ABSTRACTS OF TALKS

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"Color superconductivity in ultra-dense quark matter"

The densest predicted state of matter is color-superconducting quark matter, in which quarks near the Fermi surface form a condensate of Cooper pairs. This form of matter may well exist in the core of compact stars, and the search for signatures of its presence is an ongoing enterprise. I will review the essentials of color superconductivity, emphasizing the fundamentals of the underlying mechanism, and describing the symmetries of the ``color-flavor locked'' phase. I will then talk about how these ideas apply to real-world quark matter, where complications like the strange quark mass must be taken into account.

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"Hard pion and prompt photon at RHIC, from single to double inclusive production"

Single pion and prompt photon large transverse momentum spectra in p-p and Au-Au collisions are computed in perturbative QCD at RHIC energy, $s^{1/2}$ = 200 GeV. Next-to-leading order calculations are discussed and compared with p-p scattering data. Subsequently, quenching factors are computed to leading order for both pions and photons within the same energy loss model. The good agreement with PHENIX preliminary data allows for a lower estimate of the energy density reached in central Au-Au collisions, epsilon > 10 GeV/fm^3. Double inclusive photon-pion production in p-p and Au-Au collisions is then addressed. Next-to-leading order corrections prove rather small in p-p scattering. In Au-Au collisions, the quenching of momentum-correlation spectra is seen to be sensitive to parton energy loss processes, which would help to understand how the fragmentation dynamics is modified in nuclear collisions at RHIC.

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"A theoretical study of pentaquark baryons"

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"Testing radiative energy loss at RHIC and the LHC"

The color charge and mass dependence of radiative energy loss will be quantified as sensitive tests of the dynamics underlying high transverse momentum jet quenching. Predictions for the production of D and B mesons at RHIC and the LHC will be presented, and the relevant kinematical regions where both effect can be disentangled will be established. The situation with single electron measurements at RHIC will be discussed from a pQCD point of view, with emphasis on the uncertainties coming from the pp baseline.

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"N-Δ transition form factors"

Nucleon and Δ amplitudes have been obtained by solving a Poincaré covariant Faddeev equation, which describes baryons as composites of confined-quarks and confined-nonpointlike-diquarks. The amplitudes were used to calculate the nucleon form factors. The calculation predicts a ratio $\mu_p G_E^p / G_M^p$ that agrees with extracted JLab data and also predicts that this ratio will pass through zero at $Q^2 = 6.5 GeV^2$. This prediction will be tested in forthcoming JLab experiments. We have extended the framework to study the electromagnetic N-Δ transition form factors. Results for the ratios $G_E(p^2)/G_M(p^2)$ and $G_C(p^2)/G_M(p^2)$ are compared with observations. Effects of pion loops, which in dynamical coupled-channel models contribute substantially to $G_C(p^2)/G_M(p^2)$ at low Q^2, are also considered.

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"The Nuclear matter EOS at high density."

In neutron stars nuclear matter is expected to reach baryon densities which can exceed few times the nuclear saturation density of terrestrial nuclei. For the hadronic sector, microscopic approaches have been developed to predict the nuclear matter Equation of State in this density range. A comparison among the different methods and the corresponding predictions will be presented, together with a confrontation with possible indirect constraints which are coming from heavy ion collisions at intermediate energy. Neutron star studies based on these EOS must necessarily take into account the possible transition to quark matter in the inner part of these compact objects. The transition will be briefly discussed on the basis of few simple models for the quark matter.

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"Production of multiply heavy flavoured baryons from Quark Gluon Plasma at LHC"

The energy and system size dependence of the chemical freeze-out in the T- μ_B plane in relativistic heavy ion collisions is reviewed with emphasis on strangeness suppression and enhancement. In the second part of my talk I will argue that in Pb – Pb collisions at LHC energies there could be a sizeable production of baryons containing two or three heavy quarks from statistical coalescence. This production mechanism is peculiar of Quark Gluon Plasma and the predicted rates, in heavy ion collisions at LHC energy, exceed those from a purely hadronic scenario, particularly for χ_{bc} and Ω_{ccc}. Thus, enhanced ratios of these baryons over singly heavy flavoured hadrons, like B or D, in heavy ion collisions with respect to pp at the same energy, would be a signal of heavy quark equilibration in the Quark Gluon Plasma.

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"Review on DIS on Nuclei"

Recent results in the hadron leptoproduction off nuclei will be presented. The possible interpretation in terms of the medium modification of the parton fragmentation functions and the implication on the parton energy loss will be discussed. The leptoproduction data will be also discussed in relation with the recent heavy ion results on hadron quenching at RHIC and with the possible study of jet quenching at LHC.

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"The high temperature phase of QCD"

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"Tests of Factorization in Polarized and Unpolarized Semi-Inclusive Deep-Inelastic Scattering at Jlab"

A recent JLab Hall C has measured spin-averaged cross sections for semi-inclusive electro-production of positively and negatively charged pions from both protons and deuterons. The results for $z<0.7$, $0.2<x<0.5$, and $2<Q^2<3$ GeV^2 are in good agreement with expectations based on factorization of the response into a piece proportional to current quark densities followed by independent fragmentation of the struck quark into hadrons.

This occurs in spite of the relatively low invariant mass of the residual final state ($1.4 < M_x < 2.5$GeV) accessible with the JLab electron beam energy of 6 GeV. The possible origin of this phenomenon will be discussed. Results on double spin asymmetries for the same reactions using polarized electrons and nucleons will also be presented from the CLAS detector in Hall B at JLab. These results are also consistent with the expectations of factorization for $z<0.7$, $0.2<x<0.5$, and for values of Q^2 as low as 1 GeV^2\$. The results of both experiments have been used in the framework of LO QCD to study combinations of up and down quark parton densities that are not accessible with inclusive deep-inelastic scattering. In addition, the unpolarized results allow a study of the ratio of favoured to un-favoured fragmentation functions. Finally, recent CLAS data are examined to determine the nuclear A-dependence of SIDIS.

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"QCD above T_c : a pseudogap phase?"

QCD above the deconfinement temperature, T_c, is a strongly interacting system where correlated pairs still survive up to $T = 2\ T_c$. It is suggested that this phase is analogous to the pseudogap phase, one of the proposed explanation of high temperature superconductivity.

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"Fractional Momentum Correlations in Multiparton Collisions at LHC"

Multiple parton collisions will represent a rather common feature in pp collisions at the LHC, where regimes with very large momentum transfer may be studied and events rare in lower energy accelerators might occur with a significant rate. A reason of interest in large p_t regimes is that, differently from low p_t, evolution will induce correlations in x in the multiparton structure functions. We have estimated the cross section of multiple production of W bosons with equal sign, where the correlations in x induced by evolution are particularly relevant, and the cross section of b-bar b-bar_b production, where the effects of evolution are much smaller. Our result is that, in the case of multiple production of W bosons, the terms with correlations may represent a correction of the order of 40% of the cross sections, for pp collisions at 1 TeV c.m. energy, and a correction of the order of 20% at 14 TeV. In the case of b-bar_b pairs the correction terms are of the order of 10-15% at 1 TeV and of the order of 5% at 14 TeV.

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"Hadron propagation in the medium: the exclusive process A(e,e'p)B in few-nucleon systems"

The mechanism of propagation of hadronic states in the medium is a key point for understanding particle-nucleus and nucleus-nucleus scattering at high energies. We have investigated the propagation of a baryon in the exclusive process A(e,e'p)B in few-nucleon systems using realistic nuclear wave functions and Glauber multiple scattering theory both in its original form and within a generalized eikonal approximation. New results for the processes ^{3}He(e,e'p)^{2}H and ^{4}He(e,e'p)^{3}H are compared with the data recently obtained at the Thomas Jefferson laboratory.

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"Probing QCD at high parton densities: from RHIC to LHC"

I will review the most significant experimental results on Quark-Gluon-Plasma and small x (Color Glass Condensate) physics obtained after 5 years of operation of the Relativistic Heavy-Ion Collider (RHIC) with an emphasis on hard probes produced in Au+Au and d+Au collisions at central and forward rapidities. The new possibilities opened up in the multi-TeV regime at CERN LHC will be also discussed and prospects on hard probes signals (jets, quarkonia, photons...) will be given based on realistic luminosities expected for the first p+p and Pb+Pb runs.

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"Heavy Ion Collisions at Relativistic Energies: Testing a Nuclear Matter at High Baryon and Isospin Density"

Aim of the talk is to support an "Isospin Programme" for relativistic heavy ion collisions at intermediate energies, i.e. in the AGeV region up to the FAIR range. The interest in the study of a matter at high baryon and isospin density is twofold: i) Direct access to the poorly known properties of the isovector part of the Equation of State at high densities, of large interest for astrophysics; ii) Possibility of observing some precursor signals of a transition to a deconfined phase at relatively low temperatures, of few tens MeV. Results of "ab inito" relativistic kinetic approaches to the nucleus-nucleus collisions are presented focussing on the most EOS-sensitive observables, which appear to be linked to particle production around the threshold. For the signature of a transition to a mixed quark phase, a "neutron distillation" mechanism is suggested (in n-rich systems) with possible observable effects on the properties of hadrons produced at mid-rapidity and high transverse momentum.

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"Nucleon Form Factor and N-Δ Transition in a Hypercentral Constituent Quark Model"

We study the nucleon form factors and the nucleon D(1232) transitions in a frame work of hypercentral constituent quark model. The pion meson cloud effect is taken into account explicitly. Our results show that the pion cloud contributes substantially to the nucleon form factors as well as to the helicity amplitudes of D(1232), and it gives an improved agreement comparing to the
experimental measurement.

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"The quark-deconfinement model of Gamma-Ray bursts"

I will discuss a possible relation between the formation of deconfined quark matter inside compact star and Gamma Ray Bursts. I will concentrate on the astrophysical scenario and I will try to connect observational features with the microphysics of the model.

- GAMMA-RAY BURSTS FROM DELAYED COLLAPSE OF NEUTRON STARS TO QUARK MATTER STARS. Astrophys.J.586:1250-1253,2003
- EFFECTS OF COLOR SUPERCONDUCTIVITY ON THE STRUCTURE AND FORMATION OF COMPACT STARS. Phys.Rev.D69:057505,2004
- QUIESCENT TIMES IN GAMMA-RAY-BURSTS: EVIDENCE OF A DORMANT INNER ENGINE. Astro-ph/0512602
- BURNING OF AN HADRONIC STAR INTO A QUARK OR A HYBRID STAR. Astro-ph/0512652.

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"Saturation: Color Strings, Pomerons and Color Glass Condensate"

I review the problem of parton saturation and its implications through three in principal different approaches, but somewhat related: saturation in a geometrical approach, QCD saturation through the Color Glass Condensate and perturbative Pomeron approach with initial conditions. I also make some comments about how that could be related to a Quark Gluon Plasma formation.

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"Elastic photo and electroproduction of vector mesons"

We present an unified treatment of elastic ρ, ω, Φ and J/ Ψ photo and electroproduction, in a nonperturbative QCD framework, without free specific parameters. We show that most

features of the experimentally observed quantities are quantitatively described through the overlap of virtual photon and vector meson structures.

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"Universalities and bifurcations in the physics of strong gluon fields"

Black disc limit and universalities for cross sections in high energy QCD. Tachyon in pQCD and related dynamics . Kinks and bifurcations. New states of QCD matter. Challenging problems.

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"Overview of Physics with CLAS at Jlab"

The CLAS collaboration at Jefferson Lab is engaged in a wide range of experiments, covering mostly meson and baryon spectroscopy, nucleon structure through elastic and deep inelastic scattering, nuclear transparency and nucleon correlations in nuclei. These experiments use the CEBAF highly polarized electron beam, or the secondary tagged photon beam, together with the CLAS detector (CEBAF large acceptance detector), to which specific experiments bring additional equipment. This talk will give examples of recent results on subjects mentioned here above, with special emphasis on nucleon structure.

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"AGK cancellations in the Color Glass Condensate framework"

We consider a field theory coupled to a time-dependent external source, as in the Color Glass Condensate framework, and we study some general properties of the distribution of produced particles. We derive a formula for the probability of producing a given number of particles, in terms of cuts through vacuum-vacuum diagrams, and we show that the distribution of particle multiplicities is non Poissonian, even in the classical approximation. Then, we show how to calculate moments of the distribution of multiplicities. In particular, at leading order, the average multiplicity is very easily obtained from the retarded solution of the classical field equation of motion. Then we explain how the simplifications that occur in the calculation of moments are due to an extension of the Abramovsky-Gribov-Kancheli cancellations.

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"Interplay of nuclear structure and dynamics in the ^{3}He(e,e'p)d and ^{3}He(e,e'p)pn reactions at high momentum transfer"

Recent study of the reactions ^{3}He(e,e'p)d and ^{3}He(e,e'p)pn at Jefferson Lab has generated considerable theoretical interest that produced numerous model calculations. I shall present the data that was taken at a large momentum transfer and span a very large missing momentum – missing energy space. I shall also describe several model calculations and discuss them in comparison to the data. Details of the results indicate that the data are sensitive to a very intricate interplay between the structure of ^{3}He and the dynamics of the interaction.

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"A High Luminosity Electron - Ion Collider"

An invaluable tool for studying the fundamental structure of matter in the future will be a high luminosity electron-ion collider. With polarised beams detailed measurements can be made of the spin structure functions for the nucleons as well as spin carried by the gluon. Several proposals for such a facility are being developed. This talk will give an overview of the physics accessible with such a facility and describe some of the machine and detector configurations being considered.

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"FAIR - Research and a Status Report"

The FAIR project (Facility for Antiproton and Ion Research) has recently completed its Baseline Technical Report (BTR). The document, with more than 3000 pages, was prepared in a broad collaborative effort between GSI and the international research community and now has more than 2400 authors involved. The talk will give a brief summary overview of the project, its research goals and its status, but then will focus on some recent developments in the science areas that are at the centre of FAIR.

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"Effect of the Neutrino e.m. Form Factors on the Neutrino Cross Section in Dense Matter"

The sensitivity of the differential cross section of the interaction between neutrino and dense matter to the possibly nonzero neutrino electromagnetic properties has been investigated [1, 2]. It is found that the effects of neutrino electromagnetic properties on the differential cross section become more significant for the neutrino magnetic moment $\mu_\nu > 10^{-10}$ μB and the neutrino charge radius $R > 10^{-5}$ MeV^{-1}. In standard model, mass-less neutrinos have zero magnetic moment and electronic charge. However, there has been a laboratory upper limit of neutrino muon dipole moment given by $\mu_\nu < 7.4 \times 10^{-10}$ μB [3] and neutrino charge radius of $R > 5 \times 10^{-6}$ MeV^{-1} [4]. Moreover, various astrophysical observations provide a limit for the neutrino magnetic moment in the range from 10^{-10} μB to 4×10^{-10} μB [5] and $e_\nu < 2 \times 10^{-14}$ e [6]. Recently, by using standard model properties of

neutrinos, Horowitz and Perez-Garcia [7] has found that the muon anti-neutrinos mean free path in high density matter was considerably larger than the neutrinos one, provided that the weak magnetism of nucleons is included. Therefore, in this opportunity we will present the effect of neutrino electromagnetic properties on the mean free path difference between muon neutrino and its anti-neutrino. In this calculation, we follow the same procedure as in Ref. [2], i.e., the differential cross section is calculated in a linear response approximation, while leptons are assumed to be Fermi gas. For modelling the interacting nucleons, the relativistic mean field model inspired by effective field theory [8] has been used to describe non strange dense matter.

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"The high-energy limit of DIS diffraction in QCD"

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"Direct photon detection in pp and PbPb collisions in the ALICE experiment "

Direct photons are considered as one of the most important signatures of thermalized quark-gluon matter produced in relativistic heavy-ion collisions. The ALICE experiment at LHC, which is being prepared to study heavy-ion collisions at the energies 5.5 ATeV, will be equipped by the photon spectrometer PHOS to detect direct photons and measure their spectrum in a wide momentum range 0 <pT < 100 GeV/c with a high precision. Expected yields of direct photons at the LHC energies, as well as experimental methods to measure photon spectrum in the PHOS detector, will be discussed. The following topics will be considered in the talk: 1. Measurements of thermal photon rates at p_T < 10 GeV/c, studies of the background due to decay photons and particle identification efficiencies, expected systematical errors in the thermal photon spectrum measurement; 2.Detection of prompt photons at p_T > 10 GeV/c, background studies, photons as jet tagging, expected prompt photon statistics achievable during one year of ALICE running in pp and Pb-Pb collisions. The feasibility studies of the PHOS detector are based on simulations taking into account the realistic detector response and reconstruction algorithms within the ALICE framework for simulation, reconstruction and data analysis, aliroot.

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"Quark-Hadron Duality"

A variety of data from the Thomas Jefferson National Accelerator Facility (Jefferson Lab) have been used to precisely test duality in all of the unpolarized structure functions, in nucleons and nuclei, in polarized structure functions, and in semi-inclusive scattering. It has been said that understanding quark-hadron duality is one of the most important and challenging problems for QCD practitioners today. An overview of the experimental results will be presented, concluding that duality is apparently a fundamental aspect of nucleon structure. Finally, a brief summary of future duality experiments at Jefferson Lab as well as the MINERVA experiment at Fermilab will also be presented.

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"Jet time evolution and perturbative hadronization"

A jet initiated by a highly virtual parton dissipates a substantial fraction of its energy within a short time interval of the order of 1 fm. In order to produce a leading hadron carrying the main fraction of the jet energy, color neutralization must happen shortly after the jet origin. This observation invalidates the standard energy loss scenario based on an ad hoc assumption of a long color neutralization time scale.

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"Exclusive Scattering at Large Momentum Transfer"

A brief introduction into the concept of generalized parton distributions (GPDs) will be given and our present knowledge on the GPDs reviewed. Applications of the GPDs to high energy exclusive scattering at large momentum transfer, the so-called handbag approach, will be discussed in some detail. It will be argued that the scattering amplitudes for such processes factorize into parton-level amplitudes and new form factors which represent 1/x-moment of GPDs. Results for Compton scattering and two photon annihilation into pairs of hadrons obtained from this handbag approach will be shown and compared to recent data from Jlab and BELLE. It is to be emphasized that the investigation of exclusive reactions at large momentum transfer is complementary to that of deeply virtual exclusive reactions: while in the first class of reactions GPDs at large momentum transfer occur the second class provides information on GPDs at small momentum transfer.

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"**Hadron Physics at J-PARC"**

I discuss topics, which will be investigated at J-PARC, in hadron physics by focusing on theoretical aspects. Using the primary-proton and secondary beams, we can investigate a variety of topics. They include detailed studies of nucleon substructure, search for exotic hadrons, hadron properties in nuclear medium, and strangeness nuclear physics. For example, the nucleon structure can be investigated by Drell-Yan processes, exclusive processes, and neutrino scattering. In addition, if the proton beam is polarized, spin structure of the nucleon can be investigated.

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"Exclusive meson pair production at $\gamma^* \gamma$ scattering at forward angles"

We study the exclusive production of two mesons in hard $\gamma^* \gamma$ scattering, in the forward kinematical region where the virtuality of one photon provides us with a hard scale in the process. The newly introduced concept of Transition Distribution Amplitudes (TDA) is used to perform a QCD calculation of these reactions. Cross section for various meson-pair production are evaluated and compared to the possible background from the Bremsstrahlung process. This picture maybe tested in intense electron-positron colliders such as CLEO and B factories.

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"Quarkonia Production in p-p, p(d)-A and A-A collisions"

Quarkonia (J/ Ψ, Ψ', Upsilon) production provides a sensitive probe of gluon distributions and their modification in nuclei; and is a leading probe of the hot-dense (deconfined) matter created in high-energy collisions of heavy ions. I will discuss our current understanding of the modification of gluon distributions in nuclei and other cold-nuclear-matter effects in the context of recent p-p and p(d)-A quarkonia measurements. Then I will review the latest results for nucleus-nucleus collisions from RHIC, and together with the baseline results from d-A and p-p collisions, discuss several alternative explanations for the observed suppressions and future prospects for distinguishing these different pictures.

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"Charmonium dissociation by mesons and heavy ion collisions"

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"Deeply Virtual Compton Scattering in JLab Hall A"

Recently a new theoretical framework, the Generalized Parton Distributions (GPDs), has been proposed. It unifies form factors and parton distributions within a general description of the non-perturbative structure of the nucleon. GPDs are 4 universal functions H, E, \tilde{H}, and \tilde{E} connected to quark correlation amplitudes. Virtual Compton scattering $\gamma N \rightarrow \gamma N$ in the Bjorken limit (DVCS) is the simplest exclusive process which allows access to GPDs. In the 6~GeV energy range, the DVCS process can be investigated with polarized electrons scattering off the proton or the neutron. Jefferson Laboratory E00-110 and E03-106 experiments recently completed data taking in Hall A investigating the DVCS process on the nucleon. The experimental apparatus and methods will be presented and preliminary results will be discussed on the basis of the present analysis status.

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"Structure functions at low Q^2: higher twists and target mass effects"

We discuss lepton-nucleon structure functions in the transition region between the deep-inelastic domain at high Q^2, and the region at moderate Q^2 dominated by nucleon resonances. Here the phenomenon of quark-hadron duality can be studied in detail, and we contrast the different realizations of duality which appear in electron and neutrino scattering. Using recent data from Jefferson Lab and elsewhere on moments of structure functions, we extract the higher twist contributions which are sensitive to the long-range quark-gluon correlations in the nucleon. Finally, we outline a new implementation of target mass corrections, which avoids the threshold problem associated with unphysical structure functions at x close to 1.

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"Hadrons in the nuclear medium: recent experimental results"

The quest of hadron masses and their modification in the nuclear medium is one of the central open issues in hadron and nuclear physics. Theoretical models on the origin of hadron masses predict variations of hadron masses and widths in the nuclear medium with increasing baryon density and temperature. Experimentally, these questions have been addressed by studying meson production and decay in heavy-ion collisions and in proton- or photon-induced reactions. The elementary processes may be easier to interpret theoretically. This talk focuses on recent experiments on the photo production of ω mesons from nuclei. Compared to the corresponding measurement on a liquid hydrogen target a

downward shift of the ω mass by ≈ 5% is observed at about half of the nuclear matter density. Studying the ω yield as a function of the nuclear mass number, an in-medium width of the ω meson of about 50 MeV is deduced, corresponding to 6 times the ω width in vacuum. The lowering of the ω mass in the nuclear medium points to an attractive ω-nucleus potential which may be so strong that even bound ω-nucleus states may exist. Recent results on the search for ω mesic states will be reported.

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"Quantum Opacity, the RHIC HBT Puzzle, and the Chiral Phase Transition"

We present a relativistic quantum mechanical treatment of opacity and refractive effect that allows reproduction of observables measured in two-pion (HBT) interferometry and pion spectra at RHIC. The inferred emission duration is substantial. The results are consistent with the emission of pions from a system that has a restored chiral symmetry. The effects of interactions of pions emitted from a dense system of matter are incorporated using an optical potential formalism. The STAR Au+Au pionic data (at $s^{1/2}$= 200 GeV) for HBT correlations and the spectrum is studied for three different regions of centrality, with good agreement. The influence of the real part of the optical potential is found to be crucial: this potential is so deeply attractive that the pions can be said to be massless inside the medium.

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"The physics program of the ALICE experiment at the LHC"

ALICE is a dedicated heavy-ion experiment designed to exploit the unique physics potential of nucleus-nucleus interactions at the LHC energies. Its purpose is to study the behaviour of strongly interacting matter at extreme energy densities, where the formation of a new phase of matter, the quark-gluon plasma (QGP), is expected. The existence of such a phase and its properties are key issues in QCD for the understanding of confinement and of chiral-symmetry restoration. In order to draw strong conclusions about the QGP, a complex detector system is required, that can simultaneously measure many experimental observables and their correlations on a event-by-event basis. ALICE will also study proton-proton and proton-nucleus collisions, which will provide reference data for the nucleus-nucleus collisions. In addition the pp data will allow for a number of genuine pp physics studies, especially in the low transverse-momentum domain. In this talk the analysis and physics reach for a representative sample of physics observables from global event characteristics to hard processes will be presented.

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"Hadrons in Medium: Low and High Energy Observables"

In this talk theoretical expectations for in-medium changes of hadronic properties will be discussed. Special emphasis will be on the actual observables and their sensitivity to in-medium changes in photonuclear reactions both at the MAMI/ELSA energy regime and the HERMES regime.

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"Recent Developments in Chiral Dynamics of Hadrons and Hadrons in a Nuclear Medium"

A combination of chiral dynamics and unitarity in coupled channels results into a useful framework to deal with hadron interactions at intermediate energies. A consequence of it is the dynamical generation of some hadronic resonances, like low lying scalar mesons and $1/2^-$ baryons. I shall explore novel paths along the dynamical generation of low lying $3/2^-$ baryons and axial vector mesons, the experimental evidence for the existence of two Lambda(1405) states and related topics. Then a brief exposition will be made of applications to the interaction of particles with nuclei, with emphasis on Kbar, and a critical survey of recent claims on deeply bound kbar states in nuclei.

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"Searching for Strange Quark Matter, 'Strangelets', with the CMS/CASTOR Detector at the LHC"

We report on the CASTOR project of the LHC/CMS experiment. CASTOR is a novel tungsten/quartz EM and HAD calorimeter [1], specially designed for the study of "long penetrating hadrons", observed in hadron-rich Cosmic-Ray events and suggested to be Strangelets. Strangelets, resembling light, almost neutral metastable nuclei, with nearly equal number of u, d, s quarks, have been proposed [2] to be formed in the baryon-rich, very forward fragmentation region through the creation of deconfined quark matter in ultra-relativistic A + A collisions at the LCH. Such objects, if they exist, should be detected and identified in the 10.3 λ_I calorimeter by their azimuthal asymmetry in energy deposition and their large magnitude of fluctuations in the transition curves, as compared to normal events. We shall briefly present the calorimeter and discuss MC simulations for the production and identification of Strangelets.

[1] For reviews on CASTOR: Nucl. Phys. Proc. Suppl. 97(2001)227; CMS week-agenda, 2004-5
[2] Phys. Rev. D45 (1992) 3134; Astropart. Phys. 2 (1994) 167; Astropart. Phys.13 (2000) 173; EPJ direct C9 (2000) 1.

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"Generalized parton distributions in a meson cloud model "

We discuss the general formalism required to derive generalized parton distributions within a convolution model where the bare nucleon is dressed by its virtual meson cloud. In the one-meson approximation, the Fock states of the physical nucleon are expanded in a series involving a bare nucleon and two-particle, meson-baryon, states. In the model calculation, the baryon is assumed to be either a nucleon or a **Δ** described within the constituent quark model in terms of three valence quarks; correspondingly, the meson, assumed to be a pion, is described as a quark-antiquark pair. Explicit expressions for the unpolarized generalized parton distributions are obtained and evaluated in different kinematics.

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"Studying Close Proximity Nucleons in Nuclei via High-Energy/Large-Momentum-Transfer Exclusive Electron Nucleus Reactions."

The biggest deficiency of the independent particle model of nuclei is in ignoring correlated pairs of nucleons whose constituents are at short distances and large relative momenta. The experimental exploration of these pairs has proven to be difficult due to competing mechanisms such as final state rescattering and two-body currents. We performed recently a measurement at JLab and measured the ^{12}C(e,e'p) , ^{12}C(e,e'pp) and ^{12}C(e,e'pn) reactions under conditions sought to minimize the effects of competing mechanisms by going to high momentum transfers and large Bjorken x. Preliminary results of these measurements will be presented.

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"Hard Exclusive Reactions and Hadron Structure"

There is a scaling regime for a family of processes where baryon -> baryon, baryon -> meson and baryon -> photon transition matrix elements of nonlocal quark-antiquark or three quark operators on the light cone factorize from a hard amplitude. These processes include in particular forward and backward virtual Compton scattering e H -> e'H gamma, forward and backward meson production e H -> e'H meson, as well as crossed processes such as proton-antiproton forward annihilation processes into a lepton pair and a real photon or a meson. The scaling of the cross section of some of these processes are already tested at JLab or Hermes and will be studied at the proposed GSI intense anti-proton beam facility FAIR with the PANDA or PAX detectors. The relevant Generalized Parton Distributions (GPDs) and Transition Distribution Amplitudes (TDAs) encode the physics of the quark and gluon content of the baryons, and in particular their impact

parameter dependence may shed new light on the transverse structure of hadrons. We discuss the properties and present some phenomenological models for these objects, and the related cross sections.

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"Hadronisierung in electron-nucleus and hadron- nucleus collisions"

We discuss semi-inclusive processes in high energy e A, p A and A A collisions. Depending on the virtuality of the initial timelike parton we review results from the string model and from perturbative QCD. We emphasize the importance of the parton as a timelike probe which decays irrespective of induced collisions with the medium. Current scenarios for energy loss assume the collisions of an on shell parton with matter. We critically compare these models with the new approach.

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"Two Scales of the Hadronic Structure"

Data: Diffractive cross section is surprisingly small; Hadronic cross section rises slowly; Diffractive cone hardly shrinks with energy; Gluon shadowing is weak. Interpretation: The radius of the gluonic spots in the nucleon responsible for the above reactions is about 0.3 fm, small as compared to the confinement radius

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"Universal nuclear dependence in high energy nuclear collisions"

Nuclear dependence is an excellent probe of nuclear structure and dynamical properties of strong interacting medium produced in high energy nuclear collisions. Understanding the features of different sources of nuclear dependence is extremely important for discovering and learning new properties of QCD and strong interaction physics. In this talk, I will present a systematic calculation of resumming the universal (process independent) nuclear dependence to nuclear parton distribution functions (nPDFs). In terms of collinear QCD factorization approach, we derived a modified DGLAP evolution equations for nPDFs with all leading medium size enhanced power corrections resummed. We found that gluon evolution at small-x and low Q^2 is significantly modified.

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"Dileptons and Medium Effects in Heavy-Ion Collisions"

Dileptons are unique probes of the strongly interacting medium created in high-energy collisions of heavy nuclei, as pertinent invariant-mass spectra carry direct information on the spectral properties of the vector current in matter. We discuss the relations of medium modifications of the vector spectral functions to the restoration of chiral symmetry in hot and dense QCD matter, and how effective models can bridge and illuminate connections between experiment and lattice QCD computations of chiral order parameters. New precision data of NA60 are subjected to theoretical analysis, and future requirements to theory and experiment are identified.

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"The entropy of a correlated system of nucleons"

In a fully correlated picture, within an approach that goes beyond the mean-field and the quasi-particle pictures, the single-particle strength of a nucleon is fragmented in a wide range of energies. The spectral function computed within a Self-Consistent Green's Function approach describes such partial occupation of single-particle states. The question of how does this fragmentation affect thermodynamical properties of nuclear matter is addressed. In particular, we show that the entropy can be computed with the help of an spectral function closely related to the propagator and the self-energy. Results for the density and temperature dependences of the entropy per particle of an infinite system of correlated nucleons will be presented and compared with the lowest order finite temperature Brueckner-Hartree-Fock results.

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**"Spin Structure Functions with CLAS at JLab:
A Window into the Structure of Hadrons"**

A large program of nucleon spin structure measurements is underway in Jefferson Lab's Hall B. By using longitudinally polarized electrons with energies from 1.6 to 5.7 GeV incident upon polarized NH_3 and ND_3 targets, proton and deuteron spin observables in and above the resonance region have been investigated. Extensive data have been obtained on the first moment of the spin structure function g_1, which goes through a rapid transition from the photon point, where it is constrained by the Gerasimov-Drell-Hearn sum rule, to the deep inelastic limit where it is sensitive to the nucleon spin fraction carried by quarks. We will also present the GDH and Bjorken integrals using the 1.6 and 5.7 GeV data, as well as a new experiment underway to extend the proton GDH integral down to momentum transfers close to the photon point.

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"The signature of some promising di-meson decays"

Dimesons are expected to provide important information about the quark-quark effective interaction and about production and decay mechanisms. The cleanest, the double-heavies are difficult to identify. I shall discuss a few promising signatures for the double-charm di-mesons ccūđ and possibly for csūđ. One example is the ratio between the pionic and gamma decay which is very sensitive to the DD* binding energy, due to the small phase space for the pionic decay. Other example are the expected ratios between the following events: the expected ratios between the following events: cc\bar{q}\bar{q}/ccq ~cs\bar{q}\bar{q}/csq ~ \bar{b}\bar{q}\bar{q}/\bar{b}q ~\bar{c}\bar{q}\bar{q}/\bar{c}q ~0.1.

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"Unitarity Corrections to $\pi\pi$ Partial Waves from Dispersion Relation Formalism"

Pion pion scattering amplitude is obtained from Chiral Perturbation Theory at and $O(p^4)$ $O(p^6)$ corresponding to one- and two-loop approximations. Dispersion relation formalism provides a more economic method that was proved to reproduce the analytical structure of that amplitude at both approximation levels. This work extend the use of the formalism in order to compute further unitarity corrections to partial waves.

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"Jets in heavy ion collisions"

Jet quenching has been established as one of the main tools to study the properties of the medium produced in heavy ion collisions. Most of the experimental effort has been, up to now, on the measurements of inclusive particle suppression. This observable suffers, however, of limitations due to different trigger-bias effects. The study of jets (or particle correlations) in a medium is the most promising way out for a better characterization of the medium properties. I will present how these more differential measurements can be used to study not only the density of the medium (the traditional parameter fixed by jet quenching measurements) but also more dynamical quantities as flow fields.

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"Electromagnetic Form Factors of Hadrons and Higher Fock Components"

The simultaneous investigation of hadron electromagnetic form factors, in the space- and time-like regions, within a light-front model, allows one to address the issue of non-valence components (i.e. higher Fock components) of hadron and photon wave functions. Our relativistic approach is based on a microscopic version of the Vector Meson Dominance model for the hadronic component of the photon vertex, and on a simple parametrization for emission and absorption of a quark-antiquark pair by a single quark. The model will be illustrated through the application to the pion and the nucleon electromagnetic form factors, in the space- and time-like regions.

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"Elastic form factors of the nucleon in the relativized hyper-central constituent quark model"

We briefly report on results about the electromagnetic form factors of the nucleon obtained with different models and then we concentrate our attention on recent results obtained with the hyper-central constituent quark model.

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"Superfast Quarks in the Nuclear Medium"

We study high energy and momentum transfer electro-nuclear reactions in which partons with Bjorken x larger than one are probed. We discuss mechanisms that can generate these "superfast" quarks and demonstrate that such states will correspond to the high density fluctuations in the nuclear medium. Several predictions for signatures of the "superfast" quarks will be discussed for inclusive and semi-inclusive deep inelastic scattering off nuclei. We also demonstrate how these studies could advance our understanding of the dynamics of quark-hadron transition.

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"Japan Proton Accelerator Research Complex, J-PARC"

Japan Proton Accelerator Research Complex, J-PARC, is an accelerator complex with a Linac, a 3-GeV synchrotron, and a 50-GeV synchrotron, which aims to be a world center of research in materials and life sciences with neutrons and muons and in nuclear and particle physics with protons and mesons such as kaons, pions, and neutrinos. Its construction began in 2001, and the first beam is expected in around 2008. In this talk, an overview of the facility will be presented and examples of experimental programs to be conducted there will be introduced.

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"Higgs production through intrinsic heavy quarks"

A novel mechanism for exclusive diffractive Higgs production $pp \to H\ p\ p$ is proposed, in which the Higgs boson carries a significant fraction of the projectile proton momentum. This mechanism will provide a clear experimental signal for Higgs production due to the small background in this kinematic region. The key assumption underlying our analysis is the presence of intrinsic heavy flavor components of the proton bound state, whose existence at high light-cone momentum fraction x has growing experimental and theoretical support.

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"Generalized parton distributions of hadrons with composite constituents"

A method is reviewed for calculating the Generalized Parton Distributions (GPDs) of spin 1/2 hadrons made of composite constituents, in an Impulse Approximation framework. GPDs are obtained from the convolution between the light cone non-diagonal momentum distribution of the hadron and the GPD of the constituent. DIS structure functions and electromagnetic form factors are consistently recovered with the proposed formalism. Results will be presented for the nucleon target and for the ^{3}He nucleus. For a nucleon assumed to be made of composite constituent quarks, it will be shown that the proposed scheme permits to study the so-called Efremov-Radyushkin-Brodsky-Lepage region, difficult to access in model calculations. Results will be presented for both helicity-independent and helicity-dependent GPDs. For the ^{3}He target, the calculation has been performed by evaluating a non-diagonal spectral function in the AV18 interaction. It turns out that a measurement of GPDs for ^{3}He could shed new light on the short-range nuclear structure at the quark level.

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**"From Hadronic to Partonic World:
Phenomena At and Above Deconfinement Temperature"**

We review recent progress toward understanding of strongly coupled Quark-Gluon Plasma. RHIC experiment lead to discovery of strong radial, elliptic and conical flows, which all suggest that it is a near-perfect liquid at $T=(1\text{-}2)T_c$. Lattice effective masses and potentials, plus quantum mechanical studies, suggest many hadronic states to survive in some T interval above T_c. Furthermore, they suggested "new spectroscopy", with an array of colored binary states, as well as baryons and other many-body states such as

“polymeric chains” \bar q.g.g... q. I will also briefly review what was done on the subject of strongly coupled plasmas using classical color models as well as ADS/CFT correspondence.

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“Facts and Mysteries of Exotics at the beginning of 21 Century”

The status of the exotic baryons is briefly considered. We discuss possible properties of the lower and higher flavor multiplets and their members, assuming their existence can (and will) be verified.

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“Nonabelian Plasma Instabilities”

I will discuss recent advances in the understanding of non-equilibrium gauge field dynamics in plasmas which have particle distributions which are locally anisotropic in momentum space. In contrast to locally isotropic plasmas such anisotropic plasmas have a spectrum of soft unstable modes which are characterized by exponential growth of transverse (chromo)-magnetic fields at short times. The long-time behaviour of such instabilities depends on whether or not the gauge group is abelian or non-abelian. Here I will report on recent numerical simulations which attempt to determine the long-time behaviour of an anisotropic non-abelian plasma.

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“Revealing small x dynamics of nuclei and protons in ultraperipheral collisions at RHIC and LHC“

The physics of ultraperipheral nucleus-nucleus collisions is explained. The first results from RHIC are reviewed as well as the small x dynamics which could be studied using ultraperipheral nucleus-nucleus and proton-nucleus collisions at LHC. Our analysis suggests that for a range of important small x QCD phenomena which were studied at HERA it will be possible to reach energies which are by a factor of 10 higher than those reached at HERA for electron- proton scattering. Consequently it will be possible to explore QCD in the domain where the strength of nonlinearities is substantially higher than both at HERA and eRHIC.

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"Contribution of Strange Quarks to the Structure of the Nucleon"

We review the theoretical issues surrounding the role of strange quarks in the nucleon. This begins with consideration of the nucleon mass, the sigma commutator and ends with the electromagnetic form factors. The latter are especially topical given the enormous amount of experimental activity at JLab and Mainz at the present time.

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"Gravitational Effects in Relativistic Nucleus-Nucleus Collisions"

In relativistic Nucleus-Nucleus collisions, the energies lost by the nuclei due to collisions is deposited in the collision region. It is yet to be resolved as to what form of quanta appear in the first instant after the collision [1]. We estimate the combined effect of Lorentz contraction and relativistic mass enhancement to show that the large amout of energy lost by the relativistically moving nuclei.

[1] C.W. Wong, "Interaction to High Energy Heavy-Ion Collisions" (World Sc.), 1994,p.271

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"Topological Structure of Dense Hadronic Matter."

We describe hadronic matter in the Skyrme model, a unified approach to describe nuclear phenomena applicable in the large N_C limit of QCD, which we extend to dense matter. In our picture, dense hadronic matter is described by a "classical" soliton configuration which has the minimum energy for the given baryon number density. Incorporating the meson fluctuations on top of such ground state allows the description, by means of an effective Lagrangian, of the meson dynamics in the dense medium. The Skyrme model, with only pion fields, has been extended to include the dilaton field and vector mesons.

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"Hard probes at RHIC and at the LHC: physics challenges"