of the median sensitivity, only if symmetrical fluctuations around the Asimov sample produce symmetrical fluctuations around the Asimov sensitivity. However, this criterion is not always satisfied. The MINOS+ experiment has found that the median and Asimov sensitivities do not agree for their most recent search for sterile neutrinos, which uses a multivariate Gaussian $\chi2$ test statistic.

In this poster, we show that this situation occurs even in very highly simplified models, explore how the interplay between the shape of the physics model and the systematic uncertainties influences the difference between the Asimov and median, and illustrate how the scale of the statistical and systematic uncertainties changes the difference.

Primary author(s) : AURISANO, Adam (University of Cincinnati); DE RIJCKL, Simon

Presenter(s) : DE RIJCKL, Simon

Status: SUBMITTED

Submitted by **BEHNKE, Olaf** on **Thursday 17 January 2019**