BEACH 2016: XII International Conference on Beauty, Charm, Hyperons in Hadronic Interactions

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Book of Abstracts

Contents

73

ATLAS 750 GeV Analysis

Fuquan Wang[1]

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The observation of excess gamma-gamma events with an invariant mass around 750 GeV.

Summary:

55

Antihydrogen Studies in ALPHA

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The ALPHA antihydrogen experiment studies antihydrogen as a means to investigate the symmetry of matter and antimatter. Spectoscopic studies of antihydrogen holds the promise of the most precise direct comparisons of matter and antimatter possible. The ALPHA experiment was the first to trap antihydrogen in a magnetic trap, allowing the first ever detection of atomic transitions in an anti-atom. More recently, through stochastic heating, we have also been able to put a new limit on the neutrality of antihydrogen. ALPHA is currently preparing to perform the first laser-spectoscopy of antihydrogen, hoping to exite the the 2s state using a two-photon transition from the 1s state.

We will discuss the recent results as well as the key developments that led to these successes and discuss how we are preparing to perform the first laser-spectroscopy. We will also discuss plans to use our novel technique for gravitational tests on antihydrogen for a direct measurement of the sign of the gravitational force on antihydrogen.

Summary:

10

Baryonic B decays at LHCb

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The mechanisms behind baryonic decays of heavy flavoured particles remain mysterious and challenging to describe theoretically. Amongst interesting features observed by previous experiments it is worth mentioning the suppression of branching fractions to two-body final states and threshold enhancements in higher multiplicity decays. The large data sample accumulated by the LHCb experiment enables a variety of studies to be performed. The latest LHCb results on baryonic B decays are reviewed and discussed.

Summary:

31

Beauty mixing and CPV

Agnieszka Oblakowska-Mucha[1]

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LHCb has collected the world's largest sample of beauty hadrons. This sample is used to search for new sources of CP violation, and to measure $B^0_{d/s}$ mixing parameters. We present a selection of recent measurements performed by the LHCb experiment using the full Run 1 dataset. Among these: the measurements of the mixing-induced CP-violating phase ϕ_s in the $B^0_s - \bar{B}^0_s$ system using $B^0_s \to J/\psi hh$ (where $h = K$ or π) and $B^0_s \to D^+_s D^-_s$ decays, as well as several other modes including $B^0_s \to \psi(2S)\phi$. A good understanding of the pollution from sub-leading penguin topologies in the reference decay channels for the ϕ_s and $\sin 2\beta$ measurements can be achieved by measuring CP violation and polarization in the decay $B^0_s \to J/\psi K^*$, CP violation and branching fraction of the decay $B^+ \to J/\psi \pi^+$ and time dependent CP violation in $B^0_s \to J/\psi K^0_S$. These results together with constraints from $B^0 \to J/\psi \rho^0$ are used to put bounds on penguin pollution to ϕ_s and $\sin 2\beta$.

Summary:

23

Belle II PID systems

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A detector talk covering a system US institutions have played a large role in: Cincinnati, Hawaii, PNNL, South Carolina, Pittsburgh, Mississippi, and Indiana worked on the barrel TOP detector.

Summary:

22

Belle II Physics prospects, status, schedule

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Physics prospects, status, and schedule for Belle II

Summary:

24

Belle II muon detection

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A detector talk covering a system US institutions have played a large role in: VPI and Hawaii worked on the muon system upgrade.

Summary:

20

Charm Physics at BESIII

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The BESIII Experiment at the Beijing Electron Positron Collider (BEPCII) has accumulated the world's largest e+e- collision samples at ψ(3770) peak, around the ψ(4040) nominal mass, and at the Λc-pair mass threshold which allow us to study decays of charmed mesons and baryons in a uniquely clean background. In this talk, we will review our recent results including: (1) the extractions of the D(s)+ decay constants, the form factors of D semi-leptonic decays, and the CKM matrix elements |Vcs(d)|; (2) the measurements of the strong phase and D 0 D 0 -bar mixing parameters using quantum coherence; (3) the determinations of the absolute branching fractions of the hadronic and semi-leptonic decays of Λc+.

Summary:

59

Charm and beauty production at an Electron-Ion Collider

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An Electron_Ion Collider (EIC) with center-of-mass energy 20-100 GeV (eN) and luminosity ~10^34 cm^{-2} s^{-1} is being developed as a future facility for high-energy nuclear physics in the U.S. and worldwide. It would enable novel studies in charm and beauty physics over a wide kinematic range, using both deep-inelastic electroproduction and photoproduction, at ~10^3 times the luminosity of

the HERA collider. Present R&D focuses
on using open charm and beauty production as a probe of the gluon density in the proton and in nuclei, especially in the region x >~ 0.1 [1]. Other possible physics applications include heavy quarkonium production and spectroscopy, as well as heavy baryon production. In this talk we summarize (a) the expected heavy quark production rates at EIC; (b) the possible methods of open charm/beauty reconstruction at EIC and their requirements; (c) prospects for using charm/beauty to constrain gluons at x > 0.1; (d) production of charm/beauty baryons in the target fragmentation region; (e) other applications of charm/beauty production at EIC.

Summary:

28

Charm mixing and CPV

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LHCb has collected the world's largest sample of charmed hadrons. This sample is used to search for direct and indirect CP violation in charm, and to measure neutral D-meson mixing parameters. New measurements from several decay modes are presented, with complementary time-dependent and time-integrated analyses.

Summary:

11

Charmless b-meson and b-baryon decays at LHCb

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Charmless b-meson and b-baryon decays to pseudoscalar or vector mesons proceed via suppressed b—>u tree and b—>s,d penguin diagrams, and are sensitive probes of physics beyond the Standard Model. Relevant observables are branching fractions, CP asymmetries, polarisation fractions and T-odd correlations. Unexpected values of these observables have the potential to reveal New Physics. Moreover the sector of charmless b-baryon decays is almost unexplored and peculiar to LHCb. We present the latest LHCb results with these decays obtained using the data sample collected during the first run of the LHC.

Summary:

40

Dark sector searches at Jefferson Laboratory

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The nature of Dark Matter is one of the prominent open-questions in physics at present: although gravitational observations proof that matter in our Universe is mainly made of DM, very little is known about it. While most of "traditional" DM experiments are designed and optimized to prove the weak-force mass scale, O(100 GeV), the light DM
(LDM) region, O(10 MeV - 1 GeV) is, so far, almost unexplored. This hypothesis is a compelling possibility for new physics, and a rich experimental program is currently being proposed and developed to investigate it.

The Jefferson Laboratory community joined this program with different, complementary efforts. The APEX, HPS, and DarkLight experiments are searching for a possible U(1) force-mediator between the dark sector and SM, the "dark photon" or A'. These experiments looks for the visible dark photon decay to SM particles, mainly in the $A' \to e^+e^-$ channel.
The BDX experiment, instead, is a beam-dump experiment looking directly for the LDM scattering on a detector, resulting in a visible energy release.

In the talk, I'll discuss in details these efforts, showing the different experimental approaches and presenting the current status and the foreseen results.

Summary:

61

Double charmonium production at LHC

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Theory

Summary:

67

Effects of scalar leptoquarks in b -> s mediated rare B decays

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The rare decays of B mesons involving flavor changing neutral current (FCNC) transitions
b -> s, d, provide an excellent testing ground to look for new physics.
Although, so far we have not seen any clear indication of new physics in the b-quark sector, but there appears to be some kind of tension with the SM predictions in some b -> s penguin induced transitions. In particular, the recent measurements by LHCb collaboration show several significant deviations in semileptonic B meson decays involving the quark level transition b -> s \mu^+ \mu^-, from their corresponding SM expectations. Although it is conceivable that these anomalies could be due to statistical fluctuations or under-estimated theory uncertainties, but the possible interplay of new physics could not be ruled out. We consider the possible implications of scalar leptoquarks in order to understand these anomalies. We constrain the leptoquark parameter space using the measured branching ratios of B_{s,d} -> \mu^+ \mu^- processes by the CMS and LHCb collaborations and

we show that these anomalies can be accommodated in this model.Furthermore, we also investigate the lepton flavor violating rare B decays, e.g., as B -> K l_i^- l_j^-, which occur at tree level in the leptoquark model and are found to be within the experimental reach of B-factories

Summary:

56

Hadron Scattering, Resonances and QCD

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The non-perturbative nature of quantum chromodynamics (QCD), has historically left a gap in our understanding of the connection between the fundamental theory of the strong interactions and the rich structure of experimentally observed phenomena. For the simplest properties of stable hadrons, this is now circumvented by utilizing lattice QCD. In this talk I outline a path towards a rigorous determination of few-hadron observables from lattice QCD. I will illustrate the power of this methodology by presenting recently determined scattering amplitudes in the light-meson sector and discuss their resonance content. I will present the first determination of a electroweak form factor of a hadronic resonance from QCD. Finally, I give an outlook of this emergent field.

Summary:

27

Hadron Spectroscopy and exotics at LHCb

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The LHCb experiment is designed to study properties and decays of heavy flavoured hadrons produced from pp collisions at the LHC. During Run-1, it has recorded the world's largest data sample of beauty and charm hadrons, enabling precise spectroscopy studies of such particles. The discovery of the first pentaquark states and the first unambiguous determination of the Zc(4430) as an exotic state obtained by LHCb have dramatically increased the interest for the spectroscopy of heavy hadrons. An overview of the latest LHCb results on the subject is presented.

Summary:

see Content

33

Heavy flavour production in pp and pPb collisions

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The physics programme of the LHCb experiment has been expanded recently to new areas, notably including heavy ion data. In this talk we present measurements of heavy flavour production in pp collision at various centre-of-mass energies. These results are important inputs for QCD effective models predicting the production cross-sections and polarisations of heavy flavoured hadrons. Furthermore, we present measurements of nuclear modification factors and forward-backward asymmetries for Υ, prompt and displaced J/ψ and $\Psi(2S)$, and prompt D^0 meson production in pPb collisions.

Summary:

47

Higher order effects in epsilon'/epsilon

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The quantity ε'/ ε measures direct CP violation in Kaon decays. Recent analysis of this ratio did result in a 2.9 sigma discrepancy between the Standard Model predictions and the experimental data. Our ability to observe or constrain New Physics depends on the accuracy of determining the SM "background", so precise evaluation of ε'/ ε in this framework is particularly important. In this talk I will discuss the Standard Model prediction and the relevant matching calculations at NNLO.

Summary:

66

Implications of Lepton nonuniversality in Flavor sector

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The results from B factories provided the confirmation of the Cabibbo-Kobayashi-Maskawa mechanism of CP violation in the framework of the standard model. LHCb has also started contributing in this direction and all the results obtained so far are in agreement with the standard model (SM) expectations and there is no clear sign/ indication of physics beyond the SM, even though there are few cases in which the SM predictions and data differ by few sigma. Whether these will lead to some beyond SM signal, with accumulation of more data in LHCb and Belle-II, or not it is difficult to conclude. However, in this work we will consider the deviation observed (in Belle, Babar and LHCb) in the lepton nonuniversality of b-> c transitions, which appears to be more than 3 sigma at this point of time (in the form R_D and R_D* discrepancy). We employ model independent method and model dependent method to find out any clue to the nature of new physics. In this context we have used Left Right symmetric model, which appears to be one of candidates for physics beyond the SM.

Summary:

46

Kaonic atoms and strangeness in nuclei: SIDDHARTA-2 and AMADEUS experiments

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The dynamics of the strong interaction processes in the non-perturbative regime is currently described by lattice calculations and effective field theories (ChPT), still lacking several experimental results, fundamental for reaching a good understanding of the strangeness sector. Among these, the information provided by the low-energy kaon nucleon/nuclei interaction, accessible through the study of kaonic atoms and kaonic nuclear processes, plays a key-role. The lightest atomic systems, namely the kaonic hydrogen and the kaonic deuterium, provide in a model-independent way the isospin-dependent kaon-nucleon scattering lengths, through the timed X-ray spectroscopy of the exotic atoms during their de-excitation to the fundamental level.

The most precise kaonic hydrogen measurement to-date, together with an exploratory measurement of kaonic deuterium and of upper-level transitions in kaonic helium 3 and kaonic helium 4 were carried out at the DAFNE collider by the SIDDHARTA collaboration. The experiment took advantage of the monochromatic charged kaon beam provided by DAFNE and of the new, fast, spectroscopic SDD detectors developed by the collaboration. Presently, a significantly upgraded setup, developed by the SIDDHARTA-2 collaboration, is ready to perform a precise measurement of kaonic deuterium and, afterwards, of heavier exotic atoms.

In parallel, the kaon-nuclei interaction at momenta below 130 MeV/c is studied by the AMADEUS collaboration, using the KLOE detector and a dedicated setup inserted in the central region, near the interaction point. Preliminary results of the study of charged antikaons interacting with nuclei are shown, including an analysis of the still controversial Lambda 1405. Future experimental plans will be introduced, as well.

Summary:

Progress and perspectives in the low-energy kaon-nucleon/nuclei interaction studies at the DAFNE collider will be presented.

54

Latest (Anti-)Neutrino Oscillation Results from T2K

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The T2K long-baseline neutrino oscillation experiment has been running in anti-neutrino mode since 2014 in order to perform an electron anti-neutrino appearance search, which is an essential step to a lepton CP-violation measurement, as well as a muon anti-neutrino disappearance measurement, which could be different from that of neutrinos if CPT symmetry is violated or unknown neutrino-matter interactions exist. Results with anti-neutrino data taken through summer 2015, analyzed in the three-flavour framework, will be presented along with the results from neutrino data to obtain world-leading measurements of δCP , θ23 and Delta m_32.

Summary:

74

Light hadron Spectroscopy and XYZ states at BESIII

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The BESIII experiment at the electron positron collider BEPCII in Beijing is successfully operating since 2008 and has collected large data samples in the tau-mass region, including the world's largest data samples at the J/ψ and ψ(2S) resonances. In particular decays of these two resonances provide a rich and clean environment to study hadrons consisting out of light quarks and search for exotics. The BESIII collaboration has recently started a campaign to understand the nature of the X(1835) and Y(2175) resonances, which are debated to be exotic matter. Further, decays of η' mesons are studied to deepen our knowledge of their structure and possible symmetry breaking effects in their decays. The BESIII Experiment also collected large data samples for electron-positron collisions with center-of-mass above 4 GeV during 2013 and 2014. The analysis of these samples has resulted in a number of surprising discoveries, such as the discoveries of the electrically charged "Zc" structures, which, if resonant, cannot be accomodated in the traditional charm quark and anti-charm quark picture of charmonium. In this talk, we highlight recent results of the light hadron physics program and review the current status of the analyses of the Zc structures, as well as a number of other interesting features in the new BESIII data
samples.

Summary:

3

Low-energy hadronic cross sections measurements at BABAR, and implication for the g-2 of the muon

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The BABAR Collaboration has an intensive program studying hadronic cross sections in low-energy e+e- annihilations, accessible via initial-state radiation.
Our measurements allow significant improvements in the precision of the predicted value of the muon anomalous magnetic moment.
These improvements are necessary for shedding light on the current ~3 sigma difference between the predicted and the experimental values.
We have published results on a number of processes with two to six hadrons in the final state, and other final state are currently under investigation.
We report here on the most recent results obtained by analysing the entire BABAR dataset.

Summary:

30

Measurement of CPV gamma angle

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The angle γ is the least experimentally known parameter in the CKM unitarity triangle. Its determination in decays induced by tree-level b⟶c and b⟶u transitions is largely unaffected by new physics contributions. The ultimate goal of reaching a degree-level precision requires the exploitation of all possible channels and techniques. We present here the latest measurements on the CKM angle γ in a diverse range of decay modes, notably including the measurement of γ from the $B \to DK$ and related modes and from Dalitz plot analyses of $B^0 \to DK\pi$ and $B^0 \to DK^*$ decays. We also present the combination of all LHCb γ related measurements, which is the most precise single experiment combination to date.

Summary:

13

Measurement of W- and Z-boson production in p-Pb collisions with ALICE at the LHC

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The high collision energies available at the LHC allow for an abundant production of hard probes, such as quarkonia, high-p_{T} jets and vector bosons (W, Z), which are produced in initial hard parton scattering processes. The latter decay before the formation of the Quark-Gluon Plasma (QGP), which is a deconfined phase of QCD matter produced in high-energy heavy-ion collisions. Furthermore, their leptonic decay products do not interact strongly with the QGP. The electroweak bosons introduce a way for benchmarking in-medium modifications to coloured probes. In Pb–Pb and p–Pb collisions, precise measurements of W- and Z-boson production can constrain the nuclear Parton Distribution Functions (nPDFs), which could be modified with respect to the nucleon due to shadowing or gluon saturation, and they can be used to test the scaling of hard particle production with the number of binary nucleon–nucleon collisions. Especially in p–Pb collisions, the measurement of W yields at forward and backward rapidity allows us to probe the modification of nPDFs at small and large Bjorken-x, respectively. Such measurements can be benchmarked in pp collisions, where W- and Z-boson production is theoretically known with good precision. Also, the charge asymmetry of leptons from W-boson decays is a sensitive probe of up and down quark densities in a nucleon inside a nucleus.

The production of W- and Z-boson in p–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$~TeV is measured with the ALICE muon spectrometer via the inclusive p_{T}-differential muon yield and the invariant mass of opposite-sign muon pairs, respectively. The results will be presented at forward rapidity (p-going direction, $2.03 < y^{\mu}_{\mathrm{cms}} < 3.53$) and backward rapidity (Pb-going direction, $-4.46 < y^{\mu}_{\mathrm{cms}} < -2.96$), this rapidity region being complementary to the one of ATLAS and CMS. Comparisons with model calculations accounting for the nuclear modification of the PDFs and the W production as a function of the event activity will be discussed.

Summary:

45

Measurement of open heavy-flavour production with ALICE at the LHC

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The main goal of the ALICE experiment is to study the properties of the strongly-interacting matter, usually referred to as the Quark-Gluon Plasma (QGP), created in high-energy heavy-ion collisions. Heavy quarks, i.e. charm and beauty quarks, are good probes of the QGP as they are produced in the early stage of the collisions and witness the entire space-time evolution of the system. In particular, the study of heavy-flavour production in Pb-Pb collisions allows us to understand the energy loss mechanism of the heavy quarks inside the QGP by measuring the particle transverse momentum spectra in Pb-Pb collisions with respect to the corresponding cross section in pp collisions scaled by the nuclear overlap function. The angular distribution of open heavy-flavour particles gives information regarding the collective motion of heavy quarks inside the medium. Angular correlations of heavy-flavour particles with hadrons provide more differential information on collective phenomena and energy loss mechanisms for heavy quarks. Measurements in p-Pb collisions help us to understand cold nuclear matter effects such as modifications of the parton distribution function (PDF) in nuclei, energy loss and momentum broadening. Corresponding measurements in pp collisions provide a very good baseline to understand the results in Pb-Pb collisions and a very powerful tool to test perturbative QCD (pQCD) calculations. Measurements of open heavy-flavour particles as a function of charged-particle multiplicity in pp and p-Pb collisions allow us to study the interplay between the hard and soft processes in heavy-flavour production.

In ALICE, open heavy-flavour production is studied through the measurements of the heavy-flavour decay leptons (electrons and muons) at central and forward rapidity and via the reconstruction of D-meson hadronic decays at central rapidity. An overview of the open heavy-flavour production with ALICE in pp ($\sqrt{s}$ = 2.76 TeV and 7 TeV), p-Pb ($\sqrt{s_{\rm NN}}$ = 5.02 TeV) and Pb-Pb ($\sqrt{s_{\rm NN}}$ = 2.76 TeV) collisions will be presented. We will discuss the production cross sections, modifications of the transverse momentum distributions, azimuthal anisotropic emissions and correlations with hadrons in comparison with various theoretical predictions.

Summary:

21

Measurement of the pion form factor in the rho-peak region relevant for (g-2)mu

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Measurements of the cross section e+e- –> pi+pi-, i.e. of the pion form factor, are known to be decisive for the hadronic contribution of the anomalous magnetic moment of the muon, (g-2)mu. We present a new measurement of the pion form factor at BESIII in the energy range between 600 and 900 MeV, which corresponds to the peak region of the rho and omega resonances. The method of initial state radiation has been exploited in this measurement and a systematic uncertainty of 0.9% has been achieved. The impact of the new BESIII data on (g-2)mu as well as a comparison to existing data of the KLOE, BABAR, and VEPP-2M collaborations is presented.

Summary:

6

Mixing and CP violation in the B0 and B0s systems at ATLAS

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[with a not-yet defined ATLAS speaker]
Search for deviations from the standard model is performed in the systems of the neutral B mesons. The Bs system is studied in the decay into J/psi phi. The mixing phase phi_s and the width difference DeltaGamma_s are determined through the simultaneous study of angular distributions in the final state and of the decay time, performed together with flavour tagging at production. The measurement performed by ATLAS with the full LHC Run-1 sample is discussed and compared to the previous world average. The width difference DeltaGamma_d in the Bd system is obtained from the comparison of the decay time distributions in the flavour specific state J/psi K* and in the CP eigenstate J/psi KS. The result obtained from the full sample of data collected by ATLAS at 7 and 8 TeV is the most accurate single measurement of the width difference currently available.

Summary:

72

Modeling new XYZ states at JPAC

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The past decade witnessed a remarkable proliferation of exotic quarkonium-like resonances discovered at accelerators. In particular, the observed charged states are clearly not interpretable as QQbar mesons. Notwithstanding the considerable advances on the experimental side, conflicting theoretical descriptions do not seem to provide a definitive picture about the nature of the so-called XYZ particles. We show how to interpret data in terms of compact four-quark particles (tetraquarks), and how the role played by thresholds can be taken into account. We also summarize the other efforts of the Joint Physics Analysis Center (JPAC) in hadron spectroscopy.

Summary:

16

Neutral pion form factor measurement by the NA62 experiment

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The NA62 experiment at CERN collected a large sample of charged kaon decays with a highly efficient trigger for decays into electrons in 2007. The kaon beam represents a source of tagged neutral pion decays in vacuum. A measurement of the electromagnetic transition form factor slope of the neutral pion in the time-like region from ~1 million fully reconstructed pi0 Dalitz decay is presented.

The limits on dark photon production in pi0 decays from the earlier kaon experiment at CERN, NA48/2, are also reported.

Summary:

71

On the Standard Model predictions for R_K and R_K*

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In this talk I review our recent work where we evaluate the impact of radiative corrections in R_K and R_K*.
We find that, employing the cuts presently applied by the LHCb Collaboration, such corrections do not exceed a few percent. Moreover, their effect is well described (and corrected for) by existing Montecarlo codes. Our analysis reinforces the interest of these observables as clean probe of physics beyond the Standard Model.

Summary:

14

Physics Opportunity with an Electron-Ion Collider

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Understanding the emergence of nucleons and nuclei and their interactions from the properties and dynamics of quarks and gluons in Quantum Chromo-Dynamics (QCD) is a fundamental and compelling goal of nuclear science.
A high-energy, high-luminosity polarized electron-ion collider (EIC) will be needed to explore and advance many aspects of QCD studies in the gluon dominated regions in nucleon and nuclei.

The federal Nuclear Science Advisory Committee unanimously approved a high-energy electron ion collider to explore a new frontier in physics research. In fact, the committee calls the collider the country's next "highest priority" in new facility construction, and is one of four main recommendations contained in its 2015 Long Range Plan for Nuclear Science.
Two proposals for the EIC are being considered in the U.S.: one each at Jefferson Laboratory and at Brookhaven National Laboratory.

In this presentation I will provide an overview of the physics opportunities an EIC presents to the nuclear science community in future decades and review the Jefferson Lab proposal and its implementation plan.

Summary:

35

Production asymmetries of b and c hadrons at LHCb

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The production rates of b and c-hadrons in pp collisions are not expected to be identical to those of $\bar{b}$ and $\bar{c}$-hadrons due to the fact that there can be coalescence between a heavy quark produced in the hard scattering and u and d valence quarks in the remnant of colliding protons. In this talk we present the latest LHCb measurements on production asymmetries of b and c-hadrons.

Summary:

7

Production of exotic and conventional quarkonia and open beauty/open charm at ATLAS

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[with a not-yet defined ATLAS speaker]
ATLAS has a wide programme to study the production properties of conventional and exotic quarkonium, beauty, and charm bound states. This presentation will cover the latest results on J/psi, psi2s and Upsilon production at 7, 8, and 13 TeV, D meson and X(3872) production with Run-1 data, B+ production at 13 TeV, and studies of associated production of quarkonium with other heavy flavour states or vector bosons.

Summary:

60

Prospects for Measuring BR(KL -> pi0 nu nu) at the CERN SPS

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The feasibility of measuring of BR($K_L^0 \to \pi^0 \nu\overline{\nu}$) using a high-energy secondary neutral beam at the CERN SPS is being studied. Assuming reuse of
the NA48 liquid-krypton calorimeter and some of the NA62 infrastructure, the studies suggest a sensitivity approaching that proposed by KOTO Step 2 is achievable in five years of running. We summarize the studies thus far carried out.

Summary:

Welcome / 70

Provost's Welcome

David Wu[1]

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32

Radiative decays (Bs → φγ)

Violaine Bellee[1]

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Radiative b-hadron decays are sensitive probes of New Physics through the study of branching fractions, CP asymmetries and photon polarisation measurements. During the LHC Run 1, the LHCb experiment has collected large samples of radiative b-hadron decays. We present the latest LHCb measurements, including new results on the time dependence of Bs → φγ decays. These results help to constrain the size of right-handed currents in extensions of the Standard Model.

Summary:

5

Rare and semi-rare B meson decays at ATLAS

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[with a not-yet defined ATLAS speaker]
Processes involving the FCNC transitions in b-hadron decays are suppressed in the SM and are sensitive to new physics. New results in the search for the rare decays of Bs and Bd into mu+mu- are presented. They are based on the full sample of data collected by ATLAS at 7 and 8 TeV collision energy. The consistency with the SM and with other available measurements is discussed. The properties of the decay of the Bd meson into K*mu+mu- are also sensitive to the presence of New Physics in loops and has received renewed interest because of possible deviations from the standard model in this decay observed by LHCb. We present recent results obtained by ATLAS, concerning the angular distribution parameters FL, S_i and P'_i in the region Q^2(mu+mu-)<6 GeV^2.

Summary:

34

Rare decays at LHCb

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Rare decays of beauty and charm hadrons test the flavour structure of the underlying theory at the level of quantum corrections. They provide information on the couplings and masses of heavy virtual particles appearing as intermediate states. A review of recent results obtained by LHCb on these topics will be presented.

Summary:

1

Recent BABAR results on mixing and CP violation in the charm sector

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Based on the full data set recorded with the BABAR detector at center-of-mass energies at
and near the Upsilon(4S) resonance, and corresponding to an integrated luminosity of approximately 468 fb-1,
we measure the D0-D0bar mixing parameters using a time-dependent amplitude analysis of the decay D0 -> pi+pi-pi0.
The neutral D meson candidates are selected from D*(2010)+ -> D0 pi+ decays where the
flavour at the production is identified by the charge of the low-momentum pion.
With the same data set we perform an analysis of CP-asymmetries in the singly Cabibbo-suppressed decay process D+ -> pi+ pi0. We discuss the sensitivity to CP-violating phases, and the corresponding New Physics constraints.

Summary:

63

Recent Heavy Flavor Measurements from PHENIX at RHIC

Tristan Haseler[1]

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Heavy flavor quarks are an important probe of the initial state of the Quark Gluon Plasma formed in heavy-ion collisions. b and c quarks are primarily produced through hard interactions, early in the collision and experience the full time evolution of the medium. Measuring their production in $p+p$ collisions can also give a baseline reference to study larger collision systems, including asymmetric systems and can directly test pQCD calculations.

At PHENIX, both open heavy flavor and quarkonia states can be measured through leptonic decay channels. Some measurements have utilized silicon vertex detectors to determine meson decay lengths in order to separate D mesons from B mesons. Recent measurements have been made in the range of $\sqrt{s_{NN}} = 193 - 510$ Gev, with a variety of collision species, in both forward/backward

and central rapidity ranges. In this talk, a review of the recent heavy flavor measurements from PHENIX will be presented.

Summary:

62

Recent Results from the Daya Bay Reactor Neutrino Experiment

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.The Daya Bay Reactor Neutrino Experiment is designed to precisely measure the mixing parameter $\sin^2 2\theta_{13}$ via relative measurements with eight identically designed antineutrino detectors (ADs).
In 2012, Daya Bay first observed a non-zero $\sin^2 2\theta_{13}$ value with a significance larger than 5σ with the initial six ADs.
With the installation of two new ADs to complete the full configuration, Daya Bay is continuing to increase statistics and lower systematic uncertainties for better precision of $\sin^2 2\theta_{13}$ and for the exploration of other physics topics.
In this talk, I will present the latest analysis results of $\sin^2 2\theta_{13}$ and $|\Delta m^2_{ee}|$, including a measurement made with neutron capture on Gadolinium and an independent measurement made with neutron capture on hydrogen.
The latest results of the search for sterile neutrino in the mass splitting range of 10^{-3} eV^2 $< |\Delta m^2_{41}| < 0.3$ eV^2 and the absolute measurement of the rate and energy spectrum of reactor antineutrinos will also be presented.

Summary:

The latest results of Daya Bay on the measurements of oscillation parameters, the search for sterile neutrino, and the measurement of reactor neutrino spectrum will be presented.

75

Recent results on Lambda_c decays at BESIII

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As the lightest and most common example, the ^+_c plays a key role in our understanding of the charmed baryons. The BESIII detector has collected a sample of 597 pb^{-1} of e^+e^- annihilation data near $^+_c\bar{\Lambda}^-_c$ threshold. Using a double-tag technique, we make absolute measurements of twelve Cabibbo-favored ^+_c hadronic decay modes, including the golden reference mode, pK^{-+}, for which we find $B(^+_c \to pK^{-+}) =$ (5.84 ± 0.27(stat) ± 0.23(syst))%. We also determine $B(^+_c \to e^+{}_e) =$ (3.63 ± 0.38(stat) ± 0.20(syst))%. Preliminary results for other final states, including $nK_S{}^+$, will also be presented, along with future prospects.

Summary:

42

Recent selected results from Belle

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The Belle experiment, with the largest B meson decay events from e+e- collision, has produced numerous results that contributed to new understanding of heavy-flavor physics, including observations of CP violations in B system with subsequent confirmation of Kobayashi-Maskawa mechanism, discoveries of several electroweak penguin decays and a series of exotic charmonium-like and bottomonium-like hadrons, as well as the first evidence of mixing in D0 mesons. Moreover, Belle has also discovered semileptonic decays of B mesons to final states involving a tau lepton, which are sensitive to New Physics scenarios with an extended Higgs sector, such as the type II two Higgs doublet model. In this talk we report a selection of new and updated results from Belle, including the new measurement of $B \to D^* \tau \nu$ with semileptonic tagging and updated measurement of electroweak penguin decays $B \to K^* l^+ l^-$, based on the large data sample accumulated by the Belle experiment at the KEKB collider at KEK, Japan.

Summary:

64

Results from the OPERA experiment in the CNGS beam

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The OPERA experiment at the Gran Sasso underground laboratory has recently established nu_mu -> nu_tau oscillations in appearance mode with a significance of 5.1 sigma thanks to the observation of five signal candidate events in a sample with a signal-to-background ratio of about ten.

The nu_tau data analysis will be discussed, with emphasis on the background constraints obtained by using dedicated data-driven control samples. The analysis of the nu_mu->nu_e channel, formerly based on the first two years of run, has been extended over the full data set with a more than twofold increase in statistics. The implications of the tau neutrino and electron neutrino samples in the framework of the 3+1 sterile model will be discussed.

The Collaboration is also focusing on the characterization of nu_tau-like interactions failing the kinematical analysis defined in the experiment proposal to obtain a statistically enhanced, lower purity, signal sample. One such interesting neutrino interaction with a double vertex topology will be presented. Finally, topics in the analysis of the OPERA cosmic ray sample will be covered.

Summary:

The results achieved by the OPERA experiment at the Gran Sasso underground laboratory are reviewed and updated.

17

Search for K+ to pi+ nu nu at NA62

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K+->pi+nunu is one of the theoretically cleanest meson decay where to look for indirect effects of new physics complementary to LHC searches. The NA62 experiment at CERN SPS is designed to measure the branching ratio of this decay with 10% precision. NA62 took data in pilot runs in 2014 and 2015 reaching the final designed beam intensity. The quality of data acquired in view of the final measurement will be presented.

Summary:

53

Search for Scalar Top-Quark Production in the all Hadronic Channel at 13 TeV

Author(s): Scarlet Rachel Norberg[1]

Co-author(s): Florent Sylvain Lacroix [2] ; Hongxuan Liu [3] ; Hua Wei [2] ; Kenichi Hatakeyama [3] ; Koushik Mandal [4] ; Nadja Strobbe [5] ; Nathaniel Joseph Pastika [3] ; Richard Cavanaugh [6] ; Victor Daniel Elvira [5] ; Zhenbin Wu [6]

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A search for top squarks in events with jets and missing transverse momentum is presented. The data were collected in proton-proton collisions at a center-of-mass energy of 13 TeV with the CMS detector at the LHC and correspond to an integrated luminosity of 2.3 fb^{-1}. Events are categorized by the properties of reconstructed jets, the presence of top quark candidates, and missing transverse momentum. No statistically significant excess of events above the expected contribution from standard model processes is observed. Exclusion limits are set in the context of simplified models of top squark pair production.

Summary:

A search for top squarks in events with jets and missing transverse momentum is presented. The data were collected in proton-proton collisions at a center-of-mass energy of 13 TeV with the CMS detector at the LHC and correspond to an integrated luminosity of 2.3 fb^{-1}. Events are categorized by the properties of reconstructed jets, the presence of top quark candidates, and missing transverse momentum. No statistically significant excess of events above the expected contribution from standard model processes is observed. Exclusion limits are set in the context of simplified models of top squark pair production.

8

Searches for heavy quark states at ATLAS

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[with a not-yet defined ATLAS speaker]
Latest results in the ATLAS programme of heavy hadron production and spectroscopy are presented. These include the latest searches for the bottomonium counterpart to the X(3872), studies of B_c and Lambda_b decays, measurement of b-quark fragmentation functions, and searches for new exotic bound states.

Summary:

15

Searches for lepton number violation and resonances in the K+- –>pi mu mu decays at the NA48/2 experiment

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The NA48/2 experiment at CERN collected a large sample of charged kaon decays into final states with multiple charged particles in 2003-2004.
A new upper limit on the rate of the lepton number violating decay K+- –> pi-+ mu+- mu+- obtained from this sample is reported: 8.6 × 10^–{11} at 90% CL, which improves by more than an order of magnitude
upon the previous measurements. Searches for two-body resonances in the K+- –>pi mu mu decays (including heavy neutral leptons and inflatons) in the accessible range of masses and lifetimes are also presented.

Summary:

38

Semileptonic asymmetries in B decays

Jack Wimberley[1]

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Measurements of CP violation in neutral B-meson mixing are excellent probes to search for physics beyond the Standard Model. Recent measurements of the semileptonic asymmetries, Asls and Asld, obtained using the full Run 1 dataset collected by the LHCb experiment are presented.

Summary:

58

Status of Pion Decay Experiments

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The present status of pion decay experiments will be discussed.
The focus will be on precision tests of electron-muon universality
in weak interactions via measurements of the branching ratio
R=(pi−>e nu)/(pi ->mu nu). A recent TRIUMF measurement provided an
improved precision of 0.12 % in the ratio of g_e/g_mu. A further
improvement is expected in the future analysis based on more data.

Summary:

T1 / 0

Study of rare B decays at BABAR

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We present results on radiative and electroweak-penguin decays based on the full BABAR dataset. The decays B->K* l+l- (both charged and neutral modes) are studied using an angular analysis to extract the quantities A_FB and F_L, which are sensitive to potential effects of physics beyond the Standard Model. Furthermore, the quantity P_2, which is subject to smaller theoretical uncertainties and is more sensitive to non-SM contributions, is extracted.
We also present the first search for B+ -> K+ tau+ tau-, where one B meson from the decay of Y(4S) -> B+ B- in a hadronic decay mode is fully reconstructed, and the topology of the rest of the event is compatible with a B+ -> K+ tau+ tau- decay and leptonic decays of the tau leptons.
Finally, we report on measurement of the CP asymmetry in the radiative decay B0->Ks0 pi- pi+ gamma, a quantity that is sensitive to possible processes where non-SM photon helicities are involved. The structure of the hadronic final state is studied using the isospin-related decay B+ ->K+ pi- pi+ gamma. Along with the branching fractions of the charged and neutral decays, we present the CP asymmetry for events selected in the rho mass band, S_{KS pi+ pi- gamma}, and finally extract the contribution from decay to the CP eigenstate, B0 -> KS rho gamma.

Summary:

29

Test of Lepton Flavour Universality with B decays

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Lepton flavour universality (LFU) is one of the distinctive features of the Standard Model. Any violation of LFU would be a clear sign of new physics. Existing hints of non universality are already present in the leptonic and
semileptonic sectors. Semitauonic decays, in particular, are sensitive to contributions from non-Standard-Model particles that preferentially couple to the third generation of fermions, e.g. Higgs-like charged scalars. An overview of the latest LHCb results is presented.

Summary:

65

The DUNE Experiment

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The Long Baseline Neutrino Facility (LBNF) will consist of a 1.2-megawatt proton beam neutrino source at Fermilab in Illinois, sending high-energy neutrinos to large liquid argon detectors located 1300 kilometers away and a mile underground at the Sanford Underground Research Facility in South Dakota. The detectors will be constructed and operated by the international Deep Underground Neutrino Experiment (DUNE) collaboration. The principle goals of this experiment are a comprehensive investigation of neutrino oscillations to test CP violation in the lepton sector, determining the ordering of the neutrino masses, and testing the three-neutrino paradigm. The experiment will perform a broad set of neutrino scattering measurements with the near detector and exploit the large, high-resolution, underground far detector for non-accelerator physics topics including atmospheric neutrino measurements, searches for nucleon decay, and measurement of astrophysical neutrinos especially those from a core-collapse supernova.

Summary:

The Long Baseline Neutrino Facility (LBNF) will consist of a 1.2-megawatt proton beam neutrino source at Fermilab in Illinois, sending high-energy neutrinos to large liquid argon detectors located 1300 kilometers away and a mile underground at the Sanford Underground Research Facility in South Dakota. The detectors will be constructed and operated by the international Deep Underground Neutrino Experiment (DUNE) collaboration.
The principle goals of this experiment are a comprehensive investigation of neutrino oscillations to test CP violation in the lepton sector, determining the ordering of the neutrino masses, and testing the three-neutrino paradigm. The experiment will perform a broad set of neutrino scattering measurements with the near detector and exploit the large, high-resolution, underground far detector for non-accelerator physics topics including atmospheric neutrino measurements, searches for nucleon decay, and measurement of astrophysical neutrinos especially those from a core-collapse supernova.

43

The KLOE-2 experiment at DAFNE

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The KLOE-2 experiment at the INFN Laboratori Nazionali di Frascati (LNF) is currently taking data at the upgraded e+e- DAFNE collider.

KLOE-2 represents the continuation of KLOE with a new physics program mainly focused on the study of K short, η and η′ decays as well as on kaon interferometry, test of discrete symmetries, and search for physics beyond the Standard Model. The new data taking campaign aiming to collect more than 5 fb-1 integrated luminosity in the next 2-3 years, will allow
in particular to perform CPT symmetry and quantum coherence tests using entangled neutral kaons with an unprecedented precision.

The general purpose KLOE detector, composed by one of the biggest Drift Chamber ever built surrounded by a lead-scintillating fiber Electromagnetic Calorimeter among the best ones for energy and timing

performance at low energies, undergone several upgrades including State-of-The-art cylindrical GEM detector: the Inner Tracker.
To improve its vertex reconstruction capabilities near the interaction region, KLOE-2 is the first high-energy experiment using the GEM technology with a cylindrical geometry, a novel idea that was developed at LNF exploiting the kapton properties to build a transparent and compact tracking system.

An overview of the KLOE-2 experiment will be given including present status and achievements together with physics plans.

Summary:

25

The Muon g-2 Experiment

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The Muon g-2 Experiment at Fermilab will measure the anomalous magnetic moment of the muon to a precision of 140 parts per billion, which is a factor of four improvement over the previous E821 measurement at Brookhaven. The experiment will also extend the search for the muon's electric dipole moment (EDM) by approximately two orders of magnitude with a sensitivity down to 10-21 e.cm. Both of these measurements are made by a precise measurement of the storage-ring's 1.45T magnetic field combined with an analysis of the modulation of the decay rate of the higher-energy positrons from the (anti-)muon decays recorded by 24 calorimeters and 3 straw tracking detectors. In this talk the recent progress in establishing the uniform storage-ring magnetic field, the accelerator infrastructure, detectors and the storage-ring kicker and quadrupoles will be described and how the improvements in these over the E821 measurement will lead to a reduction of a factor of 3 in the systematic uncertainty of the measurement.

Summary:

39

The PADME experiment at LNF

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Co-author(s): Mauro Raggi [2] ; Paolo Valente [3] ; Venelin Kozhuharov [4]

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The long standing problem of reconciling the cosmological evidence of the existence of dark matter with the lack of any clear experimental observation of it, has recently revived the idea that the new particles are not directly connected with the Standard Model gauge fields, but only through mediator fields or "portals", connecting our world with new "secluded" or "hidden" sectors.
One of the simplest models just adds an additional U(1) symmetry, with its corresponding vector boson A'. All SM particles will be neutral under this symmetry, while the new field will couple to

the charged particles of the SM with an effective charge ϵe.
Additional interest arises from the observation that A' in the mass range 1 MeV/c^2 to 100 MeV/c^2 and coupling $\epsilon \sim 10^{-3}$, would justify the discrepancy
between theory and observation for the muon anomalous magnetic moment, (g – 2)μ.
This possibility has been recently disproved in the hypothesis that the A' decays to SM particles only, on the contrary if A' decays to dark sector particles, almost all of the available experimental constraints can be evaded and the dark photon is still a valuable explanation for the muon (g-2) anomaly.
At the end of 2015 INFN has formally approved a new experiment, PADME, to search for invisible decays of the A' at the DAFNE Linac in Frascati. The experiment is designed to detect dark photon produced in positron on fixed target annihilation ($e^+e^- \rightarrow \gamma A'$) decaying to dark matter by measuring the final state missing mass. The collaboration aims to complete the design and construction of the experiment by the end of 2017 and to collect $\sim 10^{13}$ positron on target by the end of 2018, thus allowing to reach the $\epsilon \sim 10^{-3}$ sensitivity up to a dark photon mass of ~ 26 MeV/c^2

Summary:

44

The PANDA Experiment At FAIR

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The PANDA experiment in preparation to be setup at FAIR (Facility for Antiproton and Ion Research) in Darmstadt, Germany will cover many important aspects of hadron physics with cooled anti-proton beams of unprecedented intensity and precision in the momentum range between 1.5 and 15 GeV/c. The versatile detector is designed to address a rich physics program. This includes spectroscopy of QCD bound states ranging from charmonium to states composed of light quarks only, which comprises studies of the recently and yet not understood X, Y, and Z states and searches for other exotics. Production of hyperons will shed further light on the strong interaction in the intermediate region between the perturbative and non-perturbative regime. Time-like nuclear form factors and properties of hadrons in medium will be accessible and round up the experimental program. In this talk aspects of the PANDA physics program will be highlighted. Major components of the detector are under construction. The current status of the experiment will be presented.

Summary:

52

The Study of Two (Anti-)proton Interaction via Correlation Measurement

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The two-particle correlation at small relative momentum is influenced by the nuclear force between two particles, which has been intensively studied for nucleons and nuclei but not much for antinucleons or antinuclei. In this talk, we present the antiproton-antiproton and proton-proton correlation function in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV based on data taken by the STAR experiment at RHIC. We show the attractive nuclear force between two antiprotons, and present the measurement of the two key parameters that characterize the corresponding strong interaction, namely, the

scattering length and the effective range. Our measurement serves as a verification of CPT symmetry. The present information on the strong force in the antiproton-antiproton system, the simplest system of antinucleons(nuclei), is a fundamental ingredient towards understanding the structure of more sophisticated anti-nuclei.

Summary:

76

The search for an electric dipole moment of the neutron at PSI

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Searches for electric dipole moments (EDM) of fundamental particles are considered to be one of the most sensitive approaches to physics beyond the Standard Model (SM) of particle physics. A non-SM mechanism that violates the combined symmetry of charge conjugation and parity inversion (CP-violation) could help to explain the huge discrepancy between the observed and predicted baryon asymmetry of the Universe. The discovery of an EDM of the neutron (nEDM) would indicate a violation of time reversal symmetry (T) and, assuming CPT invariance, CP-violation. No nEDM has yet been observed, while the current best upper limit $d_n < 2.9 \times 10^{-26}$ ecm (90% C.L.) [Baker et al. PRL(2006)131801] was published in 2006. At the Paul Scherrer Institute (PSI) in Villigen, Switzerland a measurement of the nEDM is presently running with the highest daily sensitivity ever obtained. In this talk I will discuss the principal experimental techniques, recent advances in sensitivity, and plans for future upgrades.

Summary:

Welcome / 69

Welcome and Logistics

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