XXX-th International Workshop on High Energy Physics “Particle and Astroparticle Physics, Gravitation and Cosmology: Predictions, Observations and New Projects”

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IHEP, Protvino, Theoretical Division

Book of Abstracts

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SM physics and beyond / 3

Opening Address

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SM physics and beyond / 4

Twenty Years of Searching for the Higgs Boson: Exclusion at LEP, Discovery at LHC

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The Standard Model (SM), the theory of particle physics was established 40 years ago and it seems to describe all experimental data very well. All of its elementary particles were identified long ago apart from the Higgs boson. For decades many experiments were built and operated searching for the SM Higgs boson and finally, the two main experiments of the Large Hadron Collider at CERN, CMS and ATLAS in July 2012 reported the observation of a new particle with properties close to those predicted for the Higgs boson, thereby proving the validity of the Brout-Englert-Higgs mechanism of spontaneous symmetry breaking in the Standard Model. In this talk we outline the search story: the exclusion of the SM Higgs boson at LEP, the Large Electron Positron collider, and its first observation at the LHC.

SM physics and beyond / 5

The Higgs boson in ATLAS and CMS

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Physical possibilities of future colliders and other facilities / 6

Electroweak Processes in Laser-Boosted Lepton Collisions

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The associated creation of a Higgs and a Z^0 boson in relativistic lepton-antilepton collisions taking place in a strong laser field is studied. The energy of the pre-accelerated particles may be vastly increased by their interaction with the intense laser field. The total cross section as well as the produced Higgs boson's energy distribution are calculated and related to field-free collisions of corresponding center-of-mass energy. Possible qualitative differences with regard to the detection of the Higgs bosons are presented. The required laser paramters and other experimental challenges are specified [1].

[1] S. J. Müller, C. H. Keitel, and C. Müller, Phys. Lett. B 730, 161 (2014).

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Panel discussion on Higgs boson and related topics

Moderator: Dmitri Kazakov

Panelists:
Dezso Horvath, Lydia Roos, Milos Dordevic, Yury Kolomensky, Maxim Titov

Questions:

1. Does finding the 125 GeV Higgs boson exclude all other possible mass creation mechanisms?
2. Is this the SM Higgs boson? How much space is left for extensions (like the SUSY Higgs sector)?
3. How special is the 125 GeV mass in view of the top mass? (What happens to the future of particle physics if the EW vacuum is stable?)
4. How does the 125 GeV Higgs boson orient the plans for the next colliders, ILC and/or FCC?
5. Is there any role of the Higgs boson in the evolution of the universe?

SM physics and beyond / 8

Top quark physics in ATLAS

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Top quark physics in CMS

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Standard Model physics results from ATLAS and CMS

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Supersymmetry searches at CMS

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Exotica Searches in CMS

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SUSY and Exotica Searches in ATLAS

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Physical possibilities of future colliders and other facilities / 14

Backgrounds and calorimetry at future linear colliders

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Physical possibilities of future colliders and other facilities / 15

ILC project

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TOTEM results

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Diffractive physics / 17

Diffractive scattering in ATLAS

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Diffractive physics / 18

Exclusive and Inclusive quarkonia production in the forward acceptance at the LHC

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Diffractive physics / 19

CMS results on inelastic and diffractive cross sections

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Diffractive physics / 20

Low-x and Diffraction at HERA

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Diffractive physics / 21

Vector meson production in ultra-periphereal pp, pA and aa collisions at the LHC

Corresponding Author: jenk@bitp.kiev.ua

Diffractive physics / 22

Panel discussion on Diffraction

Moderator: Vladimir Petrov

Panelists: Jan Kaspar, Antonio Sidoti, Johan Blouw, Alice Valkarova, Laszlo Jenkovszky, Igor Dremin

Questions:

1.Which problems of principle underlie the diffractive studies?

2.What is the Pomeron?

3.What is the "true asymptotic regime"("Asymptopia") , if any?

4.How to account for coherent and incoherent states of partons in proton wave functions?

5.If QCD has anything concrete to say about diffractive scattering?

QCD & general QFT / 23

QCD results from ATLAS and CMS

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QCD & general QFT / 24

Perturbative QCD at HERA

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Inclusive- Jet Cross-Section Measurement on Low Mu Run Analysis (ATLAS)

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The inclusive double-differential jet cross section measurement has been performed with the ATLAS detector on 2012 data taken at sqrt(s)=8 TeV, as a function of jet transverse momentum and rapidity. This presentation will concentrate on the analysis of a data sample with no pile-up, that has been collected on a special low mu run for detector calibration and "clean"physics studies, is used to measure the low-pt part of the spectrum, in a transverse momentum range between 20 and 100 GeV.

QCD & general QFT / 26

Probing the QCD phase boundary by fluctuations of conserved charges

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SM physics and beyond / 27

Hadronic cross section and implications for the muon g-2

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Panel discussion on QCD & QFT

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b- and c-hadron mass and lifetime measurements at LHCb

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BABAR: Recent results on charmonium

Hadron spectroscopy and Heavy quarks / 31

New results of nucleon resonances studies in photo and electroproduction of charged pion pairs in CLAS detector

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A broad scientific program of exploration of nucleon exited states(N*) spectrum and structure is carried out in Jefferson Laboratory[1]. Detailed information of N** structure and spectrum opens access to fundamental mechanisms of strong interaction in the domain of large quark-gluon coupling constant resulting in formation of nucleons as bound states of quarks and gluons. The unique combination of electron continuous beam and CLAS[2] detector made it possible to explore for the first time the photo and electroproduction of nucleon resonances in exclusive γp→π+π-p reactions[2,3].

The processes γp→πp and γp→ππp give the largest contribution to the total pion photo and electroproduction cross section. Moreover two-pion channel is more preferrable in studying high lying resonances with masses greater than 1.6 GeV because of the dominant branching ratio. Also this channel gives the opportunity to look for "missing N"states because the constituent quark model calculations show that the decays of these states to single pion channel are suppressed.

At this moment the preliminary CLAS data analysis on two-pion photo and electroproduction is complete. In case of photoproduction because of large statistics it was for the first time possible to obtain one-fold and two-fold differential cross-sections with rather narrow bin width of central mass energy –25 MeV.

It is worth noting that both photo and electroproduction will be analysed within the framework of one phenomenological model JM[3] to ensure certainty of nucleon resonances extracted parameters.

Hadron spectroscopy and Heavy quarks / 32

Panel discussion on HQ and Hadron spectroscopy

Moderator: Yury Khokhlov

Panelists: Wei Chen, Andrey Sarantsev, Anatoly Likhoded

Questions:

1. Is heavy quark flavor physics really needed in the LHC era? If LHC discovers new physics, how will flavor physics help to interpret it? What if LHC finds nothing new?
2. There is a flow of experimental results on XYZ states and their interpretations. Is there a convergence or a consensus on any of these ?
3. Most of experiments deal with s-channel formation of baryons. Are other mechanisms like t-channel useful as a complementary source ?
4. Is there a feasible unification of data presentation from various experiments for mesons similar to what is done for baryon spectroscopy?
5. Where are glueballs?

History of physics / 33

How far can a pragmatist go into quantum theory? A critical view of our current understanding of quantum phenomena.

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Quantum mechanics has proven to be the most successful theory ever devised. This theory not only has addressed the most fundamental physical problems, but its applications constitute an important part of our everyday life (actually, more sophisticated applications are still to come). There is however a "mystery"involving this theory since its inception. The fact that we cannot understand quantum phenomena under the same logic as we do with classical phenomena brings in a puzzling situation which has left open a tough debate on its interpretation since the 1930s. Probably this debate will never be really closed (or at least until we will be able to devise a new, wider theory) and, in such a case, it might be pointless to make or even talk about quantum philosophical issues or to further develop the area of the quantum foundations. This leads to a kind of hopeless situation. It directly goes to a materialization of Plato's myth of the cave: we are enforced to perceive the shadows cast on the wall of the cave (our reality) by the real world (the Reality), without the possibility to ever reaching a true understanding of the physical world.

Even in such a harsh scenario, there is still room enough to further explore the quantum world from a pragmatist's point of view. We know a lot about the vacuum properties without knowing what vacuum really is; we are developing amazing technologies based on quantum entanglement without knowing how entangled correlations really happen or operate at a fundamental level. At this point, one needs to turn back the eyes and reflect about how the quantum theory has developed since its inception at a conceptual level, what can be done nowadays, or which new, nonorthodox paths are and can be followed. One of them is the quantum hydrodynamical approach to the quantum theory, shyly developed during the 1950s and that nowadays is trying to open new pathways of understanding. This communication will deal with the evolution of this approach since its inception, its meaning and interest, the kind of quantum physics that can be inferred from it, and the contextualization of quantum mechanics according to it.

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On the history of resonance dual models

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Phenomena in Heavy Ion Collisions / 35

Phenomena in Heavy Ion Collisions

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Heavy Ion Physics at LHCb

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Phenomena in Heavy Ion Collisions / 37

Early thermalization of quark-gluon matter in heavy ion collisions

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On consistency of hydrodynamic approximation for chiral media

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Phenomena in Heavy Ion Collisions / 39

Panel discussion on Heavy Ions

Moderator: Sergei Sadovsky

Panelists: Johan Blouw, Vitaly Okorokov, Vladimir Bumazhnov, Xiao-Ming Xu, Dmitri Peresunko

Questions:

1. Which experimental data (dis)prove deconfiment of the QCD matter created in heavy ion collisions ?
2. Which grounds are there for thermodynamics application to describe the QCD matter produced at RHIC and LHC energies ?
3. Which experimental data confirm existence or absence of phase transition in heavy ion collisions?
4. Which new properties of quark-gluon matter are observed at LHC compared with those at RHIC and which are plans for the future ?
5. Is there any evolution in our understanding of the QCD matter from RHIC to LHC energies ?

CP-violation / 40

CP violation measurements at LHCb

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b-hadron decays are the ideal place to perform measurements of CP violation. Many decay channels allow to over-constrain the unitarity triangles of the CKM matrix and test the SM hypothesis that a single phase is the origin of all CP violation. Charm decays also allow for null tests of the SM. The most important recent results from LHCb are reviewed.

CP-violation / 41

Physics of BELLE experiment

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BABAR: Searches for low mass new physics: CP-odd Higgs and dark photons

CP-violation / 43

Nonzero θ_{13} and CP Violation from Broken $\mu - \tau$ Symmetry

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Neutrino physics / 44

Hyper-Kamiokande project

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Neutrino physics / 45

Detection of supernova neutrinos in Super-Kamiokande

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Neutrino physics / 46

Recent results from OPERA: search for $\nu_\mu \rightarrow \nu_\tau$ oscillations

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The OPERA experiment aims at providing a direct proof of the $\nu_\mu \rightarrow \nu_\tau$ oscillations by observing ν_τ CC interactions in an almost pure ν_μ accelerator beam, the CNGS (CERN Neutrinos to Gran Sasso).

The beam exposure started in 2008 and ended in 2012. Events recorded in the Emulsion Cloud Chamber detectors, made of lead plates and nuclear emulsions, are being analysed since 2008.
In the last period, a large additional amount of data has been extracted, leading to the validation of a 4th ν_τ candidate event. This new result brings the observation of the oscillation to a significance exceeding 4 sigma.

Neutrino physics / 47

Search for heavy neutrino in the K+ -> mu+ nu_H decay

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Neutrino physics / 48

NOvA neutrino experiment

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The NOvA experiment is a long base-line accelerator based neutrino oscillation experiment. It uses the upgraded NuMI beam from Fermilab and measures electron neutrino appearance and muon neutrino disappearance at its far detector in Ash River, Minnesota. Goals of the experiment include measurements of theta13, mass hierarchy and the CP violating phase. NOvA has begun to take neutrino data and first neutrino candidates are observed in its far detector. This talk provides an overview of the scientific reach of the experiment, the status of detector construction and physics analysis, as well as the first data.

Neutrino physics / 49

ANTARES results

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Neutrino physics / 50

On the flavor composition of the high energy neutrino events in IceCube

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Neutrino physics / 51

Panel discussion on Neutrino physics

Moderator: Vladimir Obraztsov

Panelists: Akira Konaka, Motoyasu Ikeda, Filip Jediny, Evgeny Shirokov, Oleg Kalekin, Sergio Palomares-Ruiz

Questions:

1. Can sidereal time analysis of the long time neutrino observations give information about the galaxy distribution in the Local Universe?
2. How well do we need to know the PMNS matrix elements ?

3. Is the existence of MSW effect proved experimentally ?
4. Are there new species of neutrino (e.g. the «sterile» one)?
5. What are other most important problems in neutrino physics (CP-violation)?
6. Can sidereal time analysis of the long time neutrino observations give information about the galaxy distribution in the Local Universe?
7. Perspectives of existing and future neutrino experiments (LNBF, LAGUNA, ICARUS, SHIP …)

High energy cosmic rays / 52

The Pierre Auger Observatory: latest results and future prospects

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High energy cosmic rays / 53

Measurement of the Cosmic Ray Energy Spectrum and of the Muon content of EAS with the Pierre Auger Observatory

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High energy cosmic rays / 54

Cosmic-ray research with AMS-02 on the International Space Station

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High energy cosmic rays / 55

First Results from LUX Dark Matter Experiment

Corresponding Author: solovov@coimbra.lip.pt

High energy cosmic rays / 56

Panel discussion on Cosmic Rays

Moderator: Alexandre Kisselev

Panelists: Fernando Arqueros, Henning Gast, Vladimir Solovov

Questions:

1. What is the origin of the GZK-like suppression of the cosmic ray (CR) flux? Is it due to energy loss during propagation or due to reaching maximum energy achievable in a source?
2. Are the data on mass composition of ultra- high energy CRs consistent with a hypothesis that primary particles are 100% proton? Or an admixture of heavy nuclei is also allowed?
3. Does the deficit of muons in LHC-tuned MC simulations mean that current hadronic interaction models must be seriously corrected?
4. Does the anomalous positron fraction (PF) approach a stable asymptotic value or a sharp cutoff at higher energies is possible?
5. Do we observe annihilation of a dark matter or nearby pulsar contribution? Will anisotropy in an arrival direction of CR leptons rule out a dark matter interpretation of PF?
6. Is low-mass WIMP region completely excluded by the data?

Theoretical and observational cosmology / **57**

Average thermal evolution of the universe

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The scale parameter and the average behavior of the temperatures and densities of the main components of the ΛCDM universe are sketched, beginning after the end of inflation. The universe is treated as a perfect fluid. A model of dark energy based on conformal variations of the metric is briefly discussed. Darkmatter is assumed to consist of neutralinos, a LSP and leading WIMP candidate. The main events of the thermal evolution are studied, such as the effect of particle decoupling and the transitions between eras dominated by the different entities. We examine the distinction between Majorana and Dirac neutrinos based on the influence they have on the age of the universe and on the present epoch neutrino density.

Theoretical and observational cosmology / **58**

Strong thermal Leptogenesis: an exploded view of the low energy neutrino parameters in the SO(10)-inspired model

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Theoretical and observational cosmology / **59**

B-mode in CMB polarization. What's that and why it is interesting.

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On $R + \alpha R^2$ Loop Quantum Cosmology

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Theoretical and observational cosmology / 61

Panel discussion on Cosmology

Moderator: Valery Kiselev

Panelists: Yuri Baryshev, Alex H. Blin, Luca Marzola, Alexander Dolgov, Modestov Konstantin, Chugreev Yury, Vladimir Sokolov

Questions:

1. Is there a conflict of BICEP2 data with the PLANCK measurements on the relic gravitational waves generated during the Universe inflation?
2. Do sterile neutrinos with the mass about 0.5 eV really relax PLANCK constraints on both the amplitude of tensor modes of inhomogeneity and Hubble rate?
3. Why the dark matter particles are still not detected in conflict with direct expectations of cosmological models?
4. The baryogenesis is dead, the leptogenesis is prospective, isn't it?
5. Are there crucial astrophysical observational tests which can distinct between alternative cosmological models?
6. Is it possible that observations of the large scale spatial galaxy distribution will change the SCM paradigm?
7. How does Feynman's field gravity approach change predictions for observational effects in relativistic astrophysics?

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The Progress of JUNO Liquid Scintillator Research

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Theoretical and observational cosmology / 63

Paradoxes of cosmological physics in the beginning of 21-st century

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In the history of cosmology the paradoxes played important role for development of contemporary world models. Within the modern standard cosmological model there are both observational and conceptual cosmological paradoxes which stimulate to search their solution. Confrontation of theoretical predictions of the standard cosmological model with the latest astrophysical observational data is considered. A review of conceptual problems of the Friedmann's space expending models, which are in the bases of modern cosmological model, is discussed. The main paradoxes, which are discussed in modern literature, are the Newtonian character of the exact Friedman equation, the

violation of the energy conservation within any comoving local volume, violation of the limiting recession velocity of galaxies for the observed high redshifts. Possible observational tests of the nature of the cosmological redshift are discussed.

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Relativistic astrophysics based on Feynman’s approach to gravitational interaction

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Physical properties of the relativistic compact objects stellar mass, supermassive objects in active galactic nuclei, and relativistic cosmological models essentially depend on the physics of the gravitational interaction. We compare the initial principles, main equations, and astrophysical consequences of Einstein’s geometrical approach (General Relativity) with Feynman’s field approach (Field Gravity) to the theory of gravitation. It is shown that all classical relativistic effects have the same values in Post-Newtonian approximation. The main difference of the Feynman’s field approach from GR is that in FG there is energy-momentum tensor of the gravitational field with positive energy density and that the trace of the symmetric second rank tensor potential is an essential internal scalar part which corresponds to the repulsive force. Astrophysical tests of the nature of the gravitational interaction, including solar system, pulsars in binary systems, supernova explosions, relativistic compact objects, gravitational waves, active galactic nuclei and cosmology are discussed.

Phenomena in Heavy Ion Collisions / 65

Strongly interacting matter at RHIC: experimental highlights

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Recent experimental results obtained at the relativistic heavy-ion collider (RHIC) will be discussed. Investigations of different nuclear-nuclear collisions in recent some years focus on two main tasks, namely, detail study of sQGP properties and exploration of the QCD phase diagram. Results at top RHIC energy provide important information about event shapes as well as transport and thermodynamics properties of the hot medium for various flavors. Heavy-ion collisions are unique tool for the study of topological properties of theory. Experimental results obtained for discrete QCD symmetries at finite temperatures are discussed. These results confirm indirectly the topologically non-trivial structure of QCD vacuum. Most results obtained during stage I of the RHIC beam energy scan (BES) program show smooth behavior vs initial energy. However certain results suggest the transition in the domain of dominance of hadronic degrees of freedom at center-of-mass energies between 10–20 GeV. Future developments and more precise studies of features of QCD phase diagram in the framework of stage II of RHIC BES will be briefly discussed.

Diffractive physics / 68

TOTEM results on elastic scattering and total cross-section

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SM physics and beyond / 69

Constraints on Supersymmetry using LHC data

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Daya Bay Gadolinium loaded liquid scintillator

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Hadron spectroscopy and Heavy quarks / 71

Baryon spectroscopy from analysis of meson photoproduction data

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Diffractive physics / 73

The interaction region of high energy protons

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New experimental data about proton-proton collisions obtained at the LHC allow to widen drastically the energy interval where one gets some knowledge about the structure of their interaction region.
It is shown how the shape and the darkness of the interaction region of colliding protons change with increase of their energies. In particular, the collisions become fully absorptive at small impact parameters at LHC energies that results in some special features of inelastic processes. Possible evolution of the shape from the dark core to the fully transparent one is discussed that implies the terminology of the black disk would be replaced by the black torus.
The parameter which determines the opacity of central collisions plays a crucial role in the behavior of the differential cross section of elastic scattering outside the diffraction cone where the predictions of all phenomenological models failed at LHC energies. The role of the ratio of real to imaginary part of the elastic scattering amplitude at non-forward scattering becomes decisive there. It allows to estimate this ratio for the first time by comparison with experiment at LHC energies which happens to be drastically different from its values measured at low transferred momenta. Moreover, the behaviours of the real and imaginary parts separately differ in the models and in the approach based on the unitarity condition. This problem is still waiting for its resolution.

Hadron spectroscopy and Heavy quarks / 74

Heavy tetraquark states and quarkonium hybrids

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Many of the XYZ resonances observed by the Belle, Babar, CLEO and BESIII collaborations in the past decade are difficult to interpret as conventional quark-antiquark mesons, motivating the consideration of scenarios such as multi-quark states, meson molecules, and hybrids. After a brief introduction to QCD sum-rule methods, we provide a brief but comprehensive review of the mass spectra of the quarkonium-like tetraquark states $qQ\bar{q}\bar{Q}$, doubly charmed/bottomed tetraquark states $QQ\bar{q}\bar{q}$ and the heavy quarkonium hybrid states $\bar{Q}GQ$ in the QCD sum rules approach. Possible interpretations of the XYZ resonances are briefly discussed.

Neutrino physics / 75

KM3NeT project

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The KM3NeT collaboration aims at the construction of a multi-cubic-kilometre scale neutrino telescope in the Mediterranean Sea. The main goal of KM3NeT is to observe high-energy cosmic neutrinos. The first phase of the telescope construction has started at two sites in the Mediterranean: KM3NeT-Fr and KM3NeT-It. The KM3NeT-Fr site is close to that of Antares, about 45 km off-shore Toulon, France at a depth of 2500m; the KM3NeT-It site is 100 km off-shore the south-east coast of Sicily, Italy at a depth of 3500 m. At both sites, a seafloor network and shore stations are being installed to allow for connection of about 30 KM3NeT detection units, vertical structures holding optical modules. In its full configuration, KM3NeT will consist of a few building blocks, arrays of thousands optical modules, and will be the largest and the most sensitive high-energy neutrino detector. A prototype KM3NeT optical module is successfully operational in the Antares telescope since April 2013. A prototype KM3NeT detection unit with three optical modules is operational since May 2014 at the KM3NeT-It site. In the talk, the physics objectives and the design of the KM3NeT neutrino telescope and first results from prototypes operations are presented.
Supported by the 'Helmholtz Alliance for Astroparticle Physics HAP' funded by the Initiative and Networking Fund of the Helmholtz Association

Phenomena in Heavy Ion Collisions / 76

PHENIX results

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Hard scattered partons lose significant energy traversing the medium created in high energy collisions of heavy nuclei, resulting in suppressed yields of final state high pT hadrons. Results from the PHENIX experiment at RHIC on the suppression of high pT hadrons at mid-rapidity in central Au+Au and Cu+Cu collisions will be shown and compared to corresponding results in d+Au collisions. The beam energy dependence of high pT pi0 suppression in Au+Au collisions will be presented. In addition, results on direct photon yields, which don't suffer energy loss due to the strong nuclear force, will be shown for Au+Au and d+Au collisions.

Hadron spectroscopy and Heavy quarks / 78

The BESIII experiment

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Diffractive physics / 82

Diffraction physics with ALICE at the LHC

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The ALICE experiment is equipped with a wide range of detectors providing excellent tracking and particle identification in the central barrel, as well as forward detectors with extended pseudorapidity coverage, which are well suited for studying diffractive processes. In this talk, we shall highlight cross section measurements of single and double diffractive processes performed by ALICE in pp collisions at $\sqrt{s} = 0.9,\ 2.76,\ 7\ TeV$. The plans for $\sqrt{s} = 8\ TeV$ pp data treatment will be also discussed. Currently, ALICE is studying double-gap events in pp collisions at $\sqrt{s} = 7\ TeV$, which gives an insight into central diffraction processes. We shall discuss the current status and perspectives for central diffraction studies in the ALICE experiment. The upgrade plans for diffraction studies, further extending the pseudorapidity acceptance of the ALICE setup for the coming Run 2 of the LHC, will be outlined.

Hadron spectroscopy and Heavy quarks / 83

Recent BaBar highlights on B-meson physics

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SM physics and beyond / 84

Searches for low mass new physics: CP-odd Higgs and dark photons

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Neutrino physics / 85

The recent results of the Daya Bay Experiment

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The Daya Bay Experiment measured reactor anti-neutrino disappearance on short baseline with unprecedented precision. In a three-neutrino framework our best fit for oscillation parameters is $\sin^2 2\theta_{13} = 0.084 \pm 0.005$ and $|\Delta m^2_{ee}| = 2.44^{+0.10}_{-0.11} \times 10^{-3}$ eV^2. We also preformed largely independent measurement of θ_{13} using neutron capture on hydrogen. The result $\sin^2 2\theta_{13} = 0.083 \pm 0.018$ is consistent with measurement using neutron capture on gadolinium.

With over 1 million detected inverse beta decay interactions using neutron capture on gadolinium the Daya Bay Experiment provides high statistics measurement of absolute reactor $\bar{\nu}_e$ flux. The result is in agreement with previous short-baseline experiments and favors so called 'reactor anomaly'.

With the combination of multiple baselines Daya Bay has unique chance to set the most stringent limit on light sterile neutrino mixing in region 10^{-3} eV$^2 < \Delta m^2_{41} < 10^{-1}$ eV^2.

Neutrino physics / 86

Search for nu_mu -> nu_e oscillations with the OPERA experiment

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The main goal of the OPERA experiment is the direct observation of $\nu_\mu \to \nu_\tau$ oscillations in the appearance mode in the quasi pure ν_μ CNGS beam. Profiting of the tracking capabilities of the OPERA active target it is possible to detect and reconstruct ν_e interactions and, therefore, study the subdominant $\nu_\mu \to \nu_e$ oscillation channel. Current results on this channel in the three-flavour mixing model are presented. The same data allow to constrain the non-standard oscillation parameters indicated by the LSND and MiniBooNE experiments.

Phenomena in Heavy Ion Collisions / 87

Neutral mesons and photons in pp and Pb-Pb collisions

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Measurements of direct photon and neutral pion production in heavy-ion collisions provide a comprehensive set of observables characterizing properties of the hot QCD medium. Unlike hadrons, direct photons are produced in all stages of a nucleus-nucleus collision and therefore probe the initial state of the collision as well as the space-time evolution of the produced medium. Prompt direct photons provide means to control the initial stage of the collision and ensure that the yield suppression of hard hadrons and in particular neutral pions in Pb-Pb collision is a final-state effect and should be attributed to the parton energy loss in the hot medium. The thermal direct photon spectrum and flow carry information about temperature and space-time evolution of the emitting medium. Measurements of neutral meson spectra in pp collisions at energies $\sqrt{s}$=0.9, 2.76, 7 TeV serve a reference for heavy-ion collisions, and also provide valuable data for pQCD calculations and for studying scaling properties of hadron
production at the LHC energies.

The ALICE experiment at LHC reconstructs photons via complementary methods, using the ALICE electromagnetic calorimeters and the central tracking system identifying photons converted to e^+e^- pairs in the material of the inner barrel detectors. Neutral pions are reconstructed using their two-photon decays. Since calorimetric and tracking approaches have practically independent systematic uncertainties, their comparison provides a strong cross-check. In this talk, we review recent ALICE results on neutral pion and direct photon production in pp and Pb-Pb collisions.

SM physics and beyond / 90

Introductory Address from the OC

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History of physics / 91

Half a Century with Quarks

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Physical possibilities of future colliders and other facilities / 92

ALICE Fast Interaction Trigger detector for the future

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As a result of the LHC upgrade after the Long Shutdown 2, the expected luminosity and collision rate during the so called Run 3 will considerably exceed the design parameters for several of the key ALICE detectors systems including the forward trigger detectors. Furthermore, the introduction of a new Muon Forward Tracker significantly reduces the space envelope available for the upgraded Fast Interaction Trigger (FIT) detector on the muon spectrometer side. At the same time, FIT is expected to match and even exceed the functionality and performance currently secured by three ALICE sub-detectors: the time zero detector (T0), the VZERO system, and the Forward Multiplicity Detector (FMD). The harsh conditions of Run 3 would accelerate the ageing and radiation damage (detectable already during Run 1) of the FIT detector if we were to use standard PMTs. The solution came thanks to the latest developments in MCP-PMT technology providing compact photo sensors with excellent characteristics and stability. The key design features of FIT will be presented together with the latest simulation results and benchmark tests of the prototype.

Phenomena in Heavy Ion Collisions / 93

Results from ALICE

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The ALICE experiment at the LHC performs comprehensive studies of the QCD matter with Pb-Pb, p-Pb and pp collisions. A complete set of observables measured by ALICE allows one to explore properties of the deconfnined quark-gluon medium at high temperature and energy density, to study initial-state effects of heavy-ion collisions and to study particle production in QCD vacuum. In this talk, an overview of the recent results obtained by the ALICE collaboration from the data collected during the LHC Run1, is given. Upgrade program for Run2 and Run3 will be also presented.

Theoretical and observational cosmology / 95

Cosmological consequences of the relativistic theory of gravitation

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SM physics and beyond / 96

Rare decays of b- and c-hadrons 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 LHCb results will be presented.

Excursion to the Oka-Terrace State Nature Biosphere Reserve / 99

OKA TERRACE NATURE BIOSPHERE PRESERVE

Oka Terrace (Prioksko-Terrasny) Nature Biosphere Preserve is one of Russia's smallest zapovedniks (nature reserves), sprawling over an area of 5,000 hectares along the left bank of the Oka River in the Serpukhov District of the Moscow Region. It was established in 1945 as part of the Moscow Nature Preserve and is home to 900 plant species, 130 bird species, and 54 mammal species. A wisent nursery was established in 1948 to populate the region with European bisons from the Belovezhskaya Pushcha (dense forest preserve in Belorussia) and Western Caucasus. There is also a small herd of American bisons.

Theoretical and observational cosmology / 101

Gravidynamics (scalar-tensor gravitation) and the observed discrete mass spectrum of compact stellar remnants in close binary systems.

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(1) There are two new observational facts: the mass spectrum of neutron stars and candidates to black holes shows an evident absence of compact objects with masses within the interval 2 - 6 solar ones, and in close binary stellar systems with a low-massive optical companion the most probable mass value (a peak in the masses distribution of black hole candidates) is close to 7 masses of the Sun.
(2) In the totally non-metric field/scalar-tensor model of gravitational interaction the total mass of a compact relativistic object with extremely strong gravitational field (an analog of black holes in GR) is approximately equal to 6.7 solar masses with radius of a region filled with matter (quark-gluon plasma) approx. 10 m.
(3) Polarized emission of gamma-ray bursts, a black-body component in their spectrum and other observed properties could be explained by the direct manifestation of surface of these collapsars.

Physical possibilities of future colliders and other facilities / 106

IHEP: status and prospects

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Theoretical and observational cosmology / 110

Closing Address

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