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The SuperB experiment

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With an integrated luminosity goal larger than 75 abˆ-1, the SuperB factory, to be built on the Tor Vergata Campus near Roma (Italy) by 2016, has the very ambitious goal to unravel the detailed structure of the new physics soon to be discovered at the LHC, or to explore BSM physics beyond the LHC reach if nothing is found there. This goal will be reached using a large number of rare B, charm and tau decays, very sensitive to the presence of new heavy particles via virtual loops. The physics prospects of this ultra-high luminosity eˆ+eˆ- collider will be presented in detail as well as the very innovative concepts guiding the machine and detector designs. The important advantages brought by the specific assets of the SuperB project, namely beam polarization and capability to run at the charm threshold with a significant boost, will be presented as well.

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The Thermal Model at the LHC

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Applications of the thermal model in high energy collisions are
reviewed. The transverse momentum distributions
measured by the STAR and PHENIX collaborations at
the Relativistic Heavy Ion Collider
and by the ALICE, ATLAS and CMS
collaborations at the Large Hadron Collider can be considered
in the framework of relativistic thermodynamics
using the Tsallis distribution.
Theoretical issues are clarified concerning the thermodynamic
consistency in the case of
relativistic high energy quantum distributions.
An improved form is proposed for describing the transverse
momentum distribution and fits are presented together with estimates of the parameter q and the temperature T.

Summary:

Overview of the thermal model.
Discussion of the Tsallis distribution as used by the STAR, PHENIX, ALICE, ATLAS and CMS collaborations.

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Constraints on Randall-Sundrum model from top-antitop production at the LHC

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We study the top pair production cross section at the LHC in the context of Randall-Sundrum model including the Kaluza-Klein (KK) excited gravitons. It is shown that the recent measurement of the cross section of this process at the LHC restricts the parameter space in Randall-Sundrum (RS) model considerably. We show that the coupling parameter ($\frac{k}{\overline{M}_{Pl}}$) is excluded by this measurement from 0.03 to 0.22 depending on the mass of first KK excited graviton (m_1). We also study the effect of KK excitations on the spin correlation of the top pairs. It is shown that the spin asymmetry in $t\bar{t}$ events is sensitive to the RS model parameters with a reasonable choice of model parameters.

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Searches for low-mass Higgs and dark gauge bosons at BABAR

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Many extensions of the standard model include low-mass Higgs bosons. Non-minimal supersymmetric models predict a CP-odd Higgs that may be lighter than the Upsilon mass and produced in radiative Upsilon decays. We report tight limits on such models obtained from searches for such events using BABAR's large data sets of (92.8 +- 0.8) million Upsilon(2S) and (116.8 +- 1.0) million Upsilon(3S) mesons, where the light Higgs decays into a pair of tau or mu leptons, hadrons, or invisible particles. A low-mass Higgs also arises in dark-sector scenarios. We report limits on the parameters of such models obtained from a search for a dark Higgs produced in association with a dark photon in electron-positron collisions, using the full BaBar data set.

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Searches for new sources of CP violation at BABAR

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Precise measurements at the B factories have established the Kobayashi-Maskawa mechanism as the source of CP violation observed in accelerators. Nonetheless, the baryon asymmetry of the universe indicates the existence of much larger CP-violation effects beyond the standard model. We present recent results of improved or new CP-violation measurements conducted in modes expected to be sensitive to new physics. These include decays of tau leptons, charm mesons, and multibody penguin decays of B mesons. An additional motivation for our measurements of CP violation in charm is that measurements with many decay modes are needed in order to understand the source of the direct CP violation seen in D0->KK and D0->pipi.

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Hydrodynamic models of the sQGP and the elliptic flow

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In relativistic heavy ion collisions, a perfect fluid of quarks, also called the strongly interacting quark gluon plasma (sQGP) is created for an extremely short time. The time evolution of this fluid can be described by hydrodynamical models. After expansion and cooling, the freeze-out happens and hadrons are created. Their distribution reveals information about the final state of the fluid. To access the time evolution and the initial state, one needs either additional information about the Equation of State (EoS) of this matter, or one needs to analyze penetrating probes, such as direct photon observables. In this talk hydrodynamic models of the sQGP will be reviewed, also new analytic solutions with temperature dependent EoS will be shown. Results on hadronic and direct photon elliptic flow will also be discussed.

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UNIFICATION WITH MIRROR FERMIONS

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A unification framework for the fundamental interactions in nature is presented, which is based on the use of a dynamical symmetry breaking mechanism involving mirror fermions. The hierarchy between the weak scale and the coupling unification scale, which is found to lie close to Planck energies, is naturally reproduced. In parallel, a new process leading to the emergence of symmetry is proposed, which is followed by interesting cosmological implications. Phenomenology includes the probability of detection of mirror fermions at the LHC.

Summary:

Attempts to unify fundamental interactions within a unique theory are not only based on aesthetic and philosophical grounds, but are also reinforced by experiments implying a convergence of the gauge-coupling strengths. We try here to explain fermion family structure and the hierarchy between the electroweak symmetry scale and the coupling unification scale by introducing mirror fermions. Stabilization of the electroweak scale is achieved by using a new gauge SU(3) interaction felt only by mirror fermions and becoming strong around 1 TeV, in a way that the Higgs mechanism is based on fermion condensates.

First, it is shown that a particular breaking chain of an initial gauge symmetry E_8*E_8 down to the Standard Model is compatible with the unification of the gauge couplings near the Planck scale and leads naturally to dynamical electroweak symmetry breaking at scales of around 1 TeV. The fermion fields surviving at lower energies and the effective composite fields leading to symmetry breaking appear naturally within this setting, a property which is a priori neither trivial nor obvious, although more work is required to prove the uniqueness of the chosen breaking chain. Next, an attempt is made to incorporate the Lorentz group within the initial symmetry in order to show that the model proposed is in principle compatible with models of gravity based on spinors, which could potentially allow the inclusion of gravitational interactions in related unification considerations. Then, an effort is made to justify the value of the gauge couplings at the unification scale using a rough order-of-magnitude calculation involving fermion condensates and expressing the hierarchy between the weak scale and the Planck scale in terms of a symmetry-group invariant. Last, a novel mechanism of symmetry emergence is proposed within the framework of critical phenomena, in order to reduce the arbitrariness of our choice of the

initial symmetry. Based on this approach, one can draw useful qualitative conclusions on the critical temperature involved and derive order-of-magnitude results addressing several important cosmological issues like the value of the cosmological constant, the nature of Dark Matter and the interplay between space-time and elementary particles.

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Fermiophobic Higgs boson and supersymmetry

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If the Higgs boson with mass 125 GeV is fermiophobic, as suggested by the most recent LHC results, then the MSSM is excluded. The minimal supersymmetric fermiophobic Higgs scenario can naturally be formulated in the context of the NMSSM that admits Z_3 discrete symmetries. In the fermiophobic NMSSM, the SUSY naturalness criteria are relaxed by a factor N_c y_t^4/g^4 ~ 25, removing the little hierarchy problem and allowing sparticle masses to be naturally of order 2-3 TeV. This scale motivates wino or higgsino dark matter. The SUSY flavour and CP problems as well as the constraints on sparticle and Higgs boson masses from b -> s\gamma, B_s -> \mu\mu and direct LHC searches are relaxed in fermiophobic NMSSM. The price to pay is that a new, yet unknown, mechanism must be introduced to generate fermion masses. We show that in the fermiophobic NMSSM the radiative Higgs boson branchings to \gamma\gamma, \gamma Z can be modified compared to the fermiophobic and ordinary standard model predictions, and fit present collider data better. Suppression of dark matter scattering off nuclei explains the absence of signal in XENON100.

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Hadronic observables in hydrokinetic picture of A+A collisions at RHIC and LHC

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The simultaneous description of the hadronic yields, pion, kaon and proton spectra, elliptic flows and femtoscopy scales in hydrokinetic model of A+A collisions is presented at different centralities for the top RHIC and LHC energies. The hydrokinetic model is used in its hybrid version that allows one to switch correctly to the UrQMD cascade at the isochronic hypersurface which separates the cascade stage and decaying hydrodynamic one. The results are compared with pure hybrid model where hydrodynamics and hadronic cascade are matching just at the non-space-like hypersurface of chemical freeze-out. The initial conditions are based on both Glauber- and KLN- Monte-Carlo simulations and results are compared. It seems that the observables, especially femtoscopy data, prefer the Glauber initial conditions. The modification of the particle number ratios caused, in particular, by the particle annihilations at the afterburn stage is analyzed.

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CP violation and electroweak baryogenesis in the Standard Model

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Co-authors: Aleksi Vuorinen [2]; Anders Tranberg [3]; Olli Taanila [1]

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One of the major unresolved problems in current physics is understanding the origin of the observed asymmetry between matter and antimatter in the Universe. It has become a common lore to claim that the Standard Model of particle physics cannot produce sufficient asymmetry to explain the observation. Our results suggest that this conclusion can be alleviated in the so-called cold electroweak baryogenesis scenario. On the Standard Model side, we continue the program initiated by Smit eight years ago; one derives the effective CP-violating action for the Standard Model bosons and uses the resulting effective theory in numerical simulations. We address a disagreement between two previous computations performed effectively at zero temperature, and demonstrate that it is very important to include temperature effects properly. Our conclusion is that the cold electroweak baryogenesis scenario within the Standard Model is tightly constrained, yet producing enough baryon asymmetry using just known physics still seems possible.

Summary:

An update and extension of results published previously in [Phys. Rev. Lett. 108 (2012) 041601] will be reported.

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The Telescope Array - Ultra High Energy Cosmic Rays

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The Telescope Array (TA) Experiment is the largest Ultra-High Energy cosmic ray detector in the northern hemisphere. The Telescope Array is a follow up to the High Resolution Fly's Eye and AGASA experiments. It is located near Delta, Utah, about 200 kilometers southwest of Salt Lake City. The detector consists of 507 three square meter scintillator counters distributed in a square grid with 1.2 km spacing. Three fluorescence detector stations (12, 12, and 14 telescopes) sit on the corners of a ˜30 km equilateral triangle overlooking the array of surface detectors. The stations view 108, 108, and 114 degrees in azimuth and 3-31 degrees in elevation. They provide full hybrid coverage with the scintillator array above 10 EeV. The Telescope Array underwent commissioning in 2007 and began routine data collection operations at the beginning of 2008. A low energy extension to TA (TALE) will add 10 new telescopes to the Middle Drum site and increase the elevation angle view up to about 60 degrees, providing for cosmic ray observation down to about 10ˆ16.3 eV. In conjunction with the new telescopes, a graded array of infill scintillator counters will be added. An overview of the experiment and its measurements will be presented.

Summary:

Measurement of
- Energy Spectrum
- Chemical Composition
- Anisotropy

as well as search for photons and neutrinos
in ultra high energy cosmic rays

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Implication of results from heavy-ion experiments for compact stars

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Kaon production at subthreshold densities in heavy-ion collisions is a robust tool to probe stiffness of nuclear matter at suprasaturation densities. Experimental results indicate a soft Equation of State (EoS) upto 2-3 times nuclear saturation density. This would have significant implications on properties of compact stars. Firstly, the probed density range is relevant for central densities of light neutron stars. When combined with radius measurement, this would help to constrain the density dependence of symmetry energy, which plays a crucial role in nuclear physics. Secondly, the nucleon potential extracted from heavy-ion data can be used to constrain the low density EoS upto a fiducial density within the probed density range of heavy-ion experiments. This EoS can then be connected smoothly to the stiffest EoS allowed by causality, to calculate the maximally allowed gravitational mass of a compact star. This is interesting in the light of recent observations of massive neutron stars.

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Holographic Josephson junction networks

Author: Vasilis Niarchos[1]

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I will discuss a recent construction of Josephson junction networks in the context of the AdS/CFT correspondence. The construction, which is based on an extension of the gauge/gravity duality using designer multi-gravity, aspires to become a new methodological tool for the description of strongly coupled systems like high-Tc superconductors.

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Primordial scalar perturbations via conformal mechanisms.

Author: Sabir Ramazanov[1]

Co-authors: Grigory Rubtsov [2]; Maxim Libanov [2]; Valery Rubakov [2]

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Scalar perturbations with nearly flat power spectrum may originate from
perturbations of the phase of a scalar field conformally coupled to gravity and rolling down negative quartic potential. We consider
a version of this scenario whose specific property is a long intermediate stage between the end of conformal rolling and horizon exit
of the phase perturbations. Its existence results in a small negative scalar tilt, statistical anisotropy of all even multipoles starting from quadrupole of general structure (in contrast to the usually discussed single quadrupole of special type) and non-Gaussianity of a peculiar form. We search for the signatures of the statistical anisotropy in the seven-year WMAP data using quadratic maximum likelihood method. From the non-observation of the (cosmological) effect we set an upper limit on the unique parameter h^2 of our model, which reads h^2<0.045 at the 95% confidence level.

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Multiplicities from black-hole formation in heavy-ion collisions

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The formation of trapped surfaces in the head-on collision of shock waves in conformal and non-conformal backgrounds is investigated. The backgrounds in- clude all interesting confining and non-confining backgrounds that may be relevant for QCD. Several transverse profiles of the shocks are investigated including distri- butions that fall-off as powers or exponentials. Different ways of cutting-off the UV contributions (that are expected to be perturbative in QCD) are explored. Under some plausible simplifying assumptions our estimates are converted into predictions for multiplicities for heavy-ion collisions at RHIC and LHC.

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Higgs Boson search at the CMS

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The results of the search for the Standard Model (SM) Higgs Boson with the CMS detector in proton-proton collisions at the LHC at 7 TeV center-of-mass energy are reported. A large number of the Higgs Boson decay channels in the mass range from 110 GeV to 600 GeV are considered, and combined upper limits on the production cross section as a function of the Higgs Boson mass are derived. The SM Higgs is excluded at 95% confidence level in the mass range between 127 GeV and 600 GeV. In addition, searches for Higgs Bosons in scenarios beyond the Standard Model (BSM) lead to improved constraints on the Higgs sector of BSM theories such as Supersymmetry.

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Holographic Description of the QCD Phase Structure and Out of Equilibrium Dynamics

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Holography can now be used to describe gauge theories with broken conformality and supersymmetry as well as fundamental quark fields. Finite temperature and density can also be easily introduced. This allows us to study the phase structure of gauge theories that generate chiral symmetry breaking and confinement in the quark sector. We show a range of results in top down theories and bottom-up effective models including models that share many features of the expected QCD phase diagram. A novel aspect of holography is that out of equilibrium phenomena can be studied. For example we can explore bubble formation in a strongly coupled first order phase transition or models of inflation driven by strong dynamics.

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Monopoles, holonomy and chiral symmetry breaking in QCD.

Author: Adriano Di Giacomo[1]

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The Polyakov loop is shown to be related to the size and mass of the
monopoles which condense to produce confinement.
The 't Hooft loop is instead related to the spatial density of the condensed monopoles. Rubakov effect allows to relate that density to the density of fermionic zero modes, i.e. to chiral symmetry breaking.

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Event-by-event hydrodynamics and correlations in relativistic heavy-ion collisions

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Co-author: Piotr Bozek

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The event-by-event hydrodynamic approach to fluctuations in relativistic heavy-ion collisions is reviewed. After a brief general introduction, we show that all the till-now-puzzling experimental features of two-dimensional two-particle correlations in relative azimuth and pseudorapidity found at RHIC are nicely reproduced with the event-by-event hydro: the shape of the same-side ridge, the collective flow coefficients as functions of relative rapidity, the behavior of the square of the directed-flow coefficient, or the recently-measured differential transverse-momentum correlations. This confirms the applicability of the hydrodynamic description also for the two-body observables and proves the adequacy of the "conventional" approach based on hydrodynamics with the Glauber initial condition, followed by statistical hadronization. We stress the necessity of including the charge- and

transverse-momentum conservation in model simulations, crucial for the detailed agreement with the data.

Summary:

Event-by-event hydrodynamics, two-particle correlations

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pp-collisions in Quark Gluon String Model

Author: Larissa Bravina[1]

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Correlations and fluctuations and well as collective phenomena are considered with Quark Gluon String Model.

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charm production at LHC: an overview

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An overview of results on open and hidden charm production at LHC will be presented.

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LHCb highlights / overview

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The LHCb detector is a spectrometer with acceptance covering the forward pseudorapidity region of 2<eta<5, that is designed primarily to study the properties and decays of heavy flavoured hadrons produced in pp collisions at the LHC. In particular, by studying rare decays and CP violation effects, LHCb can make precise tests of the Standard Model and search for new physics. We review the status of the LHCb experiment including the latest results from the 1 fb-1 data sample collected in 2011.

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LHCb upgrade

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The LHCb experiment is designed to perform high-precision measurements of CP violation and search for New Physics using the enormous flux of beauty and charmed hadrons produced at the LHC. The operation and the results obtained from the data collected in 2010 and 2011 demonstrate that the detector is robust and functioning very well. However, the limit of 1 fbˆ-1 of data per year cannot be overcome without improving the detector. We therefore plan for an upgraded spectrometer by 2018 with a 40 MHz readout and a much more flexible software-based triggering system that will increase the data rate as well as the efficiency specially in the hadronic channels. Here we present the LHCb detector upgrade plans, based on the recently submitted Letter of Intent.

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Charmless B decays as a venue to New Physics: status and prospects

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The LHCb detector is a spectrometer with acceptance covering the forward pseudorapidity region of 2<eta<5, that is designed primarily to study the properties and decays of heavy flavoured hadrons produced in pp collisions at the LHC. In particular, by studying mixing and CP violation effects, LHCb can make precise tests of the Standard Model and search for new physics. We review the status of the LHCb experiment including the latest results on mixing and CP violation in both charm and beauty sectors from the 1 fb-1 data sample collected in 2011.

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Rare B decays as a probe for new physics

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The branching fractions and angular distributions of decays such as Bs -> mu+ mu- and B -> K* mu+ mu- provides information on
possible New Physics (NP) contributions. LHCb is well suited for these analyses due to its large acceptance and trigger efficiency, as well as its excellent invariant mass resolution and lepton identification capabilities. The status of various analyses of rare decays with ˜1 fb-1 of pp collisions collected by LHCb in 2011 at √s=7 TeV is reviewed.

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Production and spectroscopy at LHCb

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During 2011, the LHCb experiment accumulated ˜1 fb−1 of data in proton-proton collisions data at 7 TeV, collecting a sample rich in B mesons and baryons. The data provide a wealth of new measurements as well as probes of QCD theory predictions. We present recent results in quarkonium and b and c hadron production, as well as studies of these states' properties such as masses and decay asymmetries.

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GENERATION OF HIGH-ENERGY PARTICLES, NEUTRINO AND PHOTONS IN MAGNETOSPHERE OF COLLAPSING STAR

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The initial magnetospheres of collapsing star consist with protons and electrons. These particles accelerate during collapse to relativistic energy. Interacting between himself and the magnetic fields, these particles will lose their energy on the ionization and radiation. Electrons will be loss the energy with the most speed, and therefore the electron lifetime is substantially smaller from the protons lifetime. As result the initial electrons will be loss their energy very fast. At the same time in the magnetosphere of collapsing stars will generate the secondary particles namely electrons, protons, neutrons, mesons, neutrino and photons. By the cascade interaction the secondary particles will generate the particles and photons. Thus on the later stage of collapse magnetosphere of collapsing stars consist with the particles and photons generating by multiple interaction of particles. We will consider in detail the mechanisms of the generation of the particles, photons and neutrino in the magnetosphere of collapsing stars.

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Constraints on the QCD phase diagram from imaginary chemical potentials

Author: Massimo D'Elia[1]

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We review our knowledge about the phase diagram of QCD as a function of temperature, chemical potential and quark masses, discussing the constraints put by the presence of tricritical points at imaginary values of the chemical potential.

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QCD thermodynamics and quark number susceptibilities at intermediate coupling

Authors: Aleksi Vuorinen[None]; Jens O. Andersen[1]; Michael Strickland[2]; Nan Su[3]; Sylvain Mogliacci[3]

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The weak-coupling expansion of the QCD free energy is known to the order gˆ6*log[g], however, the resulting series is poorly convergent at phenomenologically relevant temperatures. In this talk I will discuss how the gauge invariant hard-thermal-loop perturbation theory (HTLpt) reorganization of the calculation improves the convergence of the successive approximations to the QCD free energy. I will first present HTLpt results of QCD thermodynamics to 3-loop order, which are consistent with lattice data down to 2-3T_c. This is a non-trivial result since, in this temperature regime, the QCD coupling constant is neither infinitesimally weak nor infinitely strong with g˜2, or equivalently alpha_s˜0.3. Therefore, we have a crucial test of the quasiparticle picture in the intermediate coupling regime. Then I will report preliminary HTLpt results of 1-loop quark number susceptibilities, and compare to both gˆ6*log[g] results from dimensional reduction and lattice data. Our results suggest that HTLpt provides a systematic framework that could be used to calculate static and dynamic quantities for temperatures relevant at LHC.

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Large scale anomalies and pre-inflationary physics

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Current data seems to hint that there are some anomalies at large scales. If correct these anomalies imply that one of the key assumptions in cosmology, statistical isotropy, is broken. We discuss the significance of these anomalies and show that they can be explained via pre-inflationary. We also discuss how near future data (mainly from Planck) will provide us with a unique opportunity to cross correlate these large scale anomalies with short scale features.

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EPR measurement and the origin of cosmic density fluctuations — Quantum mechanics in laboratories and the Universe —

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Density fluctuations in the early Universe determine the whole cosmic structures at present. The very origin of these fluctuations is considered to be the quantum squeezed state in the inflationary era, as described in cosmology textbooks.
However, as many authors often claim, the standard naïve derivation of the density fluctuations is not valid and confuses the quantum average and the statistical correlation. This standard method does not deduce spatially inhomogeneous structures from the symmetric quantum fluctuations.

We have reconsidered this problem in the fundamental point of view. For this purpose we construct the fully physical description of the measurement apparatus in the laboratories and the objective dynamics of the cosmic quantum states. This method is based on the generalized Schwinger-Keldysh effective action theory to describe the causal dynamics of spontaneous symmetry breaking.
Relevant results are the following. (a) We successfully construct a physical description of the local measurement apparatus for squeezed state. (b) Generation of density fluctuations in the early universe is fully parallel to the EPR measurement in laboratories. (c) Highly squeezed quantum state in the inflationary era yields statistical noise on the classical order parameter as in the same way as the EPR measurement. (d) The power spectrum of the primordial density fluctuations turns out to be correct but the amplitude of them drastically varies depending on the cosmic models.

Summary:

EPR measurement and the cosmic density fluctuations in the early Universe share the same physics. We construct a unified description of them based on the generalized Schwinger-Keldysh effective action theory.

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High-energy cosmic rays and tests of basic principles of Physics

Author: Luis Gonzalez-Mestres[1]

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With the present understanding of data, the observed flux suppression for ultra-high energy cosmic rays (UHECR) at energies above 4.10E19 eV can be a signature of the Greisen-Zatsepin-Kuzmin (GZK) cutoff or correspond, for instance, to the maximum energies available at the relevant sources. In both cases, violations of standard special relativity modifying cosmic-ray propagation or acceleration at very high energy can potentially play a role. Thus, UHECR data would in principle allow to set bounds on Lorentz symmetry violation (LSV) in patterns incorporating a privileged local reference frame (the "vacuum rest frame", VRF). But the precise analysis is far from trivial, and other effects can also be present. The effective parameters can be related to Planck-scale physics, or even to physics beyond Planck scale, as well as to the dynamics and effective symmetries of LSV for nucleons, quarks, leptons and the photon. In the presence of a VRF, LSV can modify the internal structure of conventional particles at very high energy and standard symmetries may cease to be valid at energies close to the Planck scale. Other fundamental principles and conventional basic hypotheses (quantum mechanics, quark confinement, energy and momentum conservation, vacuum homogeneity and "static" properties, effective space dimensions…) can be violated at such scales, possibly leading to effects that can be tested in high-energy cosmic-ray experiments. We present an updated discussion of these topics, including experimental prospects and possible new interpretations of the observed UHECR composition in terms of LSV mechanisms where, for instance, the GZK cutoff would be replaced by spontaneous emission of photons or e+ e− pairs. The subject of a possible superluminal propagation of neutrinos at accelerator energies is also dealt with, considering bounds from possible theoretical and phenomenological inconsistencies.

Summary:

Corresponds to, and further develops, the subject of papers arXiv:1202.1277 and arXiv:0908.4070 mentioned in your invitation, as well as the topics covered in my CRIS 2010 paper arXiv:1011.4889.

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Pre-Big Bang, fundamental Physics and noncyclic cosmologies

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WMAP and Planck open the way to unprecedented Big Bang phenomenology, not only for the standard Big Bang scenario but also for less conventional approaches including pre-Big Bang cosmologies. A detailed study of WMAP and Planck data can have significant implications for noncyclic pre-Big Bang approaches incorporating a new fundamental scale beyond the Planck scale and, potentially, new ultimate constituents of matter with unconventional basic properties as compared to standard particles. Alternatives to standard physics can be considered from a cosmological point of view. They would in particular concern the structure of the physical vacuum, the nature of space-time, the origin and evolution of our Universe, the validity of quantum field theory and conventional symmetries, unconventional solutions to the cosmological constant problem, the validity of inflationary scenarios, the need for dark matter and dark energy, the interpretation of string-like theories… Lorentz-like symmetries for the properties of matter can then be naturally stable space-time configurations resulting from more general primordial scenarios that incorporate physics beyond the Planck scale and describe the formation and evolution of the physical vacuum. Then, a possible answer to the question of the origin of half-integer spins can be provided by a spinorial space-time with two complex coordinates instead of the conventional four real ones. Taking the cosmic time to be the modulus of a SU(2) spinor automatically leads to an expanding universe, with a ratio between cosmic relative velocities and distances equal to the inverse of the age of the Universe. No reference to standard matter, hidden fields, gravitation or relativity is required to get this purely geometric result that looks quite reasonable from an observational point of view. We discuss basic ideas and phenomenological issues for noncyclic pre-Big Bang cosmologies in the present context, focusing in particular on their potentialities as alternatives to standard dark matter and dark energy patterns. The cosmological implications of more general patterns involving violations of standard fundamental principles (relativity, quantum mechanics…) at energies close to Planck scale are also considered.

Summary:

Corresponds to, and further develops, the subject of paper arXiv:0912.0725 mentioned in your invitation, as well as the topics covered in my HEP 2011 paper http://pos.sissa.it/archive/conferences/134/479/EPS-HEP2011_479.pdf and in my Planck 2011 contribution arXiv:1110.6171 .

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J/ Measurements with the ALICE Experiment at the LHC

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The ALICE detector provides excellent capabilities to study quarkonium production in proton-proton (pp) and heavy-ion (A-A) collisions at the Large Hadron Collider (LHC).
Quarkonia, bound states of heavy (charm or bottom) quark anti-quark pairs such as the J/psi, are expected to be produced by hard processes. Thus they will provide insights into the earliest and hottest stages of A-A collisions where the formation of a Quark-Gluon
Plasma is expected. Furthermore high-precision data from pp collisions represent an essential baseline for the measurement of nuclear modifications in heavy-ions and serve also as a crucial test for several models of quarkonium hadroproduction.
In ALICE, the J/psi measurement is carried down to p_t = 0, via the e+e− decay channel in the central barrel (|y| < 0.9) and via μ+μ− in the muon spectrometer (2.5 < y < 4.0). Results of the inclusive and

prompt J/psi production cross section in pp collisions at ps = 7 and
2.76 TeV will be presented. A polarization measurement in the forward region and the dependence of the J/psi yield on the charged particle multiplicity in pp collisions will be discussed. Finally, results on the nuclear modification factor (R_AA) at forward rapidity in Pb-Pb collisions at sqrts{s_NN} = 2.76 TeV will be shown and its implications discussed together with prospects for other quarkonia measurements, e.g. the elliptic flow of J/psi.

45

Pseudorapidity density of charged particles in a wide pseudorapidity range and its centrality dependence in Pb-Pb collisions at \sqrt{s_{NN}} = 2.76 TeV

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In this talk we present a measurement of the pseudorapidity distribution in the range −5 < η < 5.25, for different centralities in Pb-Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV. This also allows us to estimate the total number of produced charged particles. The measurement is performed exploiting LHC satellite bunches, that is bunches captured in non-nominal RF buckets. These give rise to displaced vertices in the range −187.5 < zvtx < 375 cm, allowing the ALICE forward detectors (VZERO and FMD) to cover a wide pseudorapidity window. The dependence of dNch/dη on the number of participant nucleons or on the number of binary collisions is sensitive to mechanisms underlying particle production (eg. the effect of gluon saturation). In this contribution ALICE data will be compared to current models and an analysis of the longitudinal scaling will be performed.

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Results from the Daya Bay Reactor Neutrino Experiment

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The precise determination of the neutrino mixing angle θ_{13} is at the focus of current neutrino research. The size of this angle will directly influence our ability to measure CP-violation in the neutrino sector and its role in the dominance of matter over antimatter in the universe. The Daya Bay Reactor Neutrino Experiment has the highest sensitivity to this parameter among all the other experiments that are currently in operation or under construction. The experiment consists of multiple identical detectors placed underground at different baselines from three groups of reactor cores, a configuration that minimizes systematic uncertainties and cosmogenic backgrounds. The experiment has been taking data since August 15, 2011. The current status, including the most recent results, and future plans of the experiment will be presented.

47

Addressing Questions of Fundamental Physics using Concepts of Complexity Science

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Key features of complex systems are their small degree of predictability and the nonlinearity and complexity of the equations, which model the system –if those equations can be deduced at all. However, model-independent methods have been developed to gain information about the underlying systems, their characteristics and their development.
In this talk we will give a review about the concept of surrogate data sets and methods to quantify the information content of phase space representations of arbitrary data sets.
We will then demonstrate interdisciplinar applications of these methodologies in AGN and CMB physics:
X-ray timing observations of a well selected sample of AGNs are analyzed with respect to the detection of nonlinearites to constrain models for mass accretion around black holes.
The CMB as observed with the WMAP satellite is tested for intrinsic non-Gaussianities (NG). We will report on the highly significant detection of NGs at large scales. Further, signatures of anisotropy are found. These results –if further confirmed –would rule out slow-roll single field inflation and question the Copernican principle of homogeneity and isotropy of the space. We will comment on possible origins of these anomalies in terms of e.g. fNL-like and Bianchi-like models.

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Event reconstruction and particle identification in the ALICE experiment at the LHC

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In this talk we give an overview of the methods for track and vertex
reconstruction as well as particle identification performed with the ALICE experiment at the LHC.
Because of very high particle
multiplicities and softness of the particle momentum spectra observed in Pb–Pb collisions, the efficiency of traditional reconstruction algorithms becomes challenging. Therefore, ALICE has implemented a few ad-hoc algorithmic extensions allowing for significant improvements in the reconstruction quality. The strong and weak sides of these extensions are discussed here as well.

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Holographic dilepton production in a thermalizing plasma

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Dilepton production might offer a unique observational window into the thermalization occuring in heavy ion collisions. By using the AdS/CFT duality, we determine the out-of-equilibrium production rate of dileptons in a strongly coupled plasma. Thermalization is decribed by a thin shell in the AdS-space collapsing into a black hole. Just prior to thermalization the dilepton spectral function exhibit oscillations as a function of energy.

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Testing Quantum Foundations with circuit QED

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Circuit QED provides a framework in which the interaction of two-level systems with a quantum field can be naturally considered. The combination of superconducting qubits with transmission lines implement an artificial 1-D matter-radiation interaction, with the advantage of a large experimental accessibility and tunability of the physical parameters. Using these features, fundamental problems in Quantum Field Theory hitherto considered as ideal are now accessible to experiment, as is the case of the recent first physical realization of the dynamical Casimir effect. [1]
In this talk, we will review some of our experi- mental proposals for fundamental tests of Quantum Mechanics and Quantum Field Theory with circuit QED setups, ranging from the first experimental test of the long-lasting Fermi problem on the microcausality at the atomic level [2] to the extraction of quantum correlations from the vacuum of a quantum field to a pair of qubits [3], passing through the observation of non-Rotating Wave Approximation phenomena like ground- state qubit self-excitations [4] and their impact in the interpretation of quantum detection at short times [5].
In particular, in this latter work [5] we have shown that for typical circuit QED parameters, a significative amount of time is needed to start trusting the state of a two-level detector as informative regarding an initially excited two-level source. This is due to the breakdown of the RWA in circuit QED. By neglecting the counterrotating terms a total reliability on the information coming out of the detector would be wrongly derived for all time-scales. Our result applies to other setups and quantum detectors, although it is in the case of circuit QED where it might affect the interpretation of coming experimental results.

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Higgs and Dark Matter from SUSY Decays in the Complex MSSM

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Searches for the Higgs boson as well for the production of Dark Matter (DM) are currently performed at the LHC. Similar measurements will also be possible at a future linear e^+e^- collider (ILC, CLIC). In order to determine the underlying model it is crucial to measure the masses and couplings of Higgs and DM particles with highest precision.

If Supersymmetry is realized in nature, a light Higgs boson should
be discovered at the LHC and the lightest SUSY particle (LSP) is a perfect candidate for DM. An interesting production mechanism for the Higgs and the LSP is the decay of heavier SUSY particles. Measuring these decays to high accuracy will provide important information on the Higgs and DM.

We provide high-precision predictions for these decays, which are crucial for the correct interpretation of the experimental data. Our predictions are obtained in the Minimal Supersymmetric Standard Model (MSSM) including complex phases and constitute the most advanced calculations of these decays.

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Open heavy flavour measurements in pp and Pb-Pb collisions with ALICE at the LHC

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In ultra-relativistic heavy ion collisions heavy flavour quarks (charm and bottom) are primarily produced in the initial hard scatterings. This makes them an important probe of the high energy density QCD matter that is formed in the collision, since they should then experience the full evolution of the system. In particular, heavy flavour measurements can be utilized to test various parton energy loss models, some of which predict that heavy flavour quarks experience less in-medium energy loss than what has been observed for the lighter partons. Additional properties of the deconfined medium can be studied through the measurement of the elliptic flow, v2. The measurement of v2 at low transverse momentum probes the level of thermalization of the heavy flavour quarks.

In this talk, we present an overview of measurements related to open heavy flavour production with the ALICE experiment at the LHC. Studies are performed using single leptons (electrons at mid-rapidity and muons at forward-rapidity) and D mesons, which are reconstructed via their hadronic decay channel. The agreement of perturbative QCD calculations and the measured differential production cross sections in proton-proton collisions at sqrt(s) = 2.76 and 7 TeV will be shown. Results from Pb-Pb collisions at sqrt(s) = 2.76 TeV on the nuclear modification factor (R_AA) as a function of both transverse momentum and collision centrality will also be shown, along with the measured elliptic flow of D mesons and electrons from heavy flavour decays.

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The neutrino telescope ANTARES

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The ANTARES neutrino telescope is currently the largest neutrino detector in the Northern Hemisphere.
The detector consists of a three-dimensional array of 885 photomultiplier tubes, distributed along 12 lines, located at a depth of 2500m in the Mediterranean Sea.
The purpose of the experiment is the detection of high-energy cosmic neutrinos. The detection principle is based on the observation of Cherenkov light emitted by muons resulting from charged-current interactions of muon neutrinos in the vicinity of the detection volume.
The main scientific targets of ANTARES include the search for astrophysical neutrino point sources, the measurement of the diffuse neutrino flux and the indirect search for dark matter.
The talk will present the current status of the experiment and give a brief overview on the first results.

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CMS Upgrades

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In parallel with the LHC machine development program to reach the design conditions, alternating runs for physics and shutdowns to implement beam improvements, also the LHC experiments will proceed to a number of detector upgrades.
In particular various parts of the CMS detector will undergo substantial improvements in order to maintain current excellent detector performance or even to surpass it to cope with the ultimate luminosity that the LHC will deliver in the future.
Detectors involved are mainly hadron calorimeters, muon and pixel systems. Also other CMS infrastructures and facilities will be updated: beam radiation monitoring and luminosity measurements, trigger and data acquisition systems.
This talk will describe the upgrades and plans for carrying them out, with an emphasis on those to be installed earlier in long shutdowns foreseen in 2013/14 and 2017/18.

Summary:

In parallel with the development of LHC collision energy and luminosity to reach the design values, the CMS detector will
undergo substantial improvements in order to fully benefit from ultimate LHC performances. Upgrades involve hadron calorimeters, muon and pixel systems, trigger and data acquisition. Some will be implemented already in the earlier long shutdown foreseen next year.

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Can a Future Choice Affect a Past Measurement's Outcome?

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We study weak quantum measurements within the EPR settings. Each particle is subjected to a few weak measurements, whose individual outcomes are classically recorded. They are followed

by a strong measurement along a spin orientation freely chosen at the last moment. Agreement is expected between all outcomes. This gives rise to the following conflict: i) Bell's theorem forbids quantum values to exist prior to measurement. ii) A weak measurement cannot determine the outcome of a later strong one. iii) No disentanglement is brought about by the weak measurement. The only reasonable explanation for the results seems to be that of the Two-State-Vector Formalism, namely that the weak measurement's outcomes anticipate the experimenter's choice to be made upon performing the strong measurement, even before the experimenter knows their own choice. Causal loops are avoided by this anticipation becoming visible only after the choice is made.

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Unusual Interactions of a Pre-and-Post-Selected Particles

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We argue that weak measurement is a special case of the broader weak interaction, studied herewith. We outline this new kind of quantum interaction and explain its significance within the Two-State-Vector Formalism using perturbative methods. In light of the results, Hardy's Paradox and the Three Boxes Problem are reinterpreted.
As another example, we discuss a harmonic oscillator undergoing weak position and momentum measurements between strong position measurements. This oscillator is studied in the limit of Bohr's correspondence principle, but is nevertheless shown to possess peculiar physical properties, affecting the momentum rather than the position of another oscillator interacting with it.

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Highly-anisotropic hydrodynamics and the early thermalization puzzle in relativistic heavy-ion collisions

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Recently formulated model of highly-anisotropic and strongly dissipative hydrodynamics is used in 3+1 dimensions to study behavior of matter produced in ultra-relativistic heavy-ion collisions. We search for possible effects of the initial high anisotropy of pressure on the final soft-hadronic observables. We find that by appropriate adjustment of the initial energy density and/or the initial pseudorapidity distributions, the effects of the initial anisotropy of pressure may be easily compensated and the final hadronic observables become insensitive to early dynamics.
Our results indicate that the early thermalization assumption is not necessary to describe hadronic data, in particular, to reproduce the measured elliptic flow v2. The complete thermalization of matter (local equilibration) may take place only at the times of about 1–2 fm/c, in agreement with the results of microscopic models.

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Indirect dark matter search with the ANTARES Deep-Sea Cherenkov detector

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In 2008 the ANTARES collaboration completed the construction of an underwater neutrino telescope in the Mediterranean Sea, located 40 km off the French coast at a depth of 2475 m. With an effective area for upward muon detection of about 0.05 km2, depending on neutrino energy, ANTARES is the largest neutrino detector currently operating in the Northern hemisphere.
The experiment aims to detect high-energy neutrinos up to 104 TeV using a 3-dimensional array of 885 photomultipliers distributed in 25 storeys along 12 vertical lines. The detection is based on the measurement of Cherenkov light emitted by charged leptons resulting from charged-current neutrino interactions in the matter surrounding the telescope. The accurate measurements of the photon arrival times and of the deposited charge together with a precise knowledge of the actual positions and orientations of the photo sensors allow the reconstruction of the direction of neutrinos with good angular resolution (about 0.3o for muon neutrinos above a few TeV) and of their energy. ANTARES is performing an indirect search for dark matter by looking for a statistical excess of neutrinos coming from astrophysical massive objects, such as the Sun, the Earth and the Galactic Centre. This excess could be an evidence of the possible annihilation of dark matter particles in the centre of these objects.
In the presently accepted scenario, the dark matter is composed by WIMP particles. These particles loose kinetic energy interacting gravitationally with massive bodies and "fall down" reaching their inner core. Here they can interact with other WIMPs, in self-annihilation reactions, producing some standard model particles that, in subsequent steps, originate neutrinos that can be detected at Earth. The preliminary results of the sensitivity of the ANTARES neutrino telescope to the indirect detection of dark matter fluxes will be presented for different dark matter models.

Summary:

Indirect search of dark matter with the ANTARES neutrino telescope

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Limits on compact halo objects as dark matter from gravitational microlensing

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I will give an overview of the results obtained so far by gravitational
microlensing methods for finding compact objects in the halo of our
Galaxy and in the one of the nearby Andromeda galaxy.
Microlensing observations can clearly exclude a halo fully made
of compact objects, nonetheless they may still contribute
up to some 20% to the halo mass.

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Upsilon suppression in PbPb collisions at LHC energies

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We suggest that the combined effect of screening, gluon-induced dissociation, Landau damping, and reduced feed-down explains most of the suppression of Y states that has been observed by CMS [1] in PbPb relative to pp collisions at sqrt(s_NN) = 2.76 TeV at the CERN LHC. The suppression is thus a clear, albeit indirect, indication for the presence of a qgp.

Summary:

We calculate the suppression of both the Y(1S) ground state in the quark-gluon plasma in minimum-bias PbPb collisions, and of the Y(2S + 3S) states relative to the ground state. In a major extension of our schematic phenomenological approach presented in [2], we now explicitly consider the time dependence with transverse and longitudinal expansion, and the effect of Landau damping [3] on the widths of the states, in addition to gluodissociation.

The effect of Landau damping of the Y(nS) and Chi_b(nP) states is computed from a complex potential, and is found to be of the same order of magnitude as the gluon-induced dissociation [2] for the 1S state at the temperatures that are relevant at LHC.
The gluodissociation is treated explicitly for all five states considered here (1S, 2S, 3S, 1P and 2P), including the influence of the confining string contribution on the dissociation rates.

As compared to pp collisions at the same energy, the feed-down cascade leading to the Y(1S) ground state is drastically modified due to the substantial suppression of the excited states through screening, damping and gluodissociation. The 1S ground state remains very stable with respect to screening, its suppression is essentially due to damping, gluodissociation and reduced feed-down.

Our results are presented for different Y formation times and qgp lifetimes. For reasonable plasma temperatures at Y formation time, we obtain good agreement with the CMS data for the Y(1S) suppression factor, but less suppression than is needed
for the measured [1] ratio Y(2S + 3S)/ Y(1S) - which requires, however, better statistics.
Should the result persist in the 2011 data, it is likely that additional suppression mechanisms are at work.

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New Frontiers in Heavy-Ion Physics: the CBM experiment

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The main goal of the CBM experiment is to study the behaviour of nuclear matter at very high baryonic density in which the transition to a deconfined and chirally restored phase is expected to happen. One of the promising signatures of this new state is the enhanced production of multi-strange particles; therefore the reconstruction of multi-strange hyperons is essential for the understanding of the heavy ion collision dynamics. Another experimental challenge of the CBM experiment is online selection of open charm particles via the displaced vertex of the hadronic decay, J/Psi and low mass vector mesons in the environment of a heavy-ion collision. This task requires fast and efficient track reconstruction algorithms, primary vertex finder and particles finder. Results of feasibility studies of the multi-strange hyperons, charm particles and another key observables in the CBM experiment will be presented.

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Heavy Flavour measurements in the STAR experiment at RHIC

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We present recent selected results on open and hidden heavy flavour production at RHIC measured in the STAR experiment.
STAR is capable of directly reconstructing charmed mesons. Furthermore STAR measures open charm and beauty production via non-photonic electron measurements. STAR has measured J/ψ production over a large range in transverse momentum studying its nuclear modification factor and elliptic flow in A+A collisions. Measurements of J/ψ cross section and polarization at high pT region in p+p collisions deepen our understanding on the J/ψ production mechanism. The Υ production and nuclear modification factor have been measured as a function of centrality in Au+Au collisions. In the future STAR aims in significantly improving Heavy Flavour measurements via new upgrades in particular the Heavy Flavour Tracker and the Muon Telescope Detector.

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Present and future investigations of hadron formation mechanisms in heavy-ion collisions at LHC with the ALICE experiment

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The present status and the future of hadronization mechanism characterization in Pb-Pb collisions at LHC by measuring the pT dependence of baryon over meson ratios will be presented. The current RHIC and LHC results showing a strong enhancement of the Lambda/K0s ratio with respect to pp collisions at intermediate pT and their interpretation in terms of coalesence processes will be discussed.
A crucial extension of these studies to heavy flavor hadrons (D, B mesons and Lambda_c, Lambda_b baryons) will be enabled by the foreseen reforging of the ALICE Inner Tracking system (ITS). The main performance objectives and technological ingredients of the ITS upgrade will be summarized.

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Cleaning up the cosmological constant

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We present a novel idea for screening the vacuum energy contribution to the overall value of the cosmological constant, thereby enabling us to choose the bare value of the vacuum curvature empirically, without any need to worry about the zero-point energy contributions of each particle. The trick is to couple matter to a metric that is really a composite of other fields, with the property that the square-root of its determinant is the integrand of a topological invariant, and/or a total derivative. This ensures that the vacuum energy contribution to the Lagrangian is non-dynamical. We then give an explicit example of a theory with this property that is free from Ostrogradski ghosts, and is consistent with solar system physics and cosmological tests.

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Nuclear effect in charmonium production

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Nuclear effects for J/Psi production in pA collisions are controlled by the coherence and color transparency effects, which well explain data.
Cold matter nuclear effects in AA collisions also involve novel phenomena of double color filtering and boosted saturation scale. Attenuation of J/Psi in the dense matter created in AA collisions is sensitive to the transport coefficient, which is found to be much smaller compared with the results of high-pT hadron production
interpreted within the energy loss scenario.

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Diffractive neutrino interaction: breakdown of PCAC

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Diffractive neutrino-production of pions at low virtuality Q^2 is dominated by the axial current, which is partially conserved. PCAC in the form of the Adler relation connects diffractive diagonal and off-diagonal transitions in the axial channel. This is why high-energy neutrino interactions are usually considered as a sensitive test of the PCAC hypothesis. Final state interactions, known as absorption corrections, lead to a dramatic breakdown of the Adler relation.

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Modification of the Coulomb law and atomic levels in a superstrong magnetic field.

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The photon polarization operator in the superstrong magnetic field induces the dynamical photon "mass" which leads to the screening of the Coulomb potential at short distances z <1/m, m is the mass of an electron.
Because of screening the ground state energy of the hydrogen atom at the magnetic fields B » m^2/e^3 has the finite value E_0 = -me^4/2 \ln^2(1/e^6).
The superstrong magnetic field stimulates the spontaneous production of positrons by naked nuclei by diminishing the value of the critical charge Z_{cr}. The phenomenon of screening of the Coulomb potential by superstrong magnetic field acts in the opposite direction and prevents the nuclei with Z<52 from becoming critical. For Z>52 for a nucleus to become critical stronger B are needed than without taking screening into account.

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Searches for Extra Dimensions at the LHC

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Searches for Extra Dimensions have been performed at the LHC with up to 5 fb-1 of 7 TeV center-of-mass energy proton-proton collision data collected during 2010-2011. We report the result of searches in CMS and ATLAS with final states including photons, leptons, and jets. These results are interpreted in the context of the Large Extra Dimensions models of Arkani-Hamed, Dimopoulos and Dvali (ADD), and Randall-Sundrum (RS) as well as for Universal Extra Dimensions scenarios. No evidence of extra spatial dimensions was observed and limits were placed on various model-dependent parameters.

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Search for permanent Electric Dipole Moments of light ions (p, d, 3He) in storage rings

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The Standard Model (SM) of Particle Physics fails to explain the reason for our very existence since it is not capable to account for the apparent matter-antimatter asymmetry of our Universe. Physics beyond the SM is required and is searched for by (i) employing highest energies (e.g., at LHC), and (ii) striving for ultimate precision and sensitivity (e.g., in the search for electric dipole moments (EDMs)). Permanent EDMs of particles violate both time reversal (T) and parity (P) invariance, and are via the CPT-theorem also CP-violating. Finding an EDM would be a strong indication for physics beyond the SM, and pushing upper limits further provides crucial tests for any corresponding theoretical model, e.g., SUSY. For about half a century, neutron EDM (nEDM) measurements at many laboratories worldwide are trying to extend the already impressive experimental limits even further.

Searches for EDMs of the proton, the deuteron, and of heavier nuclei bear the potential to reach even higher levels of sensitivity (˜10ˆ-29 ecm). Since it is essential to perform EDM measurements on different targets in order to unfold the underlying physics, pEDM and dEDM searches are must-do experiments. EDM experiments with charged particles are only possible at storage rings. In the ultimate experiment with a sensitivity beyond ˜10ˆ-29 ecm, the EDM signal would be the vertical polarization produced by the EDM-induced precession of the frozen horizontal spin in a permanent radial electric field of a dedicated electric storage ring. For an all electric storage ring for protons, this goal is pursued by the BNL-EDM collaboration, while the newly found Juelich-based JEDI collaboration is pursuing an approach that shall employ eventually a combined electric-magnetic lattice which will allow access to protons, deuterons, and 3He ions.

As an intermediate step, a first direct measurement of the EDMs of protons and deuterons at ˜10ˆ-24 ecm sensitivity level will be carried out in the conventional magnetic storage ring COSY of Forschungszentrum Juelich. Here the EDM signal would be the horizontal polarization produced by the EDM-induced precession of the frozen vertical spin in a radio-frequency electric flipper with horizontal electric field. Apart from providing the first direct access to pEDM and dEDM, literally all the outstanding technological and instrumental challenges for the proposed studies at COSY constitute groundbreaking work for the next generation of dedicated electric storage rings. The research environment at Juelich coupled to the strong experienced groups of scientists and engineers from Juelich, RWTH-Aachen, and Brookhaven National Laboratory, coupled with the strong experienced groups of scientists and engineers from major Institutions from around the world provides the ideal starting point, and constitutes, on a world-wide scale, the optimal basis for one of the most spectacular possibilities in modern science: Finding a signal for new physics beyond the Standard Model through the detection of permanent electric dipole moments in a storage ring.

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Performance of the ATLAS Detector

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The performance goal expectations and realizations of the ATLAS detector at LHC are described. Attention is given to performance of the tracking and calorimetry subsystems, performance of electronics in the radiation environment, and the handling of pileup.

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J/psi production in ultra-peripheral heavy-ion collisions at forward rapidity with the ALICE experiment

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Vector meson production in photonuclear interactions can be studied in a yet unexplored kinematic regime at LHC energies. In 2011, during the LHC PbPb run, at a centre of mass energy of 2.76 TeV per nucleon pair, dedicated triggers were used by the ALICE Collaboration to select ultra-peripheral collisions and measure the J/psi production cross section and its rapidity dependence in the mu+mu- channel at forward rapidities, using the muon spectrometer. The analysis also used information from the Silicon Pixel and the VZERO scintillator detectors.

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Open heavy flavor and quarkonia measurements in heavy ion collisions at RHIC.

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The properties of the hot and dense nuclear matter produced at RHIC in heavy ion collisions can be investigated in multiple ways by heavy flavor production. The STAR and PHENIX experiments have excellent capability to study both open heavy flavor and quarkonia.
Heavy quarks are produced in early stage of the collisions and the mechanisms of their interaction with nuclear matter are not yet well understood. The open heavy flavor hadrons can
be studied using electrons from their semileptonic decays or via direct reconstruction through their hadronic decay channels.
The heavy quarkonia production is expected to be sequentially suppressed depending on the temperature of the produced nuclear matter. However cold nuclear matter effects play
important role and has to be well understood.
In this talk we present recent results from RHIC heavy ion program on non-photonic electrons, direct reconstruction of charm mesons, J/psi as well as Upsilon in p+p, d+Au and Au+Au
collisions at 200 GeV. These measurements are put in the context of recent results from LHC heavy ion program.

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Thermal characteristics confronting trace anomaly and intrinsic canonical structure of QCD

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Based on the hypotheses assumed but left without proof in the paper : S. Kabana and P. Minkowski, 'On the thermal phase structure of QCD at vanishing chemical potentials', Int.J.Mod.Phys. A26 (2011) 3035-3050, arXiv:1001.0707 [hep-ph] , the structural ingredients implementing these prooves are taken up , as they relate to the gauge- and boundary-conditions obeyed by thermal parameters and rooted in the infrared completion of the theory.

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The Dark Matter annual modulation results from DAMA/LIBRA

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The DAMA/LIBRA set-up (about 250 kg highly radiopure NaI(Tl)) is running at the Gran Sasso National Laboratory of the I.N.F.N.. The results of six annual cycles (exposure of 0.87 ton x yr) exploiting the model independent annual modulation signature for the presence of Dark Matter particles in the galactic halo will be introduced. The cumulative exposure with those previously released by the former DAMA/NaI experiment is 1.17 ton × yr, corresponding to 13 annual cycles, and the confidence level for the observed effect is 8.9 sigma. The data satisfy all the many requirements of the Dark Matter annual modulation signature. No systematics or side reaction able to mimic the observed effect (that is, able to account for the (2-6) keV single-hit events annual modulation amplitude and simultaneously satisfy all the many peculiarities of the signature) is available or suggested by anyone over more than a decade. The data of a further annual cycle, collected before the last relevant upgrading occurred at fall 2010, is already under analysis. Presently DAMA/LIBRA is in data taking in a new configuration equipped with new high quantum efficiency PMTs. Results, implications and experimental perspectives will be addressed.

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Muon Colliders

Author: Robert Palmer[1]

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Negligible synchrotron radiation allows a multi-TeV muon collider's collisions and acceleration to be in rings. This allows a muon collider's footprint to be smaller than that of a necessarily linear electron collider. For the same luminosity, because the muons collide around 500 times, the colliding muon beams can be less intense and have larger cross sections. Wall power consumption can be less. But the production and cooling of muons is much harder than of electrons. The muons are made by the decay of pions, made by an intense proton beam interacting a liquid metal target. The muons are 'ionization cooled' by energy loss in liquid hydrogen, alternating with re-acceleration with rf. Cooling and acceleration must be rapid to avoid excessive decay loss. Decay electrons in the collider ring, and detector, are challenging. A robust design, simulation and experimental 'Muon Accelerator Program' (MAP) is studying these questions.

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Neutron emission from electromagnetic dissociation at LHC measured with the ALICE ZDC

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The ALICE Zero Degree Calorimeter system (ZDC) consists of two identical sets of calorimeters, placed on each side of the interaction point (IP), complemented by two small forward electromagnetic calorimeters (ZEM). Each set of detectors consists of a neutron (ZN) and a proton (ZP) ZDC, placed at zero degrees with respect to the LHC beam line to detect neutrons and protons emerging from hadronic and electromagnetic heavy-ion collisions. During the $\sqrt{s_{NN}}$ = 2.76 TeV Pb-Pb data-taking period, a run was dedicated to measuring these two processes, requiring a minimum energy deposition in at least one of the two ZN. The ZEM calorimeters made it possible to separate the different processes and the ZN allowed distinguishing single neutron vs. multiple neutron emission. The experimental results will be presented and compared to theoretical predictions.

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NOvA experiment in light of non-zero theta13

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NOvA is an off-axis long baseline neutrino experiment searching for muon neutrino-to-electron neutrino oscillations using an upgraded NuMI neutrino beam from Fermilab, Batavia, IL, USA. With the recent discovery of a non-zero value of theta13 parameter of the neutrino mixing matrix, NOvA has a great potential for measuring a CP violation in the lepton sector and establishing the neutrino masses hierarchy. These two are the main goals of the experiment.

A large 14 kton Far detector, comprised of liquid scintillator contained in extruded PVC cells, will also provide an opportunity for other non-accelerator physics searches. While civil construction at the far detector is underway, a smaller prototype near detector has been assembled at Fermilab and is being studied.

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Recent results from lattice QCD

Author: Christian Hoelbling[1]

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I will give a short overview of lattice QCD highlighting some recent results and future challenges. In particular I will present recent progress in hadron spectroscopy, flavor physics and in the understanding of the QCD phase diagram where lattice QCD is able to provide some first-principle predictions with controlled systematic errors.

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Highlights from the T2K experiment

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The T2K experiment is a long-baseline neutrino oscillation experiment. Accelerator-based muon neutrinos produced in a very high intensity proton accelerator of Japan Proton Accelerator Research Complex (J-PARC) are detected by far neutrino detector called Super-Kamiokande located 295km far from J-PARC. Main physics motivation is a measurement of neutrino mixing angle Theta_13 using an oscillation channel, nu_mu -> nu_e, so called nu_e appearance.
The first T2K result of Theta_13 measurement published in June 2011 reported that 6 nu_e candidate events were observed using data corresponding to 1.43x10^20 protons exposed to target and allowed region for Theta_13 was 0.03 < sin^2 (2 theta_13) < 0.28 with 90% confidence level.
After long shutdown due to a big earthquake and power supply failure, physics data taking was restarted from March 2012. The accumulated data by the end of May 2012 will be 2.9x10^20 protons

on target, which is as twice data as taken by March 2011. Analysis results will be presented in the conference talk.

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Listening to the Universe with gravitational-wave interferometers: Recent observational results from LIGO and Virgo

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As we approach the era of second generation ground-based interferometers, gravitational waves have the potential to let us expand astronomy into an entirely new regime. We summarize recent observational results obtained from LIGO and Virgo's previous science runs and discuss future prospects. We focus in particular on the connections between gravitational waves and other astronomical messengers.

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Experimental perspectives of atom photon-interactions: From fundamental tests to quantum simulations

Author: Yiri Minar[1]

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Today we are at the point, where the level of precision of manipulation of atomic systems makes them very appealing platforms for various communities with applications ranging from quantum information and communication tasks to quantum simulators of condensed matter or even high energy physics phenomena. We shall discuss two specific applications. One is the fabrication of particular entangled states of light and matter with cavity QED techniques used in device independent quantum communication. The other one is the many body physics of cold atoms in artificial non-abelian gauge fields.

85

The sounds of the Big and the Little Bangs

Author: Edward Shuryak[1]

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The talk is about recent discovery of the sound propagating across the fireball created in Heavy Ion collisions (the Little Bang). Its basic physics is about the same as that in the Big Bang, seen as perturbations of Cosmic Microwave background. The theory is described and compared with correlations functions recently measured at RHIC and LHC. While the initial state perturbations are caused by fluctuation in the nucleon interactions, another source of sounds are jets. We end up describing the emerging theory and phenomenology of jet-related sounds.

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NICA Complex - Status and Plans

Authors: Alexander Kovalenko[1]; Alexander Sorin[2]; Grigory Trubnikov[3]; Igor Meshkov[4]; Richard Lednicky[5]; Viktor Matveev[6]; Vladimir Kekelidze[2]

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One of the main directions of the scientific research at the Joint Institute for Nuclear Research (JINR) in Dubna is the relativistic nuclear and spin physics. The new JINR flagship program in this direction is now realized within the project NICA (Nuclotron-based Ion Collider fAcility). The main goal of the NICA scientific program is an experimental study of hot and dense strongly interacting matter in heavy ion collisions at nucleon-nucleon centre-of-mass energies of 4-11 GeV and at average luminosity of 1027 cm-2s-1 for Au (79+) in the collider mode. In parallel, fixed target experiments at the upgraded JINR superconducting synchrotron Nuclotron are carried out with the extracted beams of various nuclei species up to gold with the momenta up to 13 GeV/c for protons. The program also foresees a study of spin physics with extracted and colliding beams of polarized deuterons and protons at the centre-of-mass energies up to 26 GeV for proton collisions. The proposed program allows to search for possible signs of the mixed phase and critical endpoint, and to shed more light on the problem of nucleon spin structure. The survey of the main directions of the JINR scientific research program and general design and construction status of the NICA complex are presented.

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Status and developments of Advanced Ligo and Advanced Virgo gravitational wave detectors

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The status of the Ligo and Virgo Advanced detectors of
gravitational waves is reviewed. After a resume of the sensitivities reached by the first generation detectors, the relevant instrumental up-grades are considered and discussed, detailing how they will contribute to lower the detectors' noise level in
the different frequency bands. The resulting, overall sensitivity of the advanced gravitational wave observatories allows finally to present the detection rates for the best known gravitational wave sources

Summary:

The status of the Ligo and Virgo Advanced detectors of
gravitational waves is reviewed. First we present the sensitivities reached by the detectors so far. Hence we present the most important up-grades, we consider the most relevant instrumental developments, the technical problems, the most innovative solutions.
In particular we focus on seismic isolation, low-thermal noise suspensions systems, interferometers optical schemes, non classical light states.
We show that the expected sensitivities are promising with respect to the detection rates for the best known gravitational wave sources

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New States with Heavy Quarks

Author: Marek Karliner[1]

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I discuss several highly accurate theoretical predictions for masses of baryons containing the b quark which have been recently confirmed by experimental data from CDF and LHCb. Proper treatment of the color-magnetic hyperfine interaction in QCD is crucial for obtaining these results. Several predictions are given for additional properties of heavy baryons. I also discuss the two charged exotic resonances Z_b with quantum numbers of a (b bbar u dbar) tetraquark, very recently reported by Belle in the channel Upsilon(nS)pi+, n=1,2,3. Among possible implications are deeply bound I=0 counterparts of the Z_b-s and existence of a (Sigma_b +Sigma_b-) dibaryon, a beauteron.

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The relevance of light dark matter

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Current limits from Dark Matter search experiments suggest fresh considerations of a candidate much lighter than the TeV scale. I review some of the issues from the point of view of cosmology, and some suggested search strategies. Finally I present a possible model which accommodates Dark Matter and Dark Energy as related phenomena in which fermionic dark matter of keV to MeV scale is natural.

Summary:

A concordant model of Dark Matter and Dark Energy where the Dark Matter candidate is fermionic and naturally light.

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String Cosmology and the LHC

Author: Nikolaos Mavromatos[1]

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I discuss implications of stringy models of the Early Universe for the dark sector, with emphasis on dark matter. I pay particular attention to discussing the role of time-dependent moduli fields, such as the dilaton, on modifying the dark matter abundances, which has important phenomenological

implications for new physics (e.g. supersymmetry) searches at Colliders such as the LHC. In particular, the dominance of the dilaton at early eras may lead to dilution of the thermal dark matter relic abundance of the leading dark matter candidates (e.g. neutralino), thereby leaving more room for Supersymmetry in the cosmologically available parameter space as compared to the Standard Cosmology. Moreover, in some stringy models of the Early universe, involving space-time D-brane defects, one also encounters CPT Violation at the Early epochs, which may result to leptonic asymmetry. The latter can be communicated to the baryon sector via topologically non-trivial sphaleron processes or baryon - lepton number conserving processes in grand unified theories. This could then lead to the observed baryon asymmetry of the Universe under some natural assumptions.

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Effect of jets on v_4/v_2^2 ratio and constituent quark scaling in relativistic heavy-ion collisions

Authors: Evgeny Zabrodin[1]; Gyulnare Eyubova[2]; Larissa Bravina[2]

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The Monte Carlo HYDJET++ model, that combines parametrized hydrodynamics with jets, is employed to study formation of second v_2 and fourth v_4 components of the anisotropic flow in ultrarelativistic heavy-ion collisions at energies of RHIC and LHC, respectively.
It is shown that the quenched jets contribute to the soft part of the $v_2(p_T)$ and $v_4(p_T)$ spectra. The jets increase the ratio v_4/v_2^2 thus leading to deviations of the ratio from the value of 0.5 predicted by the ideal hydrodynamics. Together with the event-by-event fluctuations, the influence of jets can explain quantitatively the RHIC data and qualitative behavior of the v_4/v_2^2 vs. p_T at LHC. However, about 25\% of the magnitude of the signal is still missing. Jets are also responsible for violation of the number-of-constituent-quark (NCQ) scaling at LHC despite the fact that the scaling is certainly fulfilled for the hydro-part of particle spectra.

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The eRHIC project

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"The eRHIC project plans to expand Brookhaven National Laboratory's Relativistic Heavy Ion Collider (RHIC) with a high-intensity electron beam. Building on the exciting discoveries of RHIC, CERN, HERA and others, eRHIC will break new ground in collider luminosity and will push the frontiers of knowledge in nucleon and nuclear structure and in spin physics. The varied eRHIC physics programme and the proposed machine design will be presented and discussed."

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The Neutrinoless Double Beta Decay, Physics beyond the Standard Model and the Neutrino Mass.

Author: Amand Faessler[1]

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Neutrinoless Double Beta Decay is presently the only known experiment to distinguisch between Dirac neutrinos, different from their antiparticles, and Majorana neutrinos, identical with their antiparticles. In addition the neutrinoless double beta decay allows to determine the absolute scale of the neutrino masses, what is not possible with neutrino oscillations. To determine the neutrino masses one must assume, that the light Majorana neutrino exchange is the leading mechanism and that the matrix element of this transition can ba calculated reliably. The experimental nuetrinoless transition amplitude in this mechanism is a product of the light left handed effective Majorana neutrino mass and this matrix element. The different methods, Quasi-particle Random Phase Approximation (QRPA), Shell model (SM), Projected Hartree-Fock-Bogoliubov (PHFB) and Interacting Boson Model (IBM2) used in the literature and the reliability of the matrix elements in these approaches are reviewed.
The second part it is devoted how to determine the leading mechanisms from the data of the neutrinoless double beta decay decay in different nuclei. Expicite expressions are given for the transition matrix elements.
It is shown, that possible interference terms allow to test CP (Charge and Parity conjugation) violation.

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Clustering of Color Sources and the Equation of State of the QGP

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One of the main goal of the study of relativistic heavy ion collisions is to study the de-confined matter, known as Quark-Gluon Plasma(QGP), which is expected to form at large densities. Possible phase transition of strongly interacting matter from hadron to a quark-gluon plasma state have in the past received considerable interest. It has been suggested that the transition from hadronic to QGP state can be treated by percolation theory. The clustering of color sources and their percolation is used to determine the equation of state (EOS) of the Quark-Gluon Plasma (QGP) produced
in central A-A collisions at RHIC and LHC energies. The results on the bulk thermodynamic quantities energy density, entropy density and the sound velocity will be presented.

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Top Physics at the CMS

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In 2011, an integrated luminosity of more than 5 fb-1 at 7 TeV has been delivered by the LHC. The measurement of cross section in top quark pair and single top production have been performed at the CMS experiments with this data. It already started to constrain the SM predictions. The

measurement of top quark mass and properties have also been performed. New physics was also searched looking for ttbar resonance as well as the possible deviation from the SM. The overview of the latest results of these measurements and searches will be presented.

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The Old New Frontier: Studying the CERN SPS Energy Range with NA61/SHINE

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With the Large Hadron Collider entering its third year of granting us insight into the highest collision energies to date, one should nevertheless keep in mind the unexplored physics potential of lower energies. A prime example here is the NA61/SHINE experiment at the CERN Super Proton Synchrotron. Using its large-acceptance hadronic spectrometer, SHINE aims to accomplish a number of physics goals: measuring spectra of identified hadrons in hadron-nucleus collisions to provide reference for accelerator neutrino experiments and cosmic-ray observatories, investigating particle properties in the large transverse-momentum range for hadron+hadron and hadron+nucleus collisions for studying the nuclear modification factor at SPS energies, and measuring hadronic observables in a particularly interesting region of the phase diagram of strongly-interacting matter to study the onset of deconfinement and search for the critical point of strongly-interacting matter with nucleus-nucleus collisions.

This contribution shall summarise results obtained so far by NA61/SHINE, as well as to present the current status and plans of its experimental programme.

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Charmonium dissociation and heavy quark transport in hot quenched lattice QCD

Authors: Anthony Francis[1]; Frithjof Karsch[2]; Helmut Satz[3]; Heng Tong Ding[4]; Olaf Kaczmarek[3]; Wolfgang Söldner[5]

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We study the properties of charmonium states at finite temperature in quenched lattice QCD on large and fine isotropic lattices. We perform a detailed analysis of charmonium correlation and spectral functions both below and above T_c. Our analysis suggests that both S wave and P wave states disappear at about $1.5T_c$. The charm diffusion coefficient is estimated and found to be compatible with zero below T_c and approximately $1/\pi T$ at $1.5T_c$
$lesssimT$
$lesssim3T_c$

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CP violation in D-meson decays and the fourth generation

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LHCb collaboration measured CPV at the level of one percent in the difference of assymetries in $D^0(\bar{D}^0) \to \pi^+\pi^-, K^+K^-$ decays. If confirmed on a larger statistics and final systematics this would mean New Physics manifestation. The fourth quark-lepton generation can be responsible for the observed effect.

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Directed flow measurement in Pb-Pb collisions with ALICE at the LHC

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Directed flow, v1, is measured over a wide range of pseudo-rapidity, |eta|<5.1,in Pb-Pb collisions at 2.76 TeV with ALICE at the LHC.
The results of v1 are reported as a function of the pseudo-rapidity and the transverse momentum for different collision centrality classes. Using the neutral spectator deflection at beam rapidity we investigate both the rapidity asymmetric v1 which is sensitive to the collision reaction plane, together with the rapidity symmetric v1 which is sensitive to the energy fluctuations in the initial geometry.
Results are compared to RHIC measurements.

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Femtoscopic results in pp and Pb-Pb collisions from ALICE

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Femtoscopic correlations arise at low relative momentum where quantum statistics and final-state interactions play a dominant role in particle correlations. Information about the particle emitting source such as its size, shape, chaoticity, and dynamics can be obtained with femtoscopy. Here we present the recent results of 2-particle and 3-particle correlations with mesons and baryons in sqrt(s) = 7 TeV pp and sqrt(s)_{NN}=2.76 TeV Pb-Pb collisions from ALICE.

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Quantum Physics with Massive Objects

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Over the past decades experimental quantum physics, in particular quantum optics, has enabled a great level of control over single and ensembles of micro-objects like atoms, photons, neutrons etc. Amongst others this allowed experiments that flesh out and confirm the principles underlying the quantum picture of the world.

Due to the size of the related systems in such experiments gravitation hardly ever plays a role - if it does, then typically as a classical external force only. However, to perform tests and gain understanding at the interface of quantum and gravitational physics, the design of conceptually simple quantum experiments using objects with significantly higher mass is highly desirable. One route towards such experiments has recently emerged: rapid progress has been achieved towards the control of massive mechanical resonators on the quantum level. The vistas are the generation of macroscopic quantum superpositions of massive objects and, more on the technological side, unprecedented levels of sensitivity in detection of force and mass.

I will give an overview of the relevant experiments with a focus on the field of cavity-optomechanics, where the mechanical resonators are coupled to intra-cavity light fields. This allows using quantum optics as a well-developed tool box for entering and controlling the quantum regime of such systems. I will introduce basic concepts in the field and the latest progress in laser cooling micromechanical resonators and the creation of optomechanical entanglement. An emphasis will lie on potential experiments that test quantum theory for massive objects.

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Hard and soft QCD physics in ATLAS

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Hard and soft QCD physics in ATLAS

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W, Z and diboson physics with ATLAS

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W, Z and diboson physics with ATLAS

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New Physics searches with ATLAS

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Highlights from New Physics searches with ATLAS

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SUSY searches at the CMS

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In this talk we will summarize the current status of CMS SUSY searches in final states with and without leptons. We will discuss interpertations of the results in the context of both CMSSM, as well as Simplified Models which provide a wider spectrum of mass splittings than allowed by the CMSSM. Finally we will mention strategies considered in order to enlarge the SUSY discovery potential.

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QFT in a de Sitter Universe: an Approach to Quantum Theory and Cosmological non-locality

Author: Ignazio Licata[1]

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One of the greatest problems of theoretical physics is the unification of GR and QM, and the elimination of their "singularities".We will show that this goal requires a careful reconsideration of the ordinary interpretations of space, time and relationships between QM and QFT.We write the QFT on de Sitter universe, in a new quantum cosmology scenario, the Archaic Universe .We use the concept of "transaction" in order to unify QM and QFT and investigate the cosmological non-locality, as described by Bohm with the concept of "holomovement".

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Present and future strategies for Neutrinoless Double Beta Decay

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Double Beta Decay (DBD) is a second order nuclear transition in which a nucleus (A,Z) decays emitting two electrons or two positrons. If the transition is accompanied by the emission of two (anti)neutrinos, we speak of 2nuDBD, a phenomenon predicted in 1935 by Maria Goeppert-Mayer and well inserted in the framework of the Standard Model of particle physics. If the two charged leptons come alone, then we speak of Neutrinoless DBD (0nuDBD): a Lepton Number violating process which can take place only if neutrinos are massive and if they are equal to their anti-particles, thus being Majorana particles.

The renewed interest in Neutrinoless Double Beta Decay searches is due to the fact that the Majorana nature of neutrinos is expected in many theories beyond the Standard Model, and by the fact that we now know, thanks to the neutrino oscillation experiments, that neutrinos are massive, as expected in these theories and not requested in the Standard Model. Moreover, since these experiments measure only the absolute value of the difference between the neutrino mass eigenstates, the discovery of 0nuDBD would help to disentangle questions that still remain unsolved: what is the absolute mass scale of the neutrinos and which mass hierarchy (normal, inverted or quasi-degenerate) is the correct one?

This talk will not only review the present results reached in the field by the different experiments worldwide, but will also illustrate the near and long-term strategies to reach the sensitivity to the inverted hierarchy of neutrino masses.
Special care will be devoted also to the theoretical estimations of the decay amplitude, which is needed to compare the results from different experimental approaches and to infer precisely the neutrino mass.

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Signatures of critical fluctuations in intermittency analysis of the proton transverse momenta in A+A collisions at the NA49 experiment (SPS, CERN)

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We calculate the second factorial moment in the transverse momentum space of protons in A+A collisions at the NA49 experiment (SPS, CERN) produced at midrapidity. The corresponding correlator shows a power-law dependence on the number of phase space cells for the systems Si+Si and Pb+Pb at 158A GeV with large values of the associated characteristic exponent (intermittency index). This behaviour is expected to occur when approaching the chiral critical endpoint of hadronic matter. Especially for the Si+Si system the measured intermittency index approaches in size the predictions of critical QCD. The intermittency effect is suppressed in Pb+Pb collisions at 40A GeV. Our analysis suggests that the value of the critical baryochemical potential should be closer to 240 MeV than to 380 MeV.

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Recent results from PHENIX on the evolution of hot QCD

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In the early years of RHIC it has been established that in heavy ion collisions hot and dense partonic matter is produced In this presentation we report on recent PHENIX results related to the initial conditions and hydrodynamic evolution of this matter.
A key feature of the QCD phase diagram is the existence of a critical point where the first order phase transition ends and a smooth crossover between the hadron gas and quark-gluon plasma (QGP) phases starts taking over [2]. The RHIC energy scan program explores the phase transition by varying collision energies from √sNN= 7.7 to 200 GeV and colliding different size nuclei (Cu, Au). The excitation function and centrality dependence of multiplicity distribution and transverse energy density was studied over the wide range of collision energies. Systematic study of the hydrodynamical flow (vn, n = 2, 3, 4 at various energies) provides information on the initial geometry of the collision and the dynamics of the plasma. The opaqueness of QGP was signalized by the large suppression of high-pT inclusive pion production in Au+Au collision at √sNN= 200 GeV [3, 4]. The RHIC energy scan program provided an opportunity to study the evolution of the suppression [5].
Direct photons are an important probe of the nuclear matter: they leave the partonic medium without strong interaction and depending on their pT they provide information about the thermal radiation, jet-medium interaction and initial hard scattering. Low-pT photons are interpreted as thermal radiation from the QGP and the hadron gas phase. The measured large thermal photon yield [6] suggests a very high initial temperature QGP matter as the source, while the observed high v2 of photons [7] is more consistent with dominant production in the hadron gas phase. New results of measuring direct photons by external conversion will be also presented.

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1
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Quantum spacetime and noncommutative Schwarzschild black holes

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It is now widely accepted that noncommutative or 'quantum' spacetime provides a framework to model quantum gravity effects. We describe a new wave-operator approach to this in which wave equations arise out of an anomaly for the extension of differential calculus from the classical to the quantum case in a covariant manner. The anomaly is resolved by an extra dimension and we show how gauging this introduces gravity to the model. We look particularly at the Schwarzschild black hole in this framework and by study of the noncommutative wave operator we show that the infinite time dilation or redshift factor which classically is present at the event horizon is smoothed over and made finite by quantum effects. We look at the possibility of testing this and also at the implication for standing waves now possible inside the black hole.

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New Results from The CMS Experiment

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The CMS experiment at the CERN Large Hadron Collider has produced dozens of groundbreaking results from the analysis of its 2011 data sample of 5 inverse femtobarns of proton-proton collisions at 7 TeV centre-of-mass energy, as well as a smaller data sample of heavy ion collisions at the centre-of-mass energy of 2.76 TeV per nucleon.
In this talk an overview of the most important new results will be offered, with particular emphasis on the ongoing searches for the Standard Model Higgs boson, the search for rare B meson decays, and the search for new exotics phenomena and Supersymmetric new particle signatures.

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Highlights from the OPERA experiment

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The OPERA neutrino detector built in the underground Gran Sasso Laboratory is designed to detect muon-neutrino to tau-neutrino oscillations in direct appearance mode. The hybrid apparatus consists of an emulsion/lead target complemented by electronic detectors. It is placed in the long-baseline CERN to Gran Sasso neutrino beam (CNGS) 730 km away from the source.
The running of the experiment and the extraction of data recorded in the emulsion will be described, together with the special procedures used to locate interaction vertices and detect short decay topologies.
OPERA is taking data since 2008 and a first nu-tau interaction candidate has been found in 2010. New oscillation search results with increased statistics will be presented. Up-to-date results of measurements of the neutrino velocity on the 730 km CERN-OPERA baseline using short-bunched beams will also be reported.

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The ICARUS experiment at LNGS underground laboratory

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ICARUS (Imaging Cosmic And Rare Underground Signals) is, so far, the largest Liquid Argon Time Projection Chamber (LAr-TPC containing ˜600 tons of LAr) addressed to the study of “rare events” and, among them, neutrino interactions.
Installed and operating underground, at the Gran Sasso National Laboratory (INFN-LNGS, Italy), ICARUS started working gradually since summer 2010, collecting events from both, the cosmic rays able to reach the depth of the laboratory, and the CNGS neutrino beam.
The detector, providing a completely uniform imaging and calorimetry with a high accuracy on massive volume, allows for complete event reconstruction.

The detection technique, as well as detector main features and performance will
be described.
The recent measurement of the velocity of neutrinos with short bunched CNGS beam, consistent with the speed of light, will be discussed. Also, the search for the analogue to Cherenkov radiation effect for superluminal neutrinos, will be briefly presented.

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Decoherence of QCD radiation in a quark-gluon plasma

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As a first step towards an understanding the physics of jet modifications in heavy-ion collisions, we analyze the radiation off a QCD antenna propagating through a dilute quark-gluon plasma. The resulting spectrum is characterized in terms of the hardest scale of the problem. We show that this scale is either 1) the inverse size of the antenna as probed by the medium or 2) the maximal momentum transfer from the medium, given by the saturation scale of the QGP. In the former case, called the dipole" regime, the antenna preserves its color correlation during the passage through the QGP and radiates coherently. In the latter situation, called thedecoherence" regime, the antenna constituents decohere and the resulting spectrum is predominantly the superposition of the independent spectra off the two components. In both cases, however, vacuum coherence is restored for gluons emitted with transverse momenta larger than the hard scale of the associated regime. We explore the typical timescales relevant for emissions in both cases.

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Production of Antinuclei at the Relativistic Heavy Ion Collider

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Nuclear collisions recreate conditions that existed in the universe microseconds after the Big Bang, and offer a unique opportunity to study exotic states such as antinuclei. The production and properties of antinuclei, including antihypernuclei, have implications spanning nuclear and particle physics, astrophysics, and cosmology. In 2010, the STAR collaboration at the Relativistic Heavy Ion Collider published the first observation of antinuclei with non-zero strangeness, based on AuAu collision datasets recorded in 2007 and prior years. This was followed in 2011 by the discovery of the anti-alpha, the heaviest antinucleus observed to date. The talk also includes an outline of prospects for future work in this area.

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Cosmology in a petri dish? Simulation of collective dynamics of colloids at fluid interfaces

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Interfacially trapped, micrometer-sized colloidal particles
interact via long-ranged capillary attraction which is
analogous to two-dimensional screened Newtonian gravity
with the capillary length l as the tuneable screening length.
Using Brownian dynamics simulations, density functional theory, and
analytical perturbation theory, we study the dynamics of an initially prepared distribution of colloids, either a random homogeneous distribution, or a finitely-sized patch of colloids. Whereas the limit $l \to \infty$ corresponds
to the global collapse of a self-gravitating fluid,
for smaller l the dynamics crosses over to spinodal
decomposition showing a coarsening of regions of enhanced density which emerge from initial fluctuations [1,2]. For the finite patch of colloids and intermediate l we predict theoretically and observe in simulations a ringlike density peak at the outer rim of the disclike patch, moving as an inbound shock wave [1].
Experimental realizations of this crossover scenario appear to be well possible for colloids trapped at water interfaces and having a radius of around 10 micrometer [3].
Finally, the influence of hydrodynamic interactions on this capillary collapse will be discussed.

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CLIC: Status and Plans

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The Compact Linear Collider (CLIC) is a high energy electron-positron collider with a maximal centre-of-mass energy of 3 TeV. In order to achieve high luminosity small bunches with high intensity are necessary. These lead to strong beam-beam forces, which create a challenging background environment.

The accelerator scheme and the detectors designed for CLIC will be presented. Results from detector benchmark studies presented in the CLIC conceptual design report will be summarised. An outlook for the coming years of accelerator and detector R&D for CLIC will be given.

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Measurement of the $\mu \to e\gamma$ branching ratio in the MEG experiment t

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Lepton Flavour Violation, while forbidden in the Standard Model, is expected to arise in a wide class of Supersymmetric Grand-Unified theories. An experimental proof of this violation would provide unambiguous evidence in favour of new Physics beyond the Standard Model. Among the processes being studied, the $\mu \to e\gamma$ decay is considered as one of the most sensitive probe of new Physics.

We present limits to branching ratio of this decay obtained by the MEG experiment at the Paul Scherrer Institut, based on data collected in 2009 and 2010. The sensitivity to achieve with new data as well as the perspectives of a detector upgrade will be also discussed.

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Higgs production at the LHC

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The Higgs boson is the best studied particle in the history of particle physics.
I will talk about our expectations, the confidence in our simulations and welcome
surprises that we would all like to happen in the next few months and years at the LHC
searching for this new particle.

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Realization of electronic systems operating on dynamical physical signals

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This article gives an overview of a state-of-the-art methodology for building electronic systems operating on dynamical physical signals. As an example a system for epileptic seizure prediction is used, which monitors EEG signals and continuously calculates the largest short-term Lyapunov exponents from them. In such systems, the cost of exploitation, for instance energy consumption, may vary substantially with the values of input signals. In addition, the functions describing the variations are not known at the time the system is designed. As a result, the architecture of the system must accommodate for the worst case exploitation costs which, however, rapidly exceed the available resources (as battery life) when accumulated over time.
The presented methodology solves these challenges by identifying at design time groups of possible exploitation costs, called system scenarios, and implementing a mechanism to detect system scenarios at run time and reconfigure the system to cost-efficiently accommodate them. During reconfiguration, the optimized system architecture settings for the active system scenario are selected and the total exploitation cost is reduced. The results for the example system indicate that with 10 system scenarios the average energy consumption of the system can be reduced by 28% and brought within 5% of the theoretically best solution.

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Production of Strange Particles from the Lowest to the Highest Energies

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A review of strange particle production in heavy-ion and in pp collisions starting from the threshold up to LHC energies will be presented. The experimental results are confronted with statistical model calculations. It is shown that strangeness enhancement is maximal at the threshold and decreasing towards higher incident energies. Recent ALICE results confirm this trend.

Emphasis is put on the comparison of pp and heavy-ion collisions and whether the influence of strangeness conservation in the statistical models can account for that.

Furthermore, the results focusing on the maximum in the ratio of strange-to-nonstrange particles will be revisited. Which results can be described by the statistical model? Are there hints for critical or a triple point in the energy range around 30 A GeV?

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Charged-hadron production in the three-sources RDM at LHC energies

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The centrality dependence of charged-hadron production in relativistic heavy-ion collisions at LHC energies is investigated in a nonequilibrium-statistical relativistic diffusion model (RDM) with three sources. Theoretical pseudorapidity distributions are compared with AuAu PHOBOS data at RHIC energies of sqrt(s_NN) = 0.13 and 0.2 TeV,
and with preliminary PbPb ALICE data at LHC energy of sqrt(s_NN) = 2.76 TeV for seven centralities. A previous prediction for this energy is confronted with the data. Refined predictions for 5.52 TeV PbPb are presented.

Summary:

We have analyzed recent preliminary ALICE results [1] for PbPb collisions at LHC energy of 2.76 TeV. Charged-hadron pseudorapidity distributions have been calculated analytically in the non-equilibrium statistical relativistic diffusion model RDM. For seven different centralities, the underlying RDM parameters have been determined in a chiˆ2-optimization of the analytical model solutions with respect to the preliminary data, and using limiting fragmentation scaling as an additional constraint in the rapidity region close to the beam.

A comparison with a previous prediction [2] that was based on an extrapolation of the parameters reveals that the rapidity relaxation time decreases substantially in the energy region between RHIC and

LHC energies, leading to a fragmentation-peak position that is closer to midrapidity than expected from the earlier extrapolation of the time parameter. Based on the RDM fit to the data in the three-sources model together with limited fragmentation scaling, the midrapidity source that is associated with gluon-gluon collisions accounts for about 56% of the total charged-particle multiplicity measured by ALICE in central PbPb collisions at 2.76 TeV. The fragmentation sources that correspond to particles that are mainly generated from valence quark - gluon interactions are centered at pseudorapidity 3.3. The total particle content in these sources amounts to about 44% of the total charged hadron production, but contributes only marginally to the midrapidity yield.

With the results for PbPb at 2.76 TeV LHC energy and previous RDM results for AuAu collisions at RHIC energies [3], we have extrapolated the three-sources model parameters to the LHC design energy of 5.52 TeV for PbPb, and calculated the corresponding charged-hadron pseudorapidity distribution [4]. Small corrections of the extrapolated values for the diffusion-model parameters may be required once the final measured distributions become available at both LHC energies.

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Classical and Quantum Information Acquisition: Measurement and POVM

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My intervention will focus on classical, Bayesian acquisition of information (measurement) and try to build a quantum model that fully corresponds to the classical case. This model makes use of the POVM and introduces amplitude operators that cover the three steps of measurement (and of any information acquisition):

- Preparation of the object system in a certain state. With such an operation we have ensured that there is an initial source of variety. We do not need to assume that at this stage we have already selected message (as it is often thought in classical communication theory). This can be true in controlled exchanges of signals but it is not sufficiently general. We may operationally define the state as an equivalence class of preparation procedures.
- Coupling between the object system and apparatus or premeasurement. The purpose of this operation is to select a specific observable. Indeed, different observables (especially non—commuting ones) require different experimental set-ups. It is true that we can express the state of the two systems (i.e. apparatus and object system) involved here in different bases which correspond each time to a different observable (basis degeneracy). However, we should not mix this mathematical formalism with the operational issue connected with a selected experimental set up. In the latter case, a change of observable implies a change of set up too, what means a different kind of premeasurement. We can therefore define the observable as an equivalence class of premeasurements.
- Finally, the detection event, thanks to the previous coupling and the previous preparation, will allow us to assign a certain property to the system. This is the only irreversible step in the whole measurement procedure. We can define a property as an equivalence class of detections.

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Experimental results from the event–by–event physics studies

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Fluctuations of thermodynamic quantities are fundamental for the study of the QGP phase transition. Studies of event–by–event physics observables have been used intensively the last years at the SPS, at RHIC and recently at the LHC. In this talk, I will briefly review the experimental challenges as well as the latest results from the measurement of event–by–event fluctuations and correlations in heavy–ion collisions.

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Overview of results from the ALICE experiment at the LHC

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ALICE (A Large Ion Collider Experiment) at the Large Hadron Collider has been running successfully for more than two years, recording both pp and Pb–Pb data. The analysis of these data samples revealed intriguing properties of the produced matter. They indicate that the system created in heavy–ion collisions, is larger, hotter and denser compared to the one created at lower energies. In addition, angular correlation studies demonstrate that it still behaves like a strongly interacting, almost perfect liquid. In this talk, I will review the latest experimental results from ALICE from both the 2010 and the 2011 run.

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Search for the Standard Model Higgs boson at CMS in the 4-lepton channel

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One of the main targets of the CMS experiment is to search for the Standard Model Higgs boson. The 4-lepton channel (from the decay $H \longrightarrow ZZ^{*} \longrightarrow 4l$, l = e,mu) is one of the most promising. The analysis is based on the identification of two opposite-sign, same-flavor lepton pairs: leptons are required to be isolated and to come from the same primary vertex. The Higgs would be statistically revealed by the presence of a resonance peak in the 4-lepton invariant mass distribution.

The Higgs mass is a free parameter of the Standard Model, and the 4-lepton channel search is sensitive almost in all mass range. With data collected in 2010 and 2011 (4.7 fb-1 at $\sqrt{s} = 7$ TeV) the boson has been excluded in a wide region of mass at 95% of confidence level.

The 4-lepton analysis will be presented, spanning on its most important aspects: lepton identification, variables of isolation, impact parameter, kinematics, event selection, background control and statistical analysis with data-MC comparison.

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CMS detector performance

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The CMS experiment at the LHC collected last year around 5 /fb of integrated luminosity at 7 TeV center-of-mass energy. The CMS detector has shown an excellent data taking efficiency. The global CMS and several subdetectors performances will be presented. The goal of the 2012 operations is to collect again 5 /fb by the end of June and finally 15 /fb at the end of the year, with a new center-of-mass energy at 8 TeV and higher luminosity. The CMS detector should cope with these new conditions and the first results from this year data will be given.

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Identified hadrons in pp and Pb-Pb collisions with the ALICE experiment at the LHC

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The ALICE experiment at LHC, designed to perform efficiently in a high multiplicity environment, has powerful capabilities for identifying hadrons (PID) with techniques including measurements of specific ionization (TPC and ITS detectors), time-of-flight and topological weak decays. Since 2009, ALICE collected and analyzed samples of pp collisions and Pb-Pb interactions. Results on the spectra of the identified hadrons at mid-rapidity, as well as characteristics of charged kaons identified through their weak decay, kink topology, will be presented.
Possible production mechanisms will be discussed using the information extracted from the yields and the transverse momentum spectra obtained in pp and Pb-Pb collisions.

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KATRIN: Probing Nature's Smallest Mass Scale

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The Karlsruhe Tritium Neutrino (KATRIN) experiment aims to directly measure the effective electron anti-neutrino mass utilizing the kinematics of tritium β-decay. KATRIN is currently under construction at KIT (Karlsruhe Institute of Technology) and will prospectively start taking data in 2015. The experiment will analyze the shape of the tritium β-electron spectrum at energies near the endpoint. A nonzero neutrino mass reduces the maximal energy of the outgoing β-electron and distorts the spectrum, especially at energies near this maximum. To reach the design sensitivity of 200 meV, high energy resolution, high signal count-rates and ultra low background are required.

In the KATRIN set-up, tritium decay electrons are produced in a Windowless Gaseous Tritium Source (WGTS) and then guided along magnetic field lines towards the main spectrometer where an energy analysis takes place. The main spectrometer contains a complex electrode system on high negative voltage and works as an electrostatic filter. From the point of electron creation until the point of the energy analysis, the magnetic field drops by four orders of magnitude, thereby collimating the electron momenta due to the adiabatic conservation of the electron's orbital magnetic moment. This spectrometer design, combining Magnetic Adiabatic Collimation with an Electrostatic filter (the MAC-E filter principle), intrinsically provides large solid angle acceptance and excellent energy resolution.

To capitalize on the advantages this design offers, an extremely stable source with high tritium purity is required. The WGTS for KATRIN will provide 10^{11} tritium decays per second from a 95\% pure gaseous source whose column density must be stable to less than 0.1\%. This is achieved using a two-phase neon cooling system for a temperature stability of 30mK. In order to reach an acceptably low background, the partial pressure of tritium in the spectrometer section must be less than 10^{-20} mbar, requiring a tritium flow suppression factor of 10^{11} relative to injection. This challenging demand is met through a combination of active turbomolecular pumping in the Differential Pumping Section (DPS) and passive means in the Cryogenic Pumping Section (CPS) which removes remaining tritium by trapping it at 4.5K in a thin layer of argon frost.

With a fraction of only 10^{-13} β-electrons produced falling in the the energy region of interest (the last 1 eV of the β-spectrum), an average signal rate of 10 mHz is expected. Accordingly, the background count rate is required to be of the same order of magnitude. Backgrounds arise mainly from nuclear decays in the spectrometers, principally from tritium and radon. A single nuclear decay in the spectrometer can lead to an unacceptable background for up to 10 hours, making development of active intervention techniques necessary.

Designing solutions to such varied and challenging problems requires versatile, high-quality simulation software, written especially with the KATRIN experiment in mind. This talk will give an overview of the design, particular challenges and current status of the KATRIN experiment, with a focus on the spectrometers and the simulation technology used to characterize them.

Summary:

The Karlsruhe Tritium Neutrino Experiment (KATRIN) will measure the effective anti-neutrino mass in a model-independent fashion utilizing the kinematics of tritium beta-decay with a sensitivity of 200 meV at 95% confidence level. This is achieved using a windowless gaseous tritium source and electrostatic spectrometers, realized with a collection of cutting-edge technologies and advanced techniques. Many of these are unique to the KATRIN experiment. This talk gives an overview of the principles, implementation and status of the experiment with a focus on the spectrometers and the simulations used to characterize them.

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The String and the Cosmic Bounce:

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String theory introduces a new fundamental scale (the string length) that should regularize the singularities of classical general relativity. In a cosmological context, the Big Bang is no longer the beginning of time, but just the transition between a Pre-Big Bang collapse phase and the current expansion. We will review old and recent attempts to build consistent bouncing cosmologies inspired to string theories, discussing their solved and unsolved problems, focussing on the observables that may distinguish them from standard inflationary scenarios.

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Implications of an Enhanced Diphoton Decay Width of the Higgs Boson

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Motivated by recent results from Higgs searches at the Large Hadron Collider, we consider possibilities to enhance the diphoton decay width of the Higgs boson over the standard model expectation, without modifying either its production rate or the partial widths in the WW and ZZ channels. Studying effects of new charged scalars, fermions and vector bosons, we find that significant variations in the diphoton width may be possible if the new particles have light masses of the order of a few hundreds of GeV and sizeable couplings to the Higgs boson. Such couplings could arise naturally if there is large mass mixing between two charged particles that are induced by the Higgs vacuum expectation value. In this talk, we shall present several interesting examples of new particles leading to an enhanced Higgs diphoton decay width. Interestingly, a modification in the diphoton partial width is generically accompanied by a shift in the $Z\gamma$ partial width, which tends to be of similar magnitudes in the vector case, but smaller in other cases.

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Higgs Physics as a probe of New Physics

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Higgs Physics as a probe of New Physics

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New bottomonium(-like) resonances' spectroscopy and decays at Belle

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Using in 121.4 1/fb of data collected near the Upsilon(5S) resonance
at the KEKB asymmetric-energy e^+e^- collider, the Belle collaboration

recently reported the discovery of the p-wave
Bottomonium singlets, hb(1P) and hb(2P), toghether with the observation of
resonant substructures in Y(5S) –> pi+pi- Y(nS) and pi+pi- hb(mP) (n=1-3, m=1,2).
Such large production of hb(1,2P) allowed and the first observation of the
radiative transition hb(1P) –> gamma etab(1S) and the first observation
of the missing singlet state etab(2S). We report a summary of these new
Bottomonium states, together with updates on the Y(nS) –> eta Y(mS)
transition and the first observation of exclusive Y(1S) decay into light
mesons.

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Identified particle spectra in Pb-Pb collisions from the ALICE experiment at LHC

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Identified particle spectra in PbPb collision from the ALICE experiment at the LHC

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The review of strangeness production in heavy ion collisions

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Anisotropic flow at RHIC and the LHC.

Author: Raimond Snellings[1]

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One of the fundamental questions in the field of subatomic physics is what happens to matter at extreme densities and temperatures as may have existed in the first instants after the Big Bang. The aim of ultrarelativistic heavy-ion physics is to collide nuclei at very high energies and thereby create such an extreme state of matter in the laboratory. Flow is an observable that provides experimental information on the equation of state and the transport properties of the created hot and dense system. The azimuthal anisotropy in particle production is the clearest experimental signature of collective flow in heavy-ion collisions. This so-called anisotropic flow is caused by the initial asymmetries in the geometry of the system. In this talk we will present the current ALICE anisotropic flow measurements for charged and identified particles and their implication for our understanding of the close-to-ideal fluid created in nucleus-nucleus collisions.

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Measurements of the Z boson in lepton pair decays in heavy ion collisions at ATLAS

Author: Valeri Pozdnyakov[1]

Co-author: Yulia Vertogradova [1]

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The ATLAS experiment has observed around 2000 Z boson candidates with 0.15/nb of integrated luminosity collected in the 2011 LHC PbPb run at sqrt(nn)=2.76 TeV. Within the experimental uncertainties, the per event Z boson yield integrated over rapidity |y| < 2.5 is proportional to the number of binary collisions estimated by the Glauber model. The elliptic flow coefficient of the azimuthal distribution of the Z boson with respect to the event plane is consistent with zero, in line with expectations of production in unmodified hard scattering.

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ATLAS Upgrade Programme

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With the already outstanding LHC luminosity performance, and planned LHC upgrades in the upcoming shutdowns, it is expected that within a short time-scale, the general purpose LHC experiments will have to cope with luminosities beyond their original design. In order to maintain detector performance and sensitivity to expected and new physics processes, ATLAS has defined a continuous upgrade programme which foresees staged enhancements during the next 10 years of operation, and then more widespread changes before the transition to the highest luminosities after 2022.

This talk will describe several components of the ATLAS upgrade, focusing in particular on the Inner Detector and Trigger. The Inner Detector faces two challenges in the higher luminosity environment: high particle multiplicities and increased radiation dose. These will be addressed in the short term by a new layer of Pixel detectors, and in the long term by a complete replacement. The Trigger faces an increasingly difficult task of distinguishing events of interest from a background of up to 200 proton collisions per bunch crossing at the highest luminosity. Plans include new muon trigger chambers, higher granularity calorimeter trigger information and eventually the introduction of a track trigger at Level-1.

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Highlights from SUSY Searches with ATLAS

Author: Vasiliki Mitsou[1]

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Supersymmetry (SUSY) is one of the most relevant scenarios of new physics searched for by the ATLAS experiment at the CERN Large Hadron Collider. In this talk the principal search strategies employed by ATLAS will be outlined and the most recent results for analyses targeting SUSY discovery will be presented. A wide range of signatures are covered motivated by various theoretical scenarios and topologies: strong production, third-generation fermions, long-lived particles and R-parity violation among others. The results are based on up to 5 fb-1 of data recorded in 2011 at sqrt(s) = 7 TeV centre-of-mass energy by the ATLAS experiment at the LHC.

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Recent Results from the IceCube Neutrino Observatory

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The IceCube Neutrino Observatory is the world's first kilometer scale
neutrino telescope. The detector is comprised of 5,160 photomultiplier strung on 86 cables and installed in the South Polar ice cap at depths from 1450 to 2450 m. The primary purpose of IceCube is to detect sources of high energy astrophysical neutrinos which would indicate hadronic acceleration. IceCube has already placed the most stringent limits to date on models of hadronic acceleration as an engine for gamma ray bursts. In addition to its role as a telescope, IceCube is also the world's largest particle detector. A densely instrumented region in the center of the detector allows for studies of neutrino oscillations and indirect searches for dark matter. I will review the most recent results from IceCube, as well as the sensitivity that will be gained with increased exposure.

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Highlights of Heavy Ion Physics with ATLAS

Author: Zvi Citron[1]

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An overview of the ATLAS results from Pb+Pb collisions at sqrt(s_NN) =2.76 TeV will be presented. The results for hard probes include both single jet and di-jet measurements, W and Z bosons, photons, and high pT charged tracks. Taken together these results provide a compelling picture of the interaction of hard particles in the dense QCD medium. Additionally, ATLAS has measured properties of the bulk particle production including charged particle multiplicity and extensive measurements of the azimuthal particle distributions and correlations. Results shown will be from the ˜10 inverse microbarns of minimum bias recorded in the 2010 LHC heavy ion run, as well as from ˜0.15 inverse nanobarns sampled in the 2011 LHC heavy ion run.

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Highlights from the ATLAS Experiment

Author: Sally Seidel[1]

[1] *University of New Mexico*

New results in top quark studies, investigations of Standard Model processes, Higgs searches, and searches for phenomena beyond the Standard Model are presented. This presentation is made on behalf of the ATLAS Collaboration.

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Top Quark Physics with ATLAS

Author: Lucio Cerrito[1]

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Using the data recorded in the 2011 run of the LHC, corresponding to an integrated luminosity of ˜5 fb-1 of proton-proton collisions at a center of mass energy of 7 TeV, the ATLAS collaboration has performed a number of measurements on the production and decay properties of top quarks. Additionally, numerous searches for physics beyond the Standard Model with top-like signatures have been carried out. We will present a review of these measurements, pointing out the results obtained, their current limitations, and future developments.

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Double Chooz results

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\noindent\small{Double Chooz is a reactor experiment designed to observe neutrino oscillations governed by the third, less known, leptonic mixing angle θ_{13}.
In the past, single detector experiments, like CHOOZ or Palo Verde, gave strong constraints on θ_{13} pointing towards a small, or even zero, θ_{13} scenario.
Double Chooz is a next generation experiment that exploits two identical detectors to reduce the reactor systematics and unveil the oscillation patterns driven by θ_{13} in the
atmospheric square mass splitting, Δm^2_{atm}.

Double Chooz has started stable data taking with a single, far detector since April 2011.
In this talk we shall give an overview of the concept and the status of the experiment.
An update on the θ_{13} oscillation analysis will also be presented.
Finally, perspectives and next steps of this quest will also be reviewed.
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Talk by Leonidas N. Kalousis}

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test

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test

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Dark Matter Theory

Author: Matthew Buckley[1]

[1] *Fermilab*

We have reached an era of data, when theories of dark matter are becoming constrained by results from direct and indirect detection, as well as from the LHC. In this talk, I will review these constraints on WIMP dark matter, as well as new areas of model-building motivated by experimental anomalies.

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Equation of State session

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Higgs boson searches with ATLAS

Author: Kirill Prokofiev[1]

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One of the primary goals of the ATLAS experiment at Large Hadron Collider is to investigate the mechanism of electroweak symmetry breaking by searching for the Higgs bosons. Presented in this contribution is the summary of the recent results concerning the Higgs searches in ATLAS. Both Standard Model and Supersymmetric hypotheses are investigated. Current combined exclusion limits produced by the ATLAS collaboration are discussed.

Summary:

Presented is the status of the Higgs searches in ATLAS. Both Standard Model and Beyond the Standard Model channels are discussed.

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Structure Function Measurements and QCD results from HERA

Author: Habib Shiraz[1]

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Deep inelastic scattering experiments at HERA were undertaken to study proton structure.
At centre of mass energies between 225 and 320 GeV, electrons were brought into high energy collisions with protons.
Observations of such collisions together with the well understood nature of lepton-quark interactions via the electroweak force,
set the stage to test theories of proton structure.

The almost 1 fb^{-1} of HERA data collected by the H1 and ZEUS experiments is measured and interpreted.
Measurements of the inclusive cross sections as well as heavy flavour production and jet cross sections are presented.
Advanced statistical techniques are used to extract the best precision from the data. A QCD Analysis is performed on
the data to determine the parton distribution functions (PDFs) of the proton. This provides one of the most complete pictures
we have of the proton, and an invaluable input to the LHC project at CERN.

Monday Afternoon Parallel II / 155

The Thermal Model at the LHC

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Monday Afternoon Parallel II / 156

Highly-anisotropic hydrodynamics and the early thermalization puzzle in relativistic heavy-ion collisions

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Monday Afternoon Parallel II / 157

Hydrodynamic models of the sQGP and the elliptic flow

Monday Afternoon Parallel IV / 158

Hadronic observables in hydrokinetic picture of A+A collisions at RHIC and LHC

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Charged-hadron production in the three-sources RDM at LHC energies

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Monday Afternoon Parallel II / 160

Identified hadrons in pp and Pb-Pb collisions with the ALICE experiment at the LHC

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Monday Afternoon Parallel II / 161

THERMAL: Production of Strange Particles from the Lowest to the Highest Energies

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Conference excursion / 162

Breakfast

Conference excursion / 163

Bus Departure from OAC

Conference excursion / 164

Visit Knossos + visit Museum Heraklion

Conference excursion / 165

Rethymno: free time

Conference excursion / 166

Departure from Rethymno

Conference excursion / 167

Arrival back to OAC

Lectures / 168

Physics of electroweak symmetry breaking

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Lectures / 169

Entanglement, Information, Causality

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Lectures / 170

Quantum Entanglement

Lectures / 171

Heavy Ion Physics (I)

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Lectures / 172

Heavy Ion Physics (II)

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Monday Morning Plenary I / 173

Higgs production at the LHC

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Monday Morning Plenary I / 174

Higgs Boson Searches with ATLAS

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Monday Morning Plenary I / 175

Higgs Boson search at the CMS

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Monday Morning Plenary I / 176

Implications of an Enhanced Diphoton Decay Width of the Higgs Boson

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Monday Morning Plenary I / 177

Classical and Quantum Information Acquisition: Measurement and POVM

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Monday Morning Plenary II / 178

Anisotropic flow at RHIC and the LHC.

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Monday Morning Plenary II / 179

High-pt physics in Heavy Ion collisions

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Monday Morning Plenary II / 180

Recent results from lattice QCD

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Monday Morning Plenary II / 181

Extra dimensions theory

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Monday Afternoon Parallel II / 182

Effect of jets on v_4/v_2^2 ratio and constituent quark scaling in relativistic heavy-ion collisions

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Monday Afternoon Plenary III / 183

Finite Unified Theories and the prediction of the Higgs boson mass

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Monday Afternoon Plenary III / 184

Tevatron Higgs boson searches overview

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Monday Afternoon Parallel I / 185

SUSY searches at the CMS

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Monday Afternoon Parallel I / 186

Search for the Standard Model Higgs boson at CMS in the 4-lepton channel

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Monday Afternoon Parallel I / 187

W, Z and diboson physics with ATLAS

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Monday Afternoon Parallel I / 188

Searches for Extra Dimensions at the LHC

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Monday Afternoon Parallel I / 189

Searches for low-mass Higgs and dark gauge bosons at BABAR

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Monday Afternoon Parallel I / 190

Highlights from D0

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Monday Afternoon Parallel III / 191

Diffractive neutrino interaction: breakdown of PCAC

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Monday Afternoon Parallel III / 192

Higgs and Dark Matter from SUSY Decays in the Complex MSSM

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Monday Afternoon Parallel III / 193

Modification of the Coulomb law and atomic levels in a superstrong magnetic field.

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Monday Afternoon Parallel III / 194

Fermiophobic Higgs boson and supersymmetry

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Measurement of the muon to gamma branching ratio in the MEG experiment

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Structure Function Measurements and QCD results from HERA (H1 and ZEUS)

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Tuesday Parallel III / 197

Production of Antinuclei at the Relativistic Heavy Ion Collider

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Monday Afternoon Parallel IV / 198

Monopoles, holonomy and chiral symmetry breaking in QCD.

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Monday Afternoon Parallel IV / 199

Thermal characteristics confronting trace anomaly and intrinsic canonical structure of QCD

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Monday Afternoon Parallel III / 200

pp-collisions in Quark Gluon String Model

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Monday Afternoon Parallel IV / 201

Longitudinal Dynamics at RHIC energy

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Tuesday Parallel I / 202

ATLAS Detector Performance

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Tuesday Parallel I / 203

CMS detector performance

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Tuesday Parallel I / 204

Event reconstruction and particle identification in the ALICE experiment at the LHC

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Tuesday Parallel I / 205

QCD at the CMS

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Tuesday Parallel I / 206

Hard and soft QCD physics in ATLAS

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Monday Afternoon Parallel III / 207

Measurements of the Z boson in lepton pair decays in heavy ion collisions at ATLAS

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Tuesday Parallel Session II / 209

Holographic dilepton production in a thermalizing plasma

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Tuesday Parallel Session II / 210

Heavy Ion Physics Highlights from ATLAS

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Holographic Josephson junction networks

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Tuesday Parallel Session II / 212

Multiplicities from black-hole formation in heavy-ion collisions

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Tuesday Parallel Session II / 213

Production and spectroscopy at LHCb

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Thursday Parallel Session III / 214

Cleaning up the cosmological constant

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Tuesday Parallel IV / 215

Pre-Big Bang, fundamental Physics and noncyclic cosmologies

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Massive Gravity

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Tuesday Parallel IV / 217

Listening to the Universe with gravitational-wave interferometers: Recent observational results from LIGO and Virgo

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Tuesday Parallel IV / 218

The Telescope Array - Ultra High Energy Cosmic Rays

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Tuesday Parallel IV / 219

Status and developments of Advanced Ligo and Advanced Virgo gravitational wave detectors

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Tuesday Parallel III / 220

QCD thermodynamics and quark number susceptibilities at intermediate coupling

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Tuesday Parallel III / 221

Clustering of Color Sources and the Equation of State of the QGP

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Tuesday Parallel III / 222

The Old New Frontier: Studying the CERN SPS Energy Range with NA61/SHINE

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Monday Afternoon Parallel IV / 223

Decoherence of QCD radiation in a quark-gluon plasma

Tuesday Parallel III / 224

New bottomonium(-like) resonances' spectroscopy and decays at Belle

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Production and spectroscopy at LHCb

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Thursday Parallel Session II / 226

New Physics searches with ATLAS

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Thursday Parallel Session II / 227

Top Physics with ATLAS

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Unification with mirror fermions

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Structure Function Measurements and QCD results from HERA (H1 and ZEUS)

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Thursday Parallel Session II / 230

Search for permanent Electric Dipole Moments of light ions (p, d, 3He) in storage rings

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Testing Quantum Foundations with circuit QED

Thursday Parallel Session III / 232

Unusual Interactions of a Pre-and-Post-Selected Particles

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EPR measurement and the origin of cosmic density fluctuations

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Thursday Parallel Session III / 234

The ICARUS experiment at LNGS underground laboratory

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AMS Highlights

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Thursday Parallel Session I / 236

The relevance of light dark matter

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Thursday Parallel Session I / 237

High-energy cosmic rays and tests of basic principles of Physics

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Thursday Parallel Session I / 238

Cosmology in a petri dish? Simulation of collective dynamics of colloids at fluid interfaces

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Addressing Questions of Fundamental Physics using Concepts of Complexity Science

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Thursday Parallel Session III / 240

Generation of high-energy particles, neutrinos and photons in the magnetosphere of collapsing stars

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Thursday Parallel Session IV / 241

Open heavy flavor and quarkonia measurements in heavy ion collisions at RHIC.

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Thursday Parallel Session IV / 242

Charm production at LHC: an overview

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Thursday Parallel Session IV / 243

Open heavy flavour measurements in pp and Pb-Pb collisions with ALICE at the LHC

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Thursday Parallel Session IV / 244

J/Psi Measurements with the ALICE Experiment at the LHC

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Thursday Parallel Session IV / 245

Charmonium dissociation and heavy quark transport in hot quenched lattice QCD

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Charmonium dissociation and heavy quark transport in hot quenched lattice QCD

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Highlights from SUSY Searches with ATLAS

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B Physics at the CMS

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Mixing and CP violation in the B and charm sectors

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CP violation and electroweak baryogenesis in the Standard Model

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Searches for new sources of CP violation at BABAR

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Charmless B decays as a venue to New Physics: status and prospects

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Rare B decays as a probe for new physics

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The neutrino telescope ANTARES

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KATRIN overview

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New Frontiers in Heavy-Ion Physics: the CBM experiment

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Present and future investigations of hadron formation mechanisms in heavy-ion collisions at LHC with the ALICE experiment

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CMS Upgrades

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LHCb upgrade

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Future Plans and Upgrades of the ATLAS Experiment

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NOvA experiment in light of non-zero theta13

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J/psi production in ultra-peripheral heavy-ion collisions at forward rapidity with the ALICE experiment

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Nuclear effect in charmonium production

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Event-by-event hydrodynamics and correlations in relativistic heavy-ion collisions

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Directed flow measurement in Pb-Pb collisions with ALICE at the LHC

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Femtoscopic results in pp and Pb-Pb collisions from ALICE

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Signatures of critical fluctuations in intermittency analysis of the proton transverse momenta in A+A collisions at the NA49 experiment

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Two Perspectives on the String Landscape

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Can Extra Space-Time Dimensions elucidate the Mysteries of the Standard Model ?

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Holographic Josephson junction networks

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Holographic dilepton production in a thermalizing plasma

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Neutron emission from electromagnetic dissociation at LHC measured with the ALICE ZDC

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Implication of results from heavy-ion experiments for compact stars

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Realization of electronic systems operating on dynamical physical signals

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Diffractive neutrino interaction: breakdown of PCAC

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Overview of results from the ALICE experiment at the CERN LHC

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Highlights from the ATLAS Experiment

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New Results from The CMS Experiment

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Higgs Physics as a probe of New Physics

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New States with Heavy Quarks

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The strongly interacting Quark Gluon Plasma: from RHIC to LHC

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The sounds of the Big and the Little Bangs

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Tuesday Morning Plenary II / 283

Limits on compact halo objects as dark matter from gravitational microlensing

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AMS Highlights

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New Constraints for the Transport Coefficients of the Quark Gluon Plasma Produced in RHIC and LHC collisions

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New QCD Effect: the Shrinking Radius of Hadrons

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Can a Future Choice Affect a Past Measurement's Outcome?

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Primordial scalar perturbations via conformal mechanisms

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Quantum Physics with Massive Objects

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Thursday Morning Plenary I / 290

QFT in a de Sitter Universe: an Approach to Quantum Theory and Cosmological non-locality

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Thursday Morning Plenary I / 291

Holography, energy loss at strong coupling and Lorentz violation.

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Thursday Morning Plenary II / 292

Dark Matter Theory

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The Dark Matter annual modulation results from DAMA/LIBRA

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Thursday Morning Plenary II / 294

Dark Energy Survey (DES) overview

Thursday Morning Plenary II / 295

Present and future strategies for Neutrinoless Double Beta Decay

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Thursday Afternoon Plenary III / 296

Highlights from the OPERA experiment

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Double Chooz overview

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Friday Morning Plenary I / 298

Results from the Daya Bay Reactor Neutrino Experiment

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Highlights from the T2K experiment

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International Linear Collider

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Friday Morning Plenary I / 301

CERN physics: Status and Plans

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Friday Morning Plenary I / 302

Report on European Strategy for Particle Physics from the Strategy Session of CERN Council

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Friday Morning Plenary II / 303

CP-Violation

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CP violation in D-meson decays and the fourth generation

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LHCb highlights

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Highlights from the BABAR experiment

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ICFA Report

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IPPOG report on Masterclasses - Bringing LHC data into the classroom

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Friday Afternoon Plenary III / 309

The String and the Cosmic Bounce

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Saturday Morning Plenary I / 310

Quantum spacetime and noncommutative Schwarzschild black holes

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Saturday Morning Plenary I / 311

String Cosmology and the LHC

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Saturday Morning Plenary I / 312

Quo Vadis Heavy Ions

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Saturday Morning Plenary I / 313

NICA Complex - Status and Plans

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Friday Afternoon Plenary III / 314

The eRHIC project

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Activities and programs of the European Physical Society

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Saturday Morning Plenary II / 316

The SuperB experiment

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Saturday Morning Plenary II / 317

CLIC: Status and Plans

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Saturday Morning Plenary II / 318

Muon Colliders

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Saturday Morning Plenary II / 319

ECFA report

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New Constraints for the Transport Coefficients of the Quark Gluon Plasma Produced in RHIC and LHC collisions

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IPPOG report on Masterclasses - Bringing LHC data into the classroom

Author: Yiota Foka[1]

[1] *on behalf of the International Particle Physics Outreach Group (IPPOG) (GSI)*

The International Particle Physics Outreach Group (IPPOG) has developed an educational activity that brings the excitement of cutting-edge particle physics research into the classroom.

Each year, since 2005, thousands of high school students in many countries all over the world come to nearby universities or research centres for one day in order to unravel the mysteries of particle physics and be "scientists for a day". In 2012, 10000 students from 130 institutions in 31 countries took part in the popular event over 4 weeks.

Lectures from active scientists give insight on topics and methods of fundamental research on the building blocks of matter and the forces between them, enabling the students to perform measurements on real data from particle physics experiments themselves.

The last two years featured the use of fresh LHC data from the ALICE, ATLAS and CMS experiments.

Event display programs, software tools and analysis methods are quickly mastered by students who then measure various properties of some known particles, such as the weak gauge bosons W and Z and hadrons (Jpsi, Upsilon, Lambda, K-short). The fractions of W+ and W- events are interpreted in terms of quark structure of the proton (not just the simple view of uud quarks). The concept of invariant mass is first used to identify and measure masses and widths of short-lived particles, before it is applied to look for new particles.

At the end of each day, with tools used in our international research collaborations, the participants join in a videoconference with CERN or Fermilab for discussion and combination of their results. The latter are then compared to recent results published by the experiments.

We will describe the methodology employed for the IPPOG International Masterclasses, summarise the measurements performed and report on the impact of the day on young students. We will show how you (the particle physicist) can become involved in this activity and develop your own initiatives based around the samples of LHC data and associated tools.

Saturday Morning Plenary I / 322

Experimental perspectives of atom photon-interactions: From fundamental tests to quantum simulations

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Thursday Morning Plenary I / 323

Holographic Description of the QCD Phase Structure and Out of Equilibrium Dynamics

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Thursday Parallel Session I / 324

Recent Results from the IceCube Neutrino Observatory

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Present and future investigations of hadron formation mechanisms in heavy-ion collisions at LHC with the ALICE experiment

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Friday Afternoon Parallel I-1 / 326

Present and future investigations of hadron formation mechanisms in heavy-ion collisions at LHC with the ALICE experiment

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Present and future investigations of hadron formation mechanisms in heavy-ion collisions at LHC with the ALICE experiment

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Friday Afternoon Parallel II-1 / 328

IPPOG report on Masterclasses - Bringing LHC data into the classroom

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Friday Afternoon Parallel III-1 / 329

Top Physics at the CMS

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Friday Afternoon Parallel IV-1 / 330

Neutron emission from electromagnetic dissociation at LHC measured with the ALICE ZDC

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Friday Afternoon Parallel I-1 / 331

Nuclear effect in charmonium production

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Friday Afternoon Parallel I-1 / 332

J/psi production in ultra-peripheral heavy-ion collisions at forward rapidity with the ALICE experiment

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Friday Evening Parallel I / 333

Event-by-event hydrodynamics and correlations in relativistic heavy-ion collisions

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Friday Evening Parallel I / 334

Charged-hadron production in the three-sources RDM at LHC energies

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Friday Evening Parallel I / 335

Femtoscopic results in pp and Pb-Pb collisions from ALICE

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Friday Evening Parallel I / 336

Signatures of critical fluctuations in intermittency analysis of the proton transverse momenta in A+A collisions at the NA49 experiment

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Friday Evening Parallel I / 337

Directed flow measurement in Pb-Pb collisions with the ALICE at the LHC

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Friday Afternoon Parallel II-1 / 338

The neutrino telescope ANTARES

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Friday Afternoon Parallel II-1 / 339

KATRIN overview

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Friday Evening Parallel II / 340

New Frontiers in Heavy-Ion Physics: the CBM experiment

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Friday Evening Parallel II / 341

Future Plans and Upgrades of the ATLAS Experiment

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Friday Evening Parallel II / 342

CMS Upgrades

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Friday Evening Parallel II / 343

LHCb upgrade

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Friday Evening Parallel II / 344

NOvA experiment in light of non-zero theta13

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Friday Afternoon Parallel III-1 / 345

Highlights from SUSY Searches with ATLAS

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Friday Afternoon Parallel III-1 / 346

B Physics at the CMS

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Friday Evening Parallel III / 347

Mixing and CP violation in the B and charm sectors

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Friday Evening Parallel III / 348

CP violation and electroweak baryogenesis in the Standard Model

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Friday Evening Parallel III / 349

Searches for new sources of CP violation at BABAR

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Friday Evening Parallel III / 350

Charmless B decays as a venue to New Physics: status and prospects

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Friday Evening Parallel III / 351

Rare B decays as a probe for new physics

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Can Extra Space-Time Dimensions elucidate the Mysteries of the Standard Model ?

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Diffractive neutrino interaction: breakdown of PCAC

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Friday Evening Parallel IV / 354

STAR highlights

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Friday Evening Parallel IV / 355

Recent results from PHENIX on the evolution of hot QCD

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Friday Afternoon Parallel IV-1 / 356

Implication of results from heavy-ion experiments for compact stars

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Friday Evening Parallel IV / 357

Realization of electronic systems operating on dynamical physical signals

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Thursday Parallel Session I / 358

Indirect dark matter search with the ANTARES Deep-Sea Cherenkov detector

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Tuesday Parallel IV / 359

no title

Friday Evening Parallel IV / 360

no title

Monday Afternoon Parallel IV / 361

no title

Friday Afternoon Parallel IV-1 / 362

Two Perspectives on the String Landscape

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Friday Evening Parallel IV / 363

No title