International Workshop on Discovery Physics at the LHC (KRUGER2016)

Sunday 04 December 2016 - Friday 09 December 2016

Protea Hotel KrugerGate

Book of Abstracts

Contents

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Evolution of gauge couplings and Weinberg angle in 5-dimensions for an SU(5), flipped SU(5) and G_2 gauge group

Author: Mohammed Omer Khojali[1]

Co-authors: Alan Cornell [2]; Aldo Deandrea [3]; Giacomo CACCIAPAGLIA [3]

[1] *University of the Witwatersrand*

[2] *National Institute for Theoretical Physics*

[3] *IPNL - University Lyon 1*

Corresponding Author: khogali11@gmail.com

We explicitly test, in a simplified 5-dimensional model with $SU(5)$, $SU(5) \times U(1)'$ and G_2 gauge symmetry, the evolution
of the gauge couplings. We assume that all the matter fields are propagating in the bulk, and consider orbifolds based on Abelian discrete groups which lead to 5-dimensional gauge theories compactified on an S^1/Z_2. The gauge couplings evolution is derived at one-loop level and used to test the impact on lower energy observables, in particular the Weinberg angle.

I intend to submit my contribution for the proceedings:

Yes

1

Spin-3/2 fields in black hole space-times

Author: Alan Cornell[1]

[1] *National Institute for Theoretical Physics*

Corresponding Author: alan.cornell@wits.ac.za

In previous works we have studied spin-3/2 fields near D-dimensional Schwarzschild black holes. The techniques we developed in that case have now been extended here to show that it is possible to determine the potential of spin-3/2 fields near D-dimensional black holes by exploiting the radial symmetry of the system. This removes the need to use the Newman-Penrose formalism, which is difficult to extend to D-dimensional space-times. In this talk we will derive a general D-dimensional gauge invariant effective potential for spin-3/2 fields near black hole systems. We then use this potential to determine the quasi-normal modes and absorption probabilities of spin-3/2 fields.

I intend to submit my contribution for the proceedings:

Yes

2

Small systems in p-Pb collisions – hadronic resonances

Author: Christina Markert[1]

[1] *UT Austin*

Corresponding Author: cmarkert@physics.utexas.edu

In heavy ion collisions a fireball of hot and dense matter is created. Short lived hadronic resonances are
sensitive to the medium properties, in particular to the temperature,density and system size. Resonance yields and momentum distributions are used to gain insight into the hadronic phase and its expansion velocity and time duration.
I will discuss the multiplicity dependent hadronic resonance production in p-Pb collisions and link it to the discussion of a possible extended hadronic and partonic phase in high multiplicity p-Pb collisions.
I will compare the results to EPOS+UrQMD model calculations to discuss the multiplicity dependent interactions of the medium.

I intend to submit my contribution for the proceedings:

Yes

3

Standard candles for partial compositeness

Author: Giacomo Cacciapaglia[1]

[1] *IPN Lyon*

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Models of composite Higgs with partial compositeness in the top sector have been gaining popularity as a candidate for BSM physics. Usually, composite fermions, aka top partners, are considered as the smoking gun of such models. However, their masses may be high and out of reach for the LHC. Based on a simple underlying realisation, I will discuss the role of additional light scalars that decay to a pair of gauge bosons via the WZW anomaly term. This leads to highly predictive phenomenology at the LHC as the branching ratios and production rates can be computed. Thus, the presence of diboson resonances can be considered a standard candle for this class of models, which can be disfavoured in case of lack of signals at the LHC Run II. The phenomenology of additional light scalars, like coloured ones, and the role of Lattice calculations will be touched upon.

I intend to submit my contribution for the proceedings:

Yes

4

Spin-3/2 fields in D-dimensional space-times

Author: Alan Cornell[1]

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[1] *National Institute for Theoretical Physics*

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Corresponding Author: alan.cornell@wits.ac.za

In previous works we have studied spin-3/2 fields near D-dimensional Schwarzschild black holes. The techniques we developed in that case have now been extended here to show that it is possible to determine the potential of spin-3/2 fields near D-dimensional black holes by exploiting the radial symmetry of the system. This removes the need to use the Newman-Penrose formalism, which is difficult to extend to D-dimensional space-times. In this talk we will derive a general D-dimensional gauge invariant effective potential for spin-3/2 fields near black hole systems. We then use this potential to determine the quasi-normal modes and absorption probabilities of spin-3/2 fields near a D-dimensional black hole.

I intend to submit my contribution for the proceedings:

Yes

5

Using integral and differential charge asymmetries in searches for BSM physics at the LHC

Author: Steve Muanza[1]

[1] *CPPM Marseille, CNRS-IN2P3 & Aix-Marseille University*

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Contrarily to past high energy colliders, the LHC is a charge asymmetric machine. Therefore most of the hard scattering processes producing electrically charged final states have a positive integral charge asymmetry. The latter quantity, denoted AC, is easily measurable in event topologies bearing an odd number of hard and isolated charged leptons.
We have brought to light the strong correlation between AC and the mass of the charged final state. This enabled us to setup a new method of indirect mass measurement [1]. For example, this method enables to measure the mass of the W boson with a 2% accuracy. Obviously this is not competitive with respect to the standard technique based on the W transverse mass. However for other processes where more final state particles escape detection, we've demonstrated the integral charge asymmetry method to be much more effective. We illustrate this in a search for a supersymmetric production of chargino-neutralino pairs decaying in the trilepton inclusive topology and show that we can measure M(chargino)+M(neutralino) with an accuracy better than 10%.
Nevertheless, in order to apply the integral charge asymmetry method, one needs to have a significant excess of signal events over the event yield of the corresponding background processes. We are currently extending this indirect mass measurement method using differential charge asymmetries. In addition to their sensitivity to the mass, the shape of these observables can also be exploited to improve the separation between a signal and its background processes. Our main physics case under study is the production of an heavy W' boson which decays into a single charged lepton plus missing transverse energy.
For both the use of integral and differential charge asymmetries we are also developing quantitative estimates of their sensitivity through appropriate confidence levels.

[1] S. Muanza and T. Serre,
"New Method for Indirect Mass Measurements using the Integral Charge Asymmetry at the LHC",
JHEP 1604 (2016) 179, arXiv:1412.6695 [hep-ph].

I intend to submit my contribution for the proceedings:

Yes

6

Higgs production at NLO in the Standard Model Effective Theory

Author: Nicolas Deutschmann[1]

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The Effective Field Theory approach is a fruitful way of putting model independent constraints on heavy new physics.
As the Higgs sector is one of the most popular candidates for deviations from the Standard Model prediction,
it is particularly important that the constraints extracted from the experimental data on the Higgs boson be as meaningful as possible,
which entails making accurate and precise theoretical predictions.

In this talk, I will discuss the computation of two loop amplitudes which are needed to compute next-to-leading corrections to the Higgs
gluon-fusion cross-section in the Standard Model Effective Field Theory. I will review modern multi-loop calculation techniques used throughout the computation
and I will present the first result for a two-loop form factor with an insertion of a chromomagnetic operator in the Standard Model EFT.
Finally, I will comment on the impact of this computation on future precision Higgs studies at the LHC.

I intend to submit my contribution for the proceedings:

Yes

8

Systematics of quark/gluon tagging

Authors: Andrew Larkoski[1]; Andrzej Siodmok[2]; Davison Soper[3]; Deepak Kar[4]; Gregory Soyez[5]; Jesse Thaler[6]; Lief Lonnblad[7]; Marat Freytsis[3]; Philippe Gras[8]; Simon Platzer[9]

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By measuring the substructure of a jet, one can assign it a quark or gluon tag. In this talk, we confront the challenges faced when going beyond this leading-order understanding, using both parton shower generators and first-principles calculations to assess the impact of higher-order perturbative and nonperturbative physics. Working in the idealized context of electron-positron collisions,where one can define a proxy for quark and gluon jets based on the Lorentz structure of the production vertex, we find a fascinating interplay between perturbative shower effects and nonperturbative hadronization effects. Turning to proton-proton collisions, we highlight a core set of measurements that would constrain current uncertainties in quark/gluon tagging and improve the overall modeling of jets at the Large Hadron Collider.

I intend to submit my contribution for the proceedings:

No

9

Bounds for lighter Higgses in extensions of the Standard model

Author: Aldo Deandrea[1]

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Corresponding Author: deandrea@ipnl.in2p3.fr

We consider present constraints on models with more than one Higgs boson, both from the LHC data and from other sources in order to explore the possibility of constraining scalar or pseudoscalar particles lighter than the 125 GeV Higgs boson. Contrary to naive expectations, such a lighter particle is not yet completely excluded by present data. We show with a simplified analysis that some new constraints can be obtained at the LHC if such a search is performed by the experimental collaborations.

I intend to submit my contribution for the proceedings:

Yes

10

Status of Higgs Boson studies in ep collisions

Author: Bruce Mellado[1]

[1] *University of the Witwatersrand*

The Large Electron Proton Collider (LHeC) is a project that is envisioned as an upgrade of the Large Hadron Collider (LHC). The physics programme of the LHeC is vast. It plays a critical role for the measurement precise measurement of parton density functions in a wide range of the Bjorken x and the QCD interaction constant, alpha$_S$. These are essential to fully exploit the physics potential of the LHC. Higgs boson physics is another important part of the physics programme, which complementary to corresponding programme of the LHC and has unique capabilities not available in other type of collusions. Recent progress in Higgs boson studies in ep collisions are reviewed. The capability of studying di-Higgs boson production at the Future Circular Collider with the *he* option is also discussed.

I intend to submit my contribution for the proceedings:

Yes

11

Neutron induced radiation damage of plastic scintillators for the upgrade of the Tile Calorimeter of the ATLAS detector.

Author: Joyful Mdhluli[1]

Co-authors: Bruce Mellado [1]; Charles Sandrock [1]; Elias Sideras-Haddad [1]; Gerrard Peter [1]; Harshna Jivan [1]; Nthabiseng Khanye [1]; Phuti Tjale [1]; Rudolph Erasmus [1]; Sijiye Tlou [1]; Vladimir Baranov [2]; Yuri Davydov [2]

[1] *University of the Witwatersrand*

[2] *Joint Institute for Nuclear Research (JINR)*

With the prediction that the plastic scintillators in the Gap region of the Tile Calorimeter will sustain a significantly large amount of radiation damage during the HL-LHC run time, the current plastic scintillators will need to be replaced during the phase 2 upgrade in 2018. The scintillators in the gap region were exposed to a radiation environment of up to 10 kGy/year during the first run of data taking and with the luminosity being increased by a factor of 10, the radiation environment will be extremely harsh.
We report on the radiation damage to the optical properties of plastic scintillators following irradiation using a neutron beam of the IBR-2 pulsed reactor in Joint Institute for Nuclear Research (JINR), Dubna. A comparative is drawn between polyvinyl toluene based commercial scintillators EJ200, EJ208 and EJ260 as well as polystyrene based scintillator from Kharkov. The samples were subjected to irradiation with neutrons of energy >1 MeV and a flux density range of 1•106 − 7.7•106.
Light transmission, Raman spectroscopy, fluorescence spectroscopy and light yield testing was performed to characterize the damage induced in the samples. Preliminary results from the tests done indicate a change in the optical properties of the scintillators, further studies are underway to gain a better understanding of the interaction between neutrons with plastic scintillators.

I intend to submit my contribution for the proceedings:

Yes

12

New physics signatures with final state containing a Z and a Higgs boson, and significant missing energy and the LHC

Author: Tshidiso Molupe[1]

Co-authors: Alan Cornel [1]; Bruce Mellado [1]; Deepak Kar [1]; Mukesh Kumar [1]; Shell-may Liao [1]; Skhathisumosa Mthembu [1]; Stefan von Buddenbrock [1]

[1] *University of the Witwatersrand*

The discovery of the Scalar Higgs Boson, h, in July 2012 means that the particle spectrum of the Standard Model (SM) is complete. New questions arise, whether the electroweak symmetry breaking mechanisn in the SM is really complete, and whether there are more particles with scalar like properties, like the Higgs Boson. The Wits HEP group has postulated the existince of a heavy scalar, H, with a mass around 270 GeV. If embedded into a two Higgs Doublet, heavier charged bosons and a pseudo-scalar can be predicted. In this research the main aim is to search for a heavy pseudo-scalar A, where the prime search channel would be, $pp \longrightarrow A \longrightarrow ZH$. Where the Z boson decays to two leptons, $Z \longrightarrow ll$(l = e or μ). The large branching ratios of $H \longrightarrow h\chi\chi$ and $h \longrightarrow bb$ means that the ZH + Missing Enegy (MET) channel opens up. MET is described as the transverse energy which is not detected in a particle detector but is expected due to laws of conservation of momentum. This search is feasible as long as mA > mH + mZ.

I intend to submit my contribution for the proceedings:

Yes

13

Medium-induced radiation beyond the Poisson Approximation

Author: Andriniaina Narindra Rasoanaivo[1]

Co-author: William Horowitz [1]

[1] *University of Cape Town*

Corresponding Author: andriniaina@aims.ac.za

We present a novel technique for the calculation of the probability for emission of an arbitrary number of gluons radiated from a high-pT probe of the QGP. Our work is an extension of the maximal helicity violating (MHV) method in which the usual soft-collinear factor is classified according to its symmetry under gluon permutations.

For the purposes of illustration, we show the explicit form of the result for from 1 to 3 gluon emissions and present the general expression for any generic "n" numbers of gluons. In particular, we compute for the first time the QCD corrections to the multi-gluon Poisson approximation. Our results will prove invaluable to leading particle and jet energy loss modellers.

I intend to submit my contribution for the proceedings:

Yes

14

IR divergences in massless QED

Author: Abdullah Ibrahim[1]

Co-author: William Horowitz [1]

[1] *University of Cape Town*

Corresponding Author: abdullah@aims.ac.za

We study the cancellation of both collinear and infrared divergences in a process where a massless electron scattered off of a static point charge. We found that the collinear divergences have been eliminated by the application of the well known KLN theorem. The application of the KLN theorem requires adding the absorption of a photon which spoils the cancellation of the IR divergences. We check the validity of adding the disconnected diagrams and the possibility of IR cancellation by adding the contribution from these diagrams.

I intend to submit my contribution for the proceedings:

Yes

15

Time Dependent qhat from AdS/CFT

Author: Will Horowitz[1]

[1] *University of Cape Town*

We present the first ever AdS/CFT calculation of $\hat{q}$ for a light quark jet as a function of position or, equivalently, time. Our result does not suffer from the gamma factor blow up of the usual time-independent AdS/CFT heavy quark setup and is qualitatively similar to, but about a factor of 2/3 larger than, the light flavor result from Liu, Rajagopal, and Wiedemann. Our findings can be immediately implemented into any $\hat{q}$-based energy loss model.

Our q^ derivation relies on our calculation of the average distance squared, $s^2(t)$, travelled by the endpoint of a string falling in an AdS3-Schwarzschild spacetime. The early time behavior is ballistic, $s^2(t) \sim t^2$, but the late time behavior is the usual diffusive Brownian motion, $s^2(t) \sim t$. These late time dynamics are universal and depend only on the near-horizon physics, which allows us to generalize our results to arbitrary dimensions and thus make contact with the physics explored by RHIC and LHC.

Additionally, we find that AdS/CFT predicts angular ordering for radiation in medium, just as in vacuum, and in contradistinction to weak-coupling, with its anti-angular ordering prediction. Finally, our results also imply, sensibly, that AdS/CFT predicts a smooth interpolation between the angular correlations of open heavy flavor and light flavor observables.

I intend to submit my contribution for the proceedings:

Yes

16

Exploring LHC Run 1 and 2 data using the Madala hypothesis

Author: Stefan von Buddenbrock[1]

[1] *University of the Witwatersrand*

Corresponding Author: stefvonb@gmail.com

The Standard Model (SM) Higgs boson, with its experimental discovery in 2012, has long been an interesting particle to study with the intention of exploring new physics ideas beyond the SM (BSM). Its properties are still not well understood, and there are several features in LHC Run 1 and Run 2 data which point at the possibility of extensions to the SM Higgs sector. This work explores the *Madala hypothesis*, which is the introduction of a heavy scalar (the Madala boson) to the SM, in addition to a real scalar S and dark matter (DM) candidate χ. This hypothesis has previously been used to explain several anomalous features observe in the LHC Run 1 data. This work extends the study to Run 2 data, and shows that the particle spectrum predicted in the Madala hypothesis is indeed compatible with LHC data. Further study prospects and striking signatures for searches are presented.

I intend to submit my contribution for the proceedings:

Yes

18

Exploring the top-Higgs FCNC couplings at colliders

Author: Blazenka Melic[1]

[1] *Rudjer Boskovic Institute*

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The search for the Flavor Changing Neutral Current (FCNC) processes, has been one of the leading tools to test the Standard Model (SM), in an attempt of either discovering or putting stringent limits on the new physics scenarios.
Within the SM, there are no FCNC transitions at
tree level, mediated by the Higgs Boson. These processes are severely suppressed by the unitarity constraints of the Cabibo-Kobayashi-Maskawa matrix. The top quark being the heaviest of all the quarks has the largest Yukawa coupling to the Higgs boson. The large production rate of the top quarks in the LHC, allows one to look for transition of the top quark to a quark of different flavor but same charge. This suggests looking for rare neutral flavor changing transitions, t ⟶ cH, t ⟶ uH, as no symmetry prohibits this decay. The SM branching ratio of this process is extremely small, of the order BR(t ⟶ cH) SM ≈ 10 ^(−15). This is many orders of magnitude too small to be measured in the 14 TeV LHC. Therefore an affirmative observation of the process t ⟶ qH, well above the SM rate, will be a conclusive indication of new physics beyond the SM.

We explore the FCNC top-Higgs decays in detail at polarized linear colliders and compare results with the existing LHC searches to constrain the FCNC couplings. Moreover, we emphasis advantages of linear collider searches over the hadronic ones, in particular for discriminating between chiralites of FCNC couplings.

I intend to submit my contribution for the proceedings:

Yes

19

An outlook of the study of the measurement of cross sections using the van der Meer technique

Author: Sibaliso Mhlanga[1]

[1] *Student (iThemba/University of Cape Town*

Corresponding Author: switsba@gmail.com

The performance of a particle collider is characterised by the luminosity, that is, the number of collisions produced over time per cross-section. Therefore, the luminosity is a necessity in the determination of the cross section for a reaction process. Also, it is dependent on the number of particles in each colliding beam as well as on the size of the overlap of both beams at the collision point. Therefore, the colliding beams must be optimized for effective crossing. At the LHC, luminosity optimization and calibration is done using a sample of events by choosing a reference process. The cross-section of the reference process is measured using the van der Meer technique. In this method the rate of the reference process is measured as a function of the separation of the colliding beams and this information in combination with the beam intensities is used to obtain the luminosity and hence the absolute value of the cross section of the reference process. In this talk we will give an outlook of the Van der Meer scans performed at the LHC during proton-proton collisions at a centre-of-mass energy of 13 TeV.

I intend to submit my contribution for the proceedings:

No

20

Vector bosons measurement at forward rapidity with ALICE

Author: Kgotlaesele Senosi[1]

[1] *University of Cape Town (iThemba LABS)*

Corresponding Author: senosijohnson@yahoo.com

ALICE (A Large Ion Collider Experiment) is designed and optimized to study ultra-relativistic heavy-ion collisions at the LHC, in which a hot and dense, strongly-interacting medium is created. Vector bosons (W and Z) are produced in hard scattering processes and interact weakly with the medium formed in heavy-ion collisions. Thus, they present a suitable reference for processes which are heavily affected by the medium. In proton-nucleus collisions their production can be used to study the modification of parton distribution functions in the nucleus and to test the validity of binary-collision scaling for hard processes. W bosons are studied via the inclusive single muon differential p_{T} spectrum whereas the Z-boson signal is observed in the invariant mass distribution of unlike-sign muon pairs as a peak around the Z-boson mass. In this presentation the measured cross sections of W and Z bosons and the W-boson yield per centrality interval will be discussed. The cross-sections are compared to theoretical calculations.

I intend to submit my contribution for the proceedings:

No

23

Short Path Length Energy Loss in the Quark Gluon Plasma

Author: Isobel Kolbe[1]

Co-author: William Horowitz [1]

[1] *University of Cape Town*

Corresponding Author: isobel.kolbe@gmail.com

The Quark Gluon Plasma has been studied extensively at the LHC, with jet quenching and particle suppression playing an important role in our ability to characterize this fundamental state of matter. A number of theoretical descriptions concerning the mechanisms whereby particle suppression occurs have been put forward, with perturbative methods successfully describing suppression patterns in very central Pb-Pb collisions at the LHC. However, particle suppression is by no means the only hallmark of the existence of the QGP and many measurements at the LHC of smaller colliding systems, such as peripheral Pb-Pb and central p-Pb and p-p, have hinted at the production of a droplet of QGP in alarmingly small volumes. In stark contrast, existing perturbative Quantum Chromodynamical methods rely heavily on the assumption that the system under consideration is large, demanding an extension of pQCD methods to smaller systems. We present precisely such an extension and find corrections on the order of 100% at high energies, revealing a number of shortcomings and problematic assumptions that are present even in traditional pQCD energy loss calculations.

I intend to submit my contribution for the proceedings:

Yes

24

Early thermalisation, hydrodynamics, and energy loss in holographic heavy ion collisions

Author: Wilke van der Schee[1]

[1] *MIT*

Corresponding Author: wilke@mit.edu

This talk will review recent progress in using holography to learn lessons about heavy ion collisions. I will illustrate the use of holography for the earliest stage of HIC, before hydrodynamics applies, and also during the hydrodynamic evolution in order to describe the energy loss and shape evolution of jets traversing the hydrodynamic medium. Interesting results include the fast applicability of hydrodynamics (within 0.1 fm/c), a Gaussian rapidity profile of the energy density, and a characteristic dependence of energy loss on the width of a jet.

I intend to submit my contribution for the proceedings:

No

25

Identified hadron production in pp collisions measured with ALICE

Author: Yasser Corrales Morales[1]

[1] *Universita e INFN Torino (IT)*

Corresponding Author: yasser.corrales.morales@cern.ch

The production of identified hadrons in proton-proton collisions is frequently studied as a reference for the investigation of the strongly-interacting medium created in heavy-ion collisions. In addition, measurements in pp and p-Pb collisions as a function of event multiplicity at LHC energies have shown some features reminiscent of those related to collective effects in Pb–Pb collisions. Thanks to its excellent PID capabilities and p_{T} coverage, the ALICE detector offers a unique opportunity for the measurement of p_{T} distributions, integrated yields dN/dy and mean transverse momenta $\langle p_{\mathrm{T}} \rangle$ of identified light-flavor hadrons at mid-rapidity over a wide p_{T} range.

In this contribution, results on π, K, p, $\mathrm{K}^0_{\mathrm{S}}$, Λ, Ξ, Ω and K^{*0} as a function of multiplicity in pp collisions at $\sqrt{s} = 7$ TeV are presented. The results are compared with those measured in p–Pb and Pb–Pb collisions. A similar evolution of the spectral shape, the p_{T}-differential particle ratios and the integrated yield ratios with the charged particle multiplicity in both small and large systems is observed. The production rates of strange hadrons are seen to increase more than those of non-strange particles, showing an enhancement pattern with multiplicity which is remarkably similar to the one measured in p–Pb collisions.

In addition, results on the production of light flavour hadrons in pp collisions at $\sqrt{s} = 13$ TeV, the highest centre-of-mass energy ever reached in the laboratory, are
also presented and the changes observed as a function of $\sqrt{s}$ are discussed.

I intend to submit my contribution for the proceedings:

Yes

26

Open heavy-flavour production in heavy-ion collisions with ALICE at the LHC

Author: Massimiliano Marchisone[1]

[1] *University of the Witwatersrand and iThemba LABS*

Corresponding Author: mmarchis@cern.ch

The LHC heavy-ion physics program aims at investigating the properties of QCD matter at high temperature and energy density, where a deconfined partonic state of matter called Quark-Gluon Plasma (QGP) is formed. Measurements of open heavy-flavour production in ultra-relativistic nucleus-nucleus collisions are expected to provide essential information about the QGP properties since heavy quarks interact strongly with the medium throughout its evolution.
The nuclear modification factor ($R_{\rm AA}$) is a key observable of the parton energy loss in the medium. Elliptic flow (v_2) is sensitive to the degree of thermalisation of the quarks and to the path-length dependence of energy loss at low and high transverse momentum, respectively.
Proton-ion collisions are fundamental to disentangle hot and cold nuclear matter effects, like shadowing, transverse momentum broadening, energy loss. High precision data in pp collisions serve as crucial test for several competing models of hadro-production and provide the reference for the measurements in heavy-ion collisions.

In this talk a selection of the recent results on open heavy flavour obtained by ALICE during LHC–Run1 will be presented, focusing mainly
on Pb–Pb and p–Pb collisions. Measurements obtained from
LHC–Run2 in Pb–Pb data taking will be shown as well.
The comparison with theoretical calculations will also be discussed.

I intend to submit my contribution for the proceedings:

Yes

27

Status of Higher Order QCD computations

Author: Giulia Zanderighi[1]

[1] *CERN*

Corresponding Author: giulia.zanderighi@cern.ch

From a theory side, perturbative QCD calculations, in an expansion in the strong coupling constant, made giant steps in the last two years. In the last year the calculation of the N3LO correction to Higgs boson production in gluon fusion and in vector boson fusion. A large number of two-to-two LHC scattering processes are now known to NNLO in QCD, including most importantly all di-boson production processes, boson plus jet production and top-pair production. NLO QCD calculations are now automated, with several public codes available. The automation of NLO electroweak corrections and of loop-induced processes is also under way.

From an experimental side, the second phase of LHC Run II will be just concluded in December 2016, right before the time of the conference, with probably about 40 fb-1 of data collected by then. One of the main

role of these data will be to provide useful information on the still quite poorly explored Higgs sector of the Standard Model.

In this talk I will review the status of high precision QCD calculations, with particular emphasize on the impact of theory uncertainties on measurements of Higgs production cross sections and on the extraction of Higgs couplings at the LHC. I will also discuss the conceptual bottleneck and future challenges facing high-precision QCD in the coming years.

I intend to submit my contribution for the proceedings:

No

28

Light exotic Higgs bosons at the LHC

Author: Shoaib Munir[1]

[1] *Korea Institute for Advanced Study*

Corresponding Author: smunir@kias.re.kr

Most models of new physics contain extended Higgs sectors with multiple Higgs bosons. One of these Higgs bosons should have properties consistent with the Standard Model (SM)-like one discovered recently at the Large Hadron Collider (LHC). At the same time, the remaining ones should be consistent with the negative searches corresponding to a wide range of their probable masses at the Large Electron-Positron (LEP) collider, the Tevatron and the LHC so far. In some simple extensions of the SM, like the 2-Higgs Doublet Model (2HDM) and the Next-to-Minimal Supersymmetric SM (NMSSM), these additional Higgs bosons can be rather light and still escape detection at colliders, owing to their highly reduced couplings to the SM particles. Therefore, at the LHC, in addition to the searches based on their conventional production channels, new possible search modes need to be investigated in order to establish their signatures. Such modes can include their pair production in the decays of one of the heavier Higgs bosons or even electroweak production, which is generally assumed to be insignificant. We analysed some of these search modes for points in the parameter spaces of the Type-I 2HDM and the NMSSM, that yield such light Higgs bosons while satisfying the existing experimental constraints from a variety of sources, and found promising results.

I intend to submit my contribution for the proceedings:

Yes

29

Recent status of NA61/SHINE activities

Author: Ludwik Turko[1]

[1] *University Wroclaw*

Corresponding Author: lturko@ift.uni.wroc.pl

The fixed target NA61/SHINE experiment (SPS CERN) looks for the critical point of strongly interacting matter and the properties of the onset of deconfinement. It is a two dimensional scan of measurements of particle spectra and fluctuations in proton-proton, proton-nucleus and nucleus-nucleus

interactions as a function of collision energy and system size, corresponding to a two dimensional phase diagram $(T-\mu_B)$.
New NA61/SHINE results would be presented, such as transverse momentum and multiplicity fluctuations in Ar+Sc collisions compared to NA61 p+p and Be+Be data, as well as to NA49 A + A results.

I intend to submit my contribution for the proceedings:

Yes

30

The Madala hypothesis - Theory and Constraints

Author: Mukesh Kumar[1]

[1] *University of the Witwatersrand*

Corresponding Author: mukesh.kumar@cern.ch

In this work we are hypothesising three real scalar bosons (H, S, χ) in a theory beyond the Standard Model. Our aim is to formulate a proper theory by considering an effective approach and as well by considering two Higgs doublet model. Further we study a viable parameter space to constraint the associated parameter spaces like couplings and masses of these bosons via experimental results and dark matter constraints. Further a speculations on the characteristics of S and χ has been studied.

I intend to submit my contribution for the proceedings:

Yes

31

The CMS detector upgrade and potential for future Physics

Author: Ettore Focardi[1]

[1] *University of Florence*

Corresponding Author: ettore.focardi@cern.ch

The CMS experiment had a very good start of its Physics Program at the Large Hadron Collider (LHC). One of the main questions in Particle Physics, what is the origin of the particle masses, was partially answered with the Physics runs in 2011 and 2012 when LHC delivered an integrated luminosity of ~25 fb-1 and gave as result the discovery of a Higgs boson with mass of ~125 GeV. The study of the decays of this particle and the couplings with gauge bosons of the Standard Model (SM) and photon are consistent with the SM expectations of the Higgs. The SM does not provide answers to the nature of dark matter, forces unification, matter-antimatter properties difference, then a new Physics is required. The scalar nature of the Higgs particle gives theoretical challenges: radiative corrections can result in a mass increase. New physics can appear at masses near 1 TeV to cancel this growth. The detailed study of the 125 Higgs boson must be pursued to a very high statistical precision. This study and the search for new physics provide a powerful demand for higher luminosity. The LHC machine group has a plan for achieving higher peak and integrated luminosity (HL-LHC). The CMS detector requires upgrades to preserve the efficiency, resolution and background rejection at these higher luminosity. The main challenges that must be overcome to achieve this goal are the radiation damage to the detector from the high integrated luminosity of HL-LHC and the very high 'pile-up'

coming from the high instantaneous luminosity. Details of the problems for each subsystem of CMS are given along with the proposed solutions

I intend to submit my contribution for the proceedings:

Yes

33

The LHCb Upgrade

Author: Alessio Piucci[1]

[1] *Physikalisches Institut Heidelberg*

Corresponding Author: alessio.piucci@cern.ch

During the LHC Run 1 the LHCb experiment has successfully performed a large number of high precision measurements in heavy flavour physics using 3 fb^{-1} collected at centre-of-mass energies of 7 TeV and 8 TeV.
In LHC Run 2 the LHCb is expected to integrate an additional 5 fb^{-1} data, however many of the measurements will remain limited by statistics.
For this reason LHCb will withstand in 2020 a major upgrade during the Long Shutdown 2 of LHC, with the aim to collect 50 fb^{-1} of data by 2028.
To achieve this goal the LHCb detector readout rate will be upgraded from the current 1 MHz to the LHC bunch crossing rate of 40 MHz. The luminosity delivered to the experiment will increase of a factor five, up to $2 \cdot 10^{33} cm^{-2} s^{-1}$.
The online selection of events will be uniquely performed by a pure software trigger, improving the trigger efficiencies. In order to sustain the increased luminosity and readout rate, all the sub-detectors will be upgraded.
The architecture of the upgraded DAQ system and trigger strategy will be presented, as well an overview of the sub-detector upgrades.

I intend to submit my contribution for the proceedings:

Yes

34

Wave-function and CKM renormalization: the case for new physics

Author: Domenec Espriu[1]

[1] *University of Barcelona*

Corresponding Author: espriu@icc.ub.edu

We re-examine the issue of wave function renormalisation for unstable particles in the presence of electroweak interactions and its relation with the renormalisation of the CKM mixing matrix elements. We show that a proper LSZ-compliant prescription leads to gauge independent amplitudes. The resulting wave function renormalisation constants necessarily possess absorptive parts, but they comply with the expected requirements concerning CP and CPT. The results obtained using this prescription are different (even at the level of the modulus squared of the amplitude) from the ones

neglecting the absorptive parts e.g. in the case of top decay. The difference might be numerically relevant for present determinations of the CKM elements.

Then we proceed to consider possible contributions from new physics, parametrized by an effective lagrangian with some low-energy constants. We assume that such contributions (possibly from the integration of heavy states) should be comparable con radiative corrections in the SM and try to extract possible consequences.

I intend to submit my contribution for the proceedings:

Yes

35

Nuclear modification of light-flavour and strangeness at LHC energies with ALICE

Author: Ramona Lea[1]

[1] *University and INF Trieste*

Corresponding Author: ramona.lea@cern.ch

Thanks to its unique particle identification capabilities the ALICE detec- tor is able to identify light fl vour, resonances, strange and multi-strange hadrons, including π, K, p, K0 , Λ, Ξ, Ω, ρ(770), φ(1020), over a wide range of transverse momentum, from pp and p-Pb interactions up to central Pb–Pb collisions. The latest results on transverse momentum spectra and the nu- clear modifi factor, RAA, as a function of the Pb–Pb collision centrality will be presented for various particle species at 2.76 TeV center of mass en- ergy. The RAA will be compared with the nuclear modifi factors in p-Pb collisions, to discuss the presence of hot nuclear matter effects affecting the high-pT particle production in Pb–Pb collisions. The results on the RAA
of charged hadrons at √sNN = 5.02 TeV, the highest energy ever reached in
the laboratory for heavy-ion collisions, will also be presented.

I intend to submit my contribution for the proceedings:

Yes

36

New developments in Monte Carlo tools for new physics

Author: Benjamin Fuks[1]

[1] *LPTHE - CNRS - UPMC*

Corresponding Author: fuks@lpthe.jussieu.fr

The ATLAS and CMS collaborations are extensively investigating many different channels in order to get hints for new physics. Many of these searches are currently based on Monte Carlo simulations of the signals where leading-order matrix elements of different partonic multiplicities are matched to parton showers and merged. More sophisticated differential theoretical predictions are however always helpful for setting more accurate exclusion limits, possibly refining the search strategies, and measuring the model free parameters in case of a discovery.

In this talk, I will discuss how the MadGraph5_aMC@NLO framework can provide a general platform for computing (differential) observables within several beyond the Standard Model theories at the next-to-leading order accuracy in QCD. I will present specific examples based on supersymmetric, vector-like quark, dark matter or effective field theory models.

I intend to submit my contribution for the proceedings:

Yes

37

Results and plans for the study of heavy ion collisions at LHCb

Author: Patrick ROBBE[1]

[1] *LAL Orsay*

Corresponding Author: robbe@lal.in2p3.fr

In 2015, the LHCb experiment recorded data during the PbPb run of the LHC for the first time. A new experimental program was also initiated to study collisions of the proton or Pb beam of the LHC with a gas fixed targed injected in the LHCb interaction point. In this talk, we present the results of the first data analyses, including recent measurements obtained with pPb collisions recorded in 2013, and discuss the prospects for the LHCb ion-ion collision progamme.

I intend to submit my contribution for the proceedings:

No

38

The Higgs portal and the early Universe

Author: Michael Spannowsky[1]

[1] *IPPP Durham*

Corresponding Author: michael.spannowsky@durham.ac.uk

Higgs portal interactions provide a simple mechanism for addressing two open problems in cosmology: dark matter and the baryon asymmetry. In the latter instance, Higgs portal interactions may contain the ingredients for a strong first order electroweak phase transition as well as new CP-violating interactions as needed for electroweak baryogenesis. These interactions may also allow for a viable dark matter candidate. We survey the opportunities for probing the Higgs portal as it relates to these questions in cosmology at the LHC and possible future colliders.

I intend to submit my contribution for the proceedings:

No

39

The SHiP Experiment at CERN

Author: Walter Bonivento[1]

[1] *INFN Cagliari*

Corresponding Author: walter.bonivento@ca.infn.it

SHiP is a new general purpose fixed target facility, whose Technical Proposal was reviewed by the CERN SPS Committee, who recommended that the experiment proceeds further to a Comprehensive Design phase. This recommendation was also endorsed by the CERN Research Board. In its initial phase, the 400GeV proton beam extracted from the SPS will be dumped on a heavy target with the aim of integrating $2x10^{20}$ pot in 5 years. A dedicated detector, based on a long vacuum tank followed by a spectrometer and particle identification detectors, will allow probing a variety of models with light long-lived exotic particles and masses below O(10) GeV/c^2. The main focus will be the physics of the so-called Hidden Portals, i.e. search for Dark Photons, Light scalars and pseudo-scalars, and Heavy Neutrinos. The sensitivity to Heavy Neutrinos will allow for the first time to probe, in the mass range between the kaon and the charm meson mass, a coupling range for which Baryogenesis and active neutrino masses could also be explained. Another dedicated detector will allow the study of neutrino cross-sections and angular distributions. tau neutrino deep inelastic scattering cross sections will be measured with a statistics 300 times larger than currently available, with the extraction of the F_4 and F_5 structure functions, never measured so far and allow for new tests of lepton non-universality with sensitivity to BSM physics. This second detector will also allow direct dark matter detection produced in the decay of the dark photons

I intend to submit my contribution for the proceedings:

Yes

40

Searches for Beyond the Standard Model Physics with ATLAS

Author: Bernd Stelzer[1]

[1] *Simon Fraser University*

Corresponding Author: stelzer@sfu.ca

Since 2015, the LHC is operating at a center-of-mass energy of 13 TeV and the ATLAS detector has collected data very efficiently during this time. The increased centre-of-mass energy provides a unique opportunity to find new Physics beyond the Standard Model (BSM) at the LHC. This talk will summarize the latest ATLAS results on BSM searches in a large number of final states which target searches for new massive particles, searches for dark matter, searches for supersymmetric partners and searches for new physics with unconventional signatures.

I intend to submit my contribution for the proceedings:

Yes

41

Chiral symmetry restoration versus deconfinement in heavy-ion collisions at high baryon density

Author: Elena Bratkovskaya[1]

Co-authors: Alessia Palmese [2]; Eduard Seifert [2]; Pierre Moreau [3]; Thorsten Steinert [2]; Wolfgnag Cassing [2]

[1] *GSI and Frankfurt Uni.*

[2] *Giessen Uni.*

[3] *Frankfurt. Uni.*

Corresponding Author: elena.bratkovskaya@th.physik.uni-frankfurt.de

We study the effect of the chiral symmetry restoration (CSR) in heavy-ion collisions from $\sqrt{s_{NN}}$=3-160 GeV within the Parton-Hadron-String Dynamics (PHSD) transport approach. The PHSD includes the deconfinement phase transition as well as essential aspects of CSR in the dense and hot hadronic medium, which are incorporated in the Schwinger mechanism for the hadronic particle production. Our systematic studies show that chiral symmetry restoration plays a crucial role in the description of heavy-ion collisions giving an increase of the hadronic particle production in the strangeness sector with respect to the non-strange one. We identify particle abundances and rapidity spectra to be suitable probes in order to extract information about CSR, while transverse mass spectra are less sensitive. Furthermore, the appearance/disappearance of the 'horn'-structure in the K^+/π^+ ratio is investigated as a function of the system size in central A+A collisions.

Refs:

[1] A. Palmese at al., Phys. Rev. C 94 (2016) 044912

[2] W. Cassing et al., Phys.Rev. C93 (2016) 014902

I intend to submit my contribution for the proceedings:

Yes

42

Searches Using Substructure Techniques for Exotics in ATLAS.

Author: Katharina Behr[1]

[1] *DESY Hamburg*

Corresponding Author: katharina.behr@cern.ch

The significant increase of the centre-of-mass energy of the Large Hadron Collider (LHC) from 8 to 13 TeV has allowed the experiments at the LHC to explore previously inaccessible kinematic regimes in their search for phenomena beyond the Standard Model of Particle Physics. The sensitivity of these searches depends crucially on the efficient reconstruction and identification of hadronic decays of highly energetic (boosted) objects, the decay products of which are typically collimated into a single large jet with a characteristic substructure. In this contribution, I review the searches conducted by the ATLAS experiment on data recorded during 2015 and 2016 that rely on substructure techniques to identify signatures of interest. A particular emphasis is placed on recent developments in the rapidly evolving field of boosted object tagging.

I intend to submit my contribution for the proceedings:

Yes

43

Heavy Flavor and Quarkonia production at LHCb

Author: Katharina Mueller[1]

[1] *University of Zurich*

Corresponding Author: kmueller@physik.uzh.ch

The LHCb detector with its excellent momentum resolution and flexible trigger strategy is ideally suited for measuring heavy quark and quarkonia production.
Recent LHCb measurements of inclusive and differential cross-sections of the production of J/\psi and Upsilon as well as charm, bottom and top quarks in pp collisions at different centre of mass energies are presented. The emphasis lies on the the results from data collected at a centre of mass energy of 13 TeV and ratios of cross-sections at different centre of mass energies.
Finally, results on the associated production of Upsilon and open charm hadrons are presented.The measured cross-sections and differential distributions indicate the dominance of double parton scattering as the main production mechanism.

I intend to submit my contribution for the proceedings:

Yes

44

Production of Nuclei, Hyper-Nuclei and Exotics in the ALICE Detector

Author: Benjamin Doenigus[1]

[1] *Institute for Nuclear Physics, Goethe University Frankfurt, Frankfurt, Germany*

Corresponding Author: b.doenigus@gsi.de

The high collision energies reached at the LHC lead to significant production yields of light (anti-)(hyper-)nuclei in proton-proton, proton-lead and, in particular, lead-lead collisions. The excellent particle identification capabilities of the ALICE apparatus allow for the detection of these rarely produced particles. Furthermore, the good vertexing performance gives the possibility to separate primary nuclei from those coming from the decay of heavier systems.

We present results on the production of stable nuclei and anti-nuclei in Pb–Pb and smaller collision systems. Hypernuclei production rates in Pb–Pb will also be shown, together with upper limits estimated on the production of lighter exotica candidates, like the hypothetical H-dibaryon and a possible Λn bound state. All results are compared with predictions for the production in thermal (statistical) models and alternatives using coalescence.
In order to gain further insight into the production mechanisms of light nuclei, measurements on the elliptic flow of deuterons will be presented and compared to expectations from coalescence and hydrodynamic models.

In addition, the expectations from the currently ongoing run 2 and the upgraded ALICE detector in run 3 will be discussed.

I intend to submit my contribution for the proceedings:

No

45

ALICE Results on Quarkonia and Open Heavy Flavours

Author: Diego Stocco[1]

[1] *Subatech*

Corresponding Author: stocco@subatech.in2p3.fr

ALICE is the LHC experiment dedicated to the heavy-ion physics at the Large Hadron Collider at CERN. Its aim is the study of the QCD matter at high energy densities, where the formation of the Quark-Gluon Plasma (QGP) is expected.
Heavy quarks (charm and beauty) constitute an important probe for QGP studies, since they are created in the hard scattering processes at the initial stages of the collision and their number is conserved in the partonic and hadronic phase of the medium evolution.
The sequential suppression of quarkonia (bound heavy quark-antiquark states) by colour screening has been suggested as a signature and thermometer of the QGP. However the first results in nucleus-nucleus collisions at the LHC suggest that the charmonium production in the QGP could be due to the interplay of the colour screening mechanism and the re(combination) of the abundantly produced c-cbar quark pairs.
The measurement of open heavy flavours provides additional information, giving insight in the mechanisms of in-medium energy loss, propagation and hadronisaton of heavy quarks.
Disentangling the medium-induced effects requires an accurate study of the so-called cold nuclear matter effects, which modify the heavy-quark production in proton-nucleus collisions with respect to proton-proton (pp) collisions.
Open heavy-flavour and quarkonium measurements in pp collisions are interesting not only as a reference for nucleus-nucleus and proton-nucleus results, but also because they provide an important test ground for both perturbative and non-perturbative aspects of QCD.

The ALICE experiment measured heavy-flavour and quarkonium production in pp, p-Pb and Pb-Pb collisions at different energies. An overview of the results will be presented, with an emphasis on the most recent results on run-2 data and the latest results from run-1. The comparison with the measurements at different collision energies and with available theoretical calculations will be discussed.

I intend to submit my contribution for the proceedings:

No

47

The Future of Heavy Ion Physics from an Experimental and Physics Perspective

Author: John Harris[1]

[1] *Yale University*

Corresponding Author: john.harris@yale.edu

see abstract attached

I intend to submit my contribution for the proceedings:

Yes

Plenary / **48**

Higgs Properties and Measurements in ATLAS

Author: Lydia Roos[1]

[1] *IN2P3/LPNHE*

Corresponding Author: lroos@lpnhe.in2p3.fr

The LHC has delivered a large amount of data at a center of mass energy of 13 TeV.
The experimental sensitivity with this data set is equivalent to the one from run-1 for the Higgs boson (125 GeV),
and surpasses it for searches for higher mass Higgs-like particles.
This talk will review recent ATLAS results on both of these topics.

I intend to submit my contribution for the proceedings:

No

49

ATLAS SUSY searches

Author: Michaël Ughetto[1]

[1] *Stockholm University*

Corresponding Author: mughetto@cern.ch

Despite the absence of experimental evidence, weak scale supersymmetry remains one of the best motivated and studied Standard Model extensions. This talk summarises recent ATLAS results for searches for supersymmetric (SUSY) particles, with focus on those obtained using proton-proton collisions at a centre of mass energy of 13 TeV.

I intend to submit my contribution for the proceedings:

No

50

Future Colliders

Author: Heather Gray[1]

[1] *CERN*

Corresponding Author: heather.gray@cern.ch

Although the physics program at the LHC is just beginning, preparations for future accelerators are already ongoing. I will review the ongoing projects in collider physics across the globe and focus on the Future Circular Collider project being prepared at CERN. The design of the accelerators and detectors will be discussed and an overview of the physics program will be provided.

I intend to submit my contribution for the proceedings:

Yes

51

Overview of recent ALICE results

Author: Enrico Scomparin[1]

[1] *INFN Torino (Italy)*

Corresponding Author: scomparin@to.infn.it

The main goal of the ALICE experiment is the characterization of the Quark-Gluon Plasma (QGP) created in heavy-ion collisions at the LHC. Thanks to its excellent particle identification capabilities down to low transverse momentum, a comprehensive variety of QGP-related signals has been studied. The results range from global observables (charged particle distributions, collective flow, multi-particle correlations,...) to identified particle spectra and to hard probes (high-pT particles, jets, heavy quarks, quarkonia,...) In this presentation, I will review the main ALICE results, with an emphasis on recent achievements.

I intend to submit my contribution for the proceedings:

Yes

52

Searches of physics beyond the standard model at CMS

Author: Jacopo Pazzini[1]

[1] *Padova University, INFN*

Corresponding Author: pazzini@pd.infn.it

Searches for physics beyond the Standard Model performed with the CMS experiment are summarized. The results are based on the data collected from proton-proton collisions at a center of mass energy of 13 TeV in 2015 and 2016, corresponding to 2.5 and 12.9 fb-1 respectively.

I intend to submit my contribution for the proceedings:

Yes

53

Simplified models of dark matter

Author: Greg Landsberg[1]

[1] *Brown University*

Last couple of years marked a shift in the paradigm of dark matter searches at colliders. While most of the results of earlier searches have been presented in terms of limits on effective field theory operators, the limitations of this approach have been realized and the results of new searches are now mostly being interpreted in terms of simplified models of dark matter. Not only these models allow for a more realistic comparison between collider and direct or indirect detection experiments, but they also can be used to put constraints on dark matter models from seemingly unrelated searches, e.g., a search for dijet resonances. I'll review the current status of simplified dark matter models and also talk about new ideas on expanding the existing set of models to allow for a broader interpretation of existing searches and design better strategies for future ones.

I intend to submit my contribution for the proceedings:

Yes

54

Review of SUSY Searches at CMS

Author: Greg Landsberg[1]

[1] *Brown University*

The higher machine energy reached and large amount of new data delivered by the LHC in 2015-2016 have re-energized searches for supersymmetry, which now explore new, uncharted territories, as well as more experimentally challenging signatures. With the goal to leave no stone unturned, these searches in the CMS experiment have set stringent limits on many flavors of supersymmetric models, including natural SUSY scenarios. In the talk, I'll present the most recent CMS results based on 8 and 13 TeV data, and talk about novel ideas on expanding the portfolio of SUSY searches in the coming months.

I intend to submit my contribution for the proceedings:

Yes

55

Some applications of the Tsallis distribution in High Energy Collisions

Author: Trambak Bhattacharyya[1]

[1] *Variable Energy Cyclotron Centre, Kolkata, India*

We analytically investigate the thermodynamic variables of a hot and dense system in the framework of the Tsallis non extensive classical statistics in the massless and in the massive cases. Emphasis has been put on the method used to deal with the massive case where the cumbersome momentum integral has been replaced by the simpler ones. In addition to that, we study the effect of Tsallis Power Law distribution on the multi-particle production in the high-energy collisions. The effect of the Tsallis q parameter on the experimentally measurable nuclear suppression factor has been investigated and an attempt to describe the transverse momentum distribution of hadrons produced in high-energy collisions has been made.

I intend to submit my contribution for the proceedings:

Yes

56

Overview of Results from CMS

Author: Christopher Neu[1]

[1] *University of Virginia*

The incredible performance of the LHC in 2016 has provided the collider experiments the opportunity to study the physics of the fundamental world at the largest energies and smallest length scales ever probed. In this talk I will summarize some recent, high-profile results from the CMS experiment, one of two general-purpose experiments at the LHC. The presentation will touch on all aspects of the experiment's physics program: high-precision measurements of previously-observed effects – the so-called rediscovery of the Standard Model; the pursuit of answers to known open questions about the universe, such as the characterization of the recently-discovered Higgs boson and the attempts to produce and detect dark matter; and the search for completely new dynamics that could reveal yet-unknown secrets of the fundamental world.

I intend to submit my contribution for the proceedings:

Yes

57

Holography at Tc

Author: Burkhard Kampfer[1]

[1] *HZDR*

HZDR

A holographic model is presented which accommodates

(i) features of qcd thermodynamics at Tc (the cross-over or second order or first order transition temperature, depending on quark masses) and (ii) the appearance of hadron states at Tc (either sequentially or instantenously). The bulk vicosity is as strong as the shear vicosity at Tc. Issues of nonzero baryon density effects are addressed holographically, too.

I intend to submit my contribution for the proceedings:

Yes

58

CP violation in b- and c-hadron decays at LHCb

Author: Olaf Steinkamp[1]

[1] *Universitaet Zuerich*

Testing the Standard Model of particle physics by precision measurements of CP violating observables in the decays of b and c hadrons has been one of the design goals of the LHCb experiment. The CKM angle gamma is still the least known angle of the unitarity triangle, and the only one easily accessible using tree level decays. A recent combination of LHCb measurements in various $B \to DK$ decay modes has yielded the most precise determination of gamma from a single experiment to date. Measurements of time-dependent CP violation in the mixing of neutral B mesons and in the interference between mixing and decay are excellent probes to search for physics beyond the Standard Model. LHCb has performed world leading measurements of the semileptonic asymmetries, Asls and Asld, and of the mixing-induced CP-violating phase ϕ_s in the $B_s^0 - \bar{B}_s^0$ system. Measurements of CP violating observables and other constraints from the decays $B_s^0 \to J/\psi K^*$, $B^+ \to J/\psi \pi^+$, $B_s^0 \to J/\psi K_S^0$ and $B^0 \to J/\psi \rho^0$ can be employed to put bounds on the possible pollution from Penguin topologies in measurements of ϕ_s and $\sin 2\beta$.

The LHCb experiment is collecting unprecedented samples of beauty baryons, allowing for the first time to study CP violating observables in their decays and to test the validity of the CKM mechanism in the baryon sector. First evidence for CP violation in the baryon sector has been observed using the decay mode $\Lambda_b^0 \to p\pi^-\pi^+\pi^-$.

Finally, LHCb also has the largest samples of charmed hadron decays collected by any experiment to date. These samples yield some of the world's most sensitive searches for direct and indirect CP violation in charm decays.

I intend to submit my contribution for the proceedings:

Yes

59

The LPPP - A Particle Physics Simulation for Outreach

Author: Harald Fox[1]

[1] *Lancaster University*

The Lancaster University HEP group has developed a particle physics simulation for UK based Masterclasses aimed at A-level students:
http://lppp.lancs.ac.uk/ The Lancaster Particle Physics Package is based on a toy Monte Carlo and takes students from the basic principles of particle kinematics to neutrino oscillations and Higgs branching ratios.
While being continuously updated and improved, the LPPP has been used in the UK for almost 20 years. In this talk the simulation is presented as well as use cases for outreach are given. The wider framework of its use within the Lancaster and UK outreach activities will be discussed.

I intend to submit my contribution for the proceedings:

Yes

60

Higgs phenomenology at the LHC using di-Higgs searches

Author: Yaquan Fang[1]

[1] *Institute of High Energy Physics*

The discovery of a light Higgs particle h0 (125 GeV) opens up new prospect for searching heavier Higgs boson(s) at the LHC Run-2, which will unambiguously point to new physics beyond the standard model (SM). We study the detection of a heavier neutral Higgs boson H0 via di-Higgs production channel at the LHC (14 TeV) with H0 → h0h0 →bbɣ ɣ ,W W*γ γ , WW*WW. *This directly probes the Hhh cubic Higgs interaction, which exists in most extensions of the SM Higgs sector. For the decay products of final states WW* ɣ ɣ, both pure leptonic mode WW→*lvlv and semi-leptonic mode WW*→qqlv are included. For WW*WW* analysis, only same signed di-lepton final state is considered. We analyze signals and backgrounds by performing fast detector simulation for the full process pp → H → hh over the mass range of MH from 250 to 600 GeV. For generic two-Higgs-doublet models (2HDM), we present the discovery reach of the heavier Higgs boson at the LHC Run-2, and compare it with the current Higgs global fit of the 2HDM parameter space. In addition, the impact of the h0 replaced by a scalar particle instead of 125 GeV will be briefly discussed.

I intend to submit my contribution for the proceedings:

Yes

61

Upgrade physics prospects at the ATLAS Experiment

Author: Victoria Martin[1]

[1] *University of Edinburgh*

Corresponding Author: victoria.martin@ed.ac.uk

The High Luminosity run of the Large Hadron Collider (LHC) will start in 2026 and aims to collect $3000\ \mathrm{fb}^{-1}$ of proton-proton collisions by 2037. This enormous dataset will increase the discovery potential of the LHC and allow precision measurements of Standard Model processes. However, the very high instantaneous luminosity of $5 - 7 \times 10^{34}\ \mathrm{cm}^{-2}\,\mathrm{s}^{-1}$ poses serious challenges in terms of high "pile-up" of 140 or 200 overlapping proton-proton collisions per bunch crossing inside the ATLAS detector.

In this talk, I will summarise the planned ATLAS detector upgrades and the analysis techniques, including pile-up mitigation, for High Luminosity-LHC running. I will also present the physics prospects for the ATLAS experiment, including results for precision measurements of the $125\ \mathrm{GeV}$ Higgs boson and the top quark, for vector boson scattering and the physics reach for supersymmetric and other beyond-the-Standard-Models.

I intend to submit my contribution for the proceedings:

No

62

Results on top-quark physics and top-quark-like signatures by CMS

Author: Eric Chabert[1]

[1] *IPHC/Unistra*

Corresponding Author: eric.chabert@cern.ch

A review of the CMS results on top quark physics will be presented focusing on the analyses based on the pp collisions at a center-of-mass of 13 TeV provided by the LHC at Run II. The presentation will cover the measurements of single-top, top quark pairs and associated productions as well as the measurement of top quark properties. Finally several beyond the standard model searches involving top quark in the final states will be presented such as searches for supersymmetry in the 3rd generation, heavy resonances decaying into a top quark pair, or dark matter produced in association to a single-top or a top quark pair.

I intend to submit my contribution for the proceedings:

No

63

Expansion of a plasma based on the Nambp-Jona-Lasinio Lagrangian

Author: Joerg Aichelin[1]

[1] *SUBATECH*

The study of the properties of the quark gluon plasma (QGP) at finite baryon chemical potential is one of the primary goals of the upcoming facilities at FAIR and NICA. Models predict that at finite chemical potential the phase transition between the partonic and hadronic world is of first order.If calculated beyond mean field level (arXiv:1601.01706) the Polyakov Nambu Jona-Lasinio Lagrangian (with parameters fixed by vacuum masses and decay constants) gives an equation of state at zero chemical potential which comes close to that of the lattice gauge calculations and shows a first order phase transition for finite baryon chemical potentials. Based on this Lagrangian we developed a transport theory (Phys.Rev. C87 034912) to study the expanding plasma at final chemical potential. Elastic and hadronisation cross sections are obtained from the Lagrangian without any new parameters. We compare the results of our approach with that of other transport theories for RHIC energies, report on how the cross sections and masses change as a function of the chemical potential and discuss how the expanding system passes over the phase transition.

I intend to submit my contribution for the proceedings:

Yes

64

Standard Model and Top Measurements in ATLAS

Author: kate shaw[1]

[1] *The International Centre for Theoretical Physics*

Corresponding Author: kshaw@ictp.it

Recent results from the ATLAS experiment at CERN on Standard Model and Top quark physics are presented, for analysis using the full 8 TeV dataset and fresh results from 13 TeV analysis.

I intend to submit my contribution for the proceedings:

Yes

Parallel Session V / 65

Results from ttH/VH searches in ATLAS

Author: Mirkoantonio Casolino[1]

[1] *IFAE - UAB*

Since the discovery of a Higgs boson by the ATLAS and CMS experiments at the Large Hadron Collider (LHC), the emphasis has shifted towards measurements of its properties and the search for less sensitive channels in order to explore any deviation from the Standard Model. The WH and ZH production modes, jointly denoted as VH, provide high sensitivity channels to observe Higgs boson decays to a bottom quark pair, which allows its coupling to quarks to be directly probed, as well as measuring its dominant decay mode. The associated production of the Higgs boson with top quarks (ttH) should also allow the direct observation of its coupling to top quarks. This channel also benefits from a large cross-section enhancement when increasing the LHC centre-of-mass energy from 8 to 13 TeV. ATLAS results covering the Higgs boson searches in the VH(H->bb) and ttH (H->bb, dibosons) channels will be presented, using approximately 13.2 fb-1 of pp collision data collected at the LHC with a centre-of-mass energy of 13 TeV.

I intend to submit my contribution for the proceedings:

Yes

66

Heavy Flavour spectroscopy at LHCb (including exotic states)

Author: Rafael Coutinho[1]

[1] *University of Zurich*

The LHCb experiment is designed to study the decays and properties of heavy flavoured hadrons produced in the forward region from pp collisions at the LHC. It has recorded the world's largest data sample of beauty and charm hadrons, enabling precise studies into the spectroscopy of such particles. The unique sample of $Lambda_b$ decays has led to the discovery of a new class of exotic baryon resonances in the $J/\psi p$ system. The status and latest results of the investigations of these states will be presented.

I intend to submit my contribution for the proceedings:

Yes

Plenary / **67**

STAR Beam Energy Sca

Corresponding Author: keane@kent.edu

Plenary / **68**

Status of the NICA Project

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Plenary / **69**

The Future Collider Program

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Parallel Session V / **70**

Exploring the top-Higgs FCNC couplings at colliders

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Parallel Session V / **71**

Using integral and differential charge asymmetries in searches for BSM physics at the LHC