

Selected Abstracts from Other Physical Review Journals

Abstracts of papers which are published in **other Physical Review journals** and may be of interest to *Physical Review C* readers are printed here. The Editors of *Physical Review C* routinely scan the abstracts of **Physical Review D** papers. Appropriate abstracts of papers in other *Physical Review journals* may be included upon request.

Deviation of atmospheric mixing from maximal and structure in the leptonic flavor sector. André de Gouvêa, *Northwestern University, Department of Physics & Astronomy, 2145 Sheridan Road, Evanston, Illinois 60208, USA.* (Received 10 February 2004; published 28 May 2004)

I attempt to quantify how far from maximal one should expect the atmospheric mixing angle to be given a neutrino mass matrix that leads, at zeroth order, to a ν_3 mass eigenstate that is 0% ν_e , 50% ν_μ , and 50% ν_τ . This is done by assuming that the solar mass-squared difference is induced by an “anarchical” first order perturbation, an approach then can naturally lead to experimentally allowed values for all oscillation parameters. In particular, both $|\cos 2\theta_{\text{atm}}|$ (the measure for the deviation of atmospheric mixing from maximal) and $|U_{e3}|$ are of order $\sqrt{\Delta m_{\text{sol}}^2/\Delta m_{\text{atm}}^2}$ in the case of a normal neutrino mass hierarchy or of order $\Delta m_{\text{sol}}^2/\Delta m_{\text{atm}}^2$ in the case of an inverted one. Hence, if any of the textures analyzed here has anything to do with reality, next-generation neutrino experiments can see a nonzero $\cos 2\theta_{\text{atm}}$ in the case of a normal mass hierarchy, while in the case of an inverted mass hierarchy only neutrino factories should be able to see a deviation of $\sin^2 2\theta_{\text{atm}}$ from 1. [*Phys. Rev. D* **69**, 093007 (2004)]

Generalized parton distributions and composite constituent quarks. Sergio Scopetta, *Dipartimento di Fisica, Università degli Studi di Perugia, via A. Pascoli 06100 Perugia, Italy, and INFN, Sezione di Perugia, Perugia, Italy;* Vicente Vento, *Departament de Física Teòrica, Universitat de València, 46100 Burjassot, València, Spain, and Institut de Física Corpuscular, Consejo Superior de Investigaciones Científicas, València, Spain.* (Received 10 July 2003; published 13 May 2004)

An approach is proposed to calculate generalized parton distributions (GPDs) in a constituent quark model (CQM) scenario, considering the constituent quarks as complex systems. The GPDs are obtained from the wave functions of the nonrelativistic CQM of Isgur and Karl, convoluted with the GPDs of the constituent quarks themselves. The latter are modeled by using the structure functions of the constituent quark, the double distribution representation of GPDs, and a recently proposed phenomenological constituent quark form factor. The present approach permits us to access a kinematical range corresponding to both the Dokshitzer-Gribov-Lipatov-Altarelli-Parisi and the Efremov-Radyushkin-Brodsky-Lepage regions, for small values of the momentum transfer and of the skewedness parameter. In this kinematical region, the cross sections relevant to deeply virtual Compton scattering could be estimated by using the obtained GPDs. As an example, the leading twist, unpolarized GPD H has been calculated. Its general relations with the nonrelativistic definition of the electric form factor and with the leading twist unpolarized quark density are consistently recovered

from our expressions. Further natural applications of the proposed approach are addressed. [*Phys. Rev. D* **69**, 094004 (2004)]

Cronin effect and energy conservation constraints in high energy proton-nucleus collisions. Enrico Cattaruzza and Daniele Treleani, *Dipartimento di Fisica Teorica dell'Università di Trieste and INFN, Sezione di Trieste, Strada Costiera 11, Miramare-Grignano, I-34014 Trieste, Italy.* (Received 14 January 2004; published 14 May 2004)

We estimate the Cronin effect in pA collisions at the CERN LHC and at the BNL RHIC, using a Glauber-eikonal model of initial state multiparton interactions. For a correct determination of the initial parton flux, we upgrade the model cross section, taking carefully into account all kinematical constraints of each multiparton interaction process. As compared with previous results, derived with approximate kinematics, we obtain a softer spectrum of produced partons, while improving the agreement of the model with the recent measurements of π^0 production in $d+Au$ collisions at $\sqrt{s}=200A$ GeV. [*Phys. Rev. D* **69**, 094006 (2004)]

Mixing and screening of photons and gluons in a color superconductor. Andreas Schmitt, *Institut für Theoretische Physik, J.W. Goethe-Universität, D-60054 Frankfurt/Main, Germany;* Qun Wang, *Institut für Theoretische Physik, J.W. Goethe-Universität, D-60054 Frankfurt/Main, Germany, and Physics Department, Shandong University, Jinan, Shandong, 250100, People's Republic of China;* Dirk H. Rischke, *Institut für Theoretische Physik, J.W. Goethe-Universität, D-60054 Frankfurt/Main, Germany.* (Received 4 November 2003; published 21 May 2004)

We calculate the Debye and Meissner masses of photons and gluons for a spin-one color superconductor in the polar and color-spin-locked phases as well as for a spin-zero color superconductor in the 2SC and color-flavor-locked phases. A general derivation for photon-gluon mixing is provided in terms of the QCD partition function. We show qualitatively and quantitatively which of the gauge bosons attain a mass via the Anderson-Higgs mechanism. Contrary to the spin-zero phases, both spin-one phases exhibit an electromagnetic Meissner effect. [*Phys. Rev. D* **69**, 094017 (2004)]

Z^* resonances: Phenomenology and models. Byron K. Jennings, *TRIUMF, 4004 Wesbrook Mall, Vancouver, British Columbia, Canada V6T 2A3;* Kim Maltman, *Department of Mathematics and Statistics, York University, 4700 Keele Street, Toronto, Ontario, Canada M3J 1P3, and CSSM, University of Adelaide, Adelaide,*

5005, *Australia*. (Received 11 December 2003; published 26 May 2004)

We explore the phenomenology of, and models for, the Z^* resonances, the lowest of which is now well established, and called the Θ . We provide an overview of three models which have been proposed to explain its existence and/or its small width, and point out other relevant predictions and potential problems, for each. The relation to what is known about KN scattering, including possible resonance signals in other channels, is also discussed. [Phys. Rev. D **69**, 094020 (2004)]

Atmospheric neutrinos can make beauty strange. Roni Harnik, Daniel T. Larson, and Hitoshi Murayama, *Theoretical Physics Group, Ernest Orlando Lawrence Berkeley National Laboratory, University of California, Berkeley, California 94720, USA, and Department of Physics, University of California, Berkeley, California 94720, USA*; Aaron Pierce, *Theoretical Physics Group, Stanford Linear Accelerator Center, Stanford University, Stanford, California 94309, USA*. (Received 25 July 2003; published 27 May 2004)

The large observed mixing angle in atmospheric neutrinos, coupled with grand unification, motivates the search for large mixing between right-handed strange and bottom squarks. Such mixing does not appear in the standard Cabibbo-Kobayashi-Maskawa phenomenology, but may induce significant $b \rightarrow s$ transitions through gluino diagrams. Working in the mass eigenbasis, we show quantitatively that an $O(1)$ effect on CP violation in $B_d^0 \rightarrow \phi K_S$ is possible due to a large mixing between $\tilde{s}_R$ and $\tilde{b}_R$, while still satisfying constraints from $b \rightarrow s \gamma$. We also include the effect of $\tilde{b}_L$ - $\tilde{b}_R$ mixing proportional to $m_b \mu \tan \beta$. In the case where $m_b \mu \tan \beta \ll M_{\text{SUSY}}^2$ there may be a large effect in B_s mixing correlated with a large effect in $B_d^0 \rightarrow \phi K_S$, typically yielding an unambiguous signal of new physics at Tevatron run II. [Phys. Rev. D **69**, 094024 (2004)]

Instantons and the spin of the nucleon. T. Schäfer, *Department of Physics, North Carolina State University, Raleigh, North Carolina 27696, USA, and Riken-BNL Research Center, Brookhaven National Laboratory, Upton, New York 11973, USA*; V. Zetocha, *Department of Physics, North Carolina State University, Raleigh, North Carolina 27696, USA, and Department of Physics, SUNY Stony Brook, Stony Brook, New York 11794, USA*. (Received 28 January 2004; published 28 May 2004)

Motivated by measurements of the flavor singlet axial coupling constant of the nucleon in polarized deep inelastic scattering we study the contribution of instantons to Okubo-Zweig-Iizuka rule (OZI) violation in the axial-vector channel. We consider, in particular, the $f_1 - a_1$ meson splitting, the flavor singlet and triplet axial coupling of a constituent quark, and the axial coupling constant of the nucleon. We show that instantons provide a short distance contribution to OZI violating correlation functions which is repulsive in the f_1 meson channel and adds to the flavor singlet three-point function of a constituent quark. We also show that the sign of this contribution is determined by positivity arguments. We compute long distance contributions using numerical simulations of the instanton liquid. We find that the isovector axial coupling constant of

a constituent quark is $(g_A^3)_Q = 0.9$ and that of a nucleon is $g_A^3 = 1.28$, in good agreement with experiment. The flavor singlet coupling of a quark is close to one, while that of a nucleon is suppressed, $g_A^0 = 0.77$. However, this number is larger than the experimental value $g_A^0 = (0.28 - 0.41)$. [Phys. Rev. D **69**, 094028 (2004)]

Pentaquark Θ^+ , constituent quark structures, and prediction of charmed Θ_c^0 and bottomed Θ_b^+ . Kingman Cheung, *Department of Physics and NCTS, National Tsing Hua University, Hsinchu, Taiwan, Republic of China*. (Received 22 August 2003; published 28 May 2004)

The newly observed Θ^+ resonance is believed to be a pentaquark with the constituent quarks $uudd\bar{s}$. There are a few options for the constituent quark structure. Some advocate diquark-diquark-antiquark $(ud)-(ud)-\bar{s}$ while others favor diquark-triquark $(ud)-(uds)$ structure. We use the color-spin hyperfine interaction to examine the energy levels of these structures, and we find that the diquark-diquark-antiquark structure is slightly favored. We proceed to write down the flavor triplet and antisextet of the charmed or bottomed exotic baryons with internal $qqqq\bar{Q}$ quarks. We also estimate the mass of Θ_c^0 and Θ_b^+ . [Phys. Rev. D **69**, 094029 (2004)]

Remarks on the multiparameter reweighting method for the study of lattice QCD at nonzero temperature and density. Shinji Ejiri, *Fakultät für Physik, Universität Bielefeld, D-33615 Bielefeld, Germany*. (Received 6 January 2004; published 19 May 2004)

We comment on the reweighting method for the study of finite density lattice QCD. We discuss the applicable parameter range of the reweighting method for models that have more than one simulation parameter. The applicability range is determined by the fluctuations of the modification factor of the Boltzmann weight. In some models having a first order phase transition, the fluctuations are minimized along the phase transition line if we assume that the pressure in the hot and the cold phases is balanced at the first order phase transition point. This suggests that the reweighting method with two parameters is applicable in a wide range for the purpose of tracing out the phase transition line in the parameter space. To confirm the usefulness of the reweighting method for two-flavor QCD, the fluctuations of the reweighting factor are measured by numerical simulations for the cases of reweighting in the quark mass and chemical potential directions. The relation to the phase transition line is discussed. Moreover, the sign problem caused by the complex phase fluctuations is studied. [Phys. Rev. D **69**, 094506 (2004)]

Behavior of charmonium systems after deconfinement. Saumen Datta and Frithjof Karsch, *Fakultät für Physik, Universität Bielefeld, D-33615 Bielefeld, Germany*; Peter Petreczky, *Physics Department, Brookhaven National Laboratory, Upton, New York 11973, USA*; Ines Wetzorke, *NIC/DESY Zeuthen, Plataneallee 6, D-15738 Zeuthen, Germany*. (Received 18 January 2004; published 20 May 2004)

We present a study of charmonia in hot gluonic plasma, for temperatures up to three times the deconfinement transition temperature T_c . $q\bar{q}$ systems with quark masses close to the charm mass and different spin-parity quantum numbers were studied on very fine isotropic lattices. The analysis of temporal correlators, and spectral functions constructed from them, shows that the J/ψ and η_c survive up to quite high temperatures, with little observable change up to $1.5T_c$, and then gradually weaken and disappear by $3T_c$. For the scalar and axial vector channels, serious modifications are induced by the hot medium already close to T_c , possibly dissociating the mesons by $1.1T_c$. [Phys. Rev. D **69**, 094507 (2004)]

Pion structure from improved lattice QCD: Form factor and charge radius at low masses. J. van der Heide, *National Institute for Nuclear Physics and High-Energy Physics (NIKHEF), 1009 DB Amsterdam, The Netherlands*; J. H. Koch, *NIKHEF and Institute for Theoretical Physics, University of Amsterdam, Valckenierstraat 65, 1018 XE Amsterdam, The Netherlands*; E. Laermann, *Fakultät für Physik, Universität Bielefeld, D-33615 Bielefeld, Germany*. (Received 19 December 2003; revised manuscript received 28 January 2004; published 28 May 2004)

The charge form factor of the pion is calculated in lattice QCD. The nonperturbatively improved Sheikholeslami-Wohlert action is used together with the $O(a)$ improved vector current. Other choices for the current are examined. The form factor is extracted for pion masses from 970 down to 360 MeV and for momentum transfers $Q^2 \leq 2 \text{ GeV}^2$. The mean square charge radius is extracted and compared to previous determinations, and its extrapolation to lower masses discussed. [Phys. Rev. D **69**, 094511 (2004)]

Calculation of the QCD phase diagram at finite temperature, and baryon and isospin chemical potentials. A. Barducci, R. Casalbuoni, G. Pettini, and L. Ravagli, *Department of Physics, University of Florence and INFN Sezione di Firenze, Via G. Sansone 1, I-50109, Sesto F.no, Firenze, Italy*. (Received 12 February 2004; published 27 May 2004)

We study the phases of a two-flavor Nambu–Jona-Lasinio model at finite temperature T , and baryon and isospin chemical potentials $\mu_B = (\mu_u + \mu_d)/2$, $\mu_I = (\mu_u - \mu_d)/2$. This study completes a previous analysis where only small isospin chemical potentials μ_I were considered. [Phys. Rev. D **69**, 096004 (2004)]

Meson-meson bound states in a (2+1)-dimensional strongly coupled lattice QCD model. Paulo A. Faria da Veiga and Michael O’Carroll, *Departamento de Matemática, ICMC-USP, C.P. 668, 13560-970 São Carlos, SP, Brazil*; Antônio Francisco Neto, *Departamento de Física e Informática, IFSC-USP, C.P. 369, 13560-970 São Carlos, SP, Brazil*. (Received 21 October 2003; published 13 May 2004)

We consider bound states of two mesons (antimesons) in lattice quantum chromodynamics in an Euclidean formulation. For simplicity, we analyze an SU(3) theory with a single flavor in 2+1

dimensions and two-dimensional Dirac matrices. For a small hopping parameter κ and small plaquette coupling g_0^{-2} , such that $0 < g_0^{-2} \ll \kappa \ll 1$, recently we showed the existence of a (anti)meson-like particle, with an asymptotic mass of the order of $-2 \ln \kappa$ and with an isolated dispersion curve—i.e., an upper gap property persisting up to near the meson-meson threshold which is of the order of $-4 \ln \kappa$. Here, in a ladder approximation, we show that there is no meson-meson (or antimeson-antimeson) bound state solution to the Bethe-Salpeter equation up to the two-meson threshold. Remarkably the absence of such a bound state is an effect of a potential which is nonlocal in space at order κ^2 , i.e., the leading order in the hopping parameter κ . A local potential appears only at order κ^4 and is repulsive. The relevant spectral properties for our model are unveiled by considering the correspondence between the lattice Bethe-Salpeter equation and a lattice Schrödinger resolvent equation with a nonlocal potential. [Phys. Rev. D **69**, 097501 (2004)]

Linking the chiral and deconfinement phase transitions. Yoshitaka Hatta, *Department of Physics, Kyoto University, Kyoto 606-8502, Japan*, *The Institute of Physical and Chemical Research (RIKEN) Wako, Saitama 351-0198, Japan*, and *High Energy Theory, Department of Physics, Brookhaven National Laboratory, Upton, New York 11973, USA*; Kenji Fukushima, *Department of Physics, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan*. (Received 13 July 2003; published 17 May 2004)

We show that the electric glueball becomes massless at the end point of the deconfinement phase transition in finite temperature QCD. Based on this observation and existing lattice data, we argue that the chiral phase transition at a zero quark mass and the deconfinement phase transition at an infinite quark mass are continuously connected by the glueball-sigma mixing. [Phys. Rev. D **69**, 097502 (2004)]

Exploring the sub-eV neutrino mass range with supernova neutrinos. Enrico Nardi, *INFN, Laboratori Nazionali di Frascati, C.P. 13, I00044 Frascati, Italy*, and *Instituto de Física, Universidad de Antioquia, A.A. 1226, Medellín, Colombia*; Jorge I. Zuluaga, *Instituto de Física, Universidad de Antioquia, A.A. 1226, Medellín, Colombia*. (Received 30 July 2003; revised manuscript received 27 January 2004; published 12 May 2004)

A new method to study the effects of neutrino masses on a supernova neutrino signal is proposed. The method relies exclusively on the analysis of the full statistics of neutrino events, it is independent of astrophysical assumptions, and does not require the observation of any additional phenomenon to trace possible delays in the neutrino arrival times. The sensitivity of the method to the sub-eV neutrino mass range, defined as the capability of disentangling at 95% C.L. the case $m_\nu = 1 \text{ eV}$ from $m_\nu = 0$, is tested by analyzing a set of synthetic neutrino samples modeled according to the signal that could be detected at SuperKamiokande. For a supernova at the Galactic center success is achieved in more than 50% of the cases. It is argued that a future Galactic supernova yielding several thousands of inverse β decays might provide enough information to explore a neutrino mass range somewhat below 1 eV. [Phys. Rev. D **69**, 103002 (2004)]

Precision primordial ^4He measurement from the CMB. Greg Huey and Richard H. Cyburt, *Department of Physics, University of Illinois, Urbana, Illinois 61801, USA*; Benjamin D. Wandelt, *Department of Physics, University of Illinois, Urbana, Illinois 61801, USA*, and *Department of Astronomy, UIUC, 1002 W. Green Street, Urbana, Illinois 61801, USA*. (Received 7 July 2003; published 12 May 2004)

Big bang nucleosynthesis (BBN) and the cosmic microwave background (CMB) are two major pillars of cosmology. Standard BBN accurately predicts the primordial light element abundances (^4He , D, ^3He and ^7Li), depending on one parameter, the baryon density. Light element observations are used as a baryometer. The CMB anisotropies also contain information about the content of the Universe which allows an important consistency check on the big bang model. In addition CMB observations now have sufficient accuracy to not only determine the total baryon density, but also resolve its principal constituents H and ^4He . We present a global analysis of all recent CMB data, with special emphasis on the concordance with BBN theory and light element observations. We find $\Omega_B h^2 = 0.0250^{+0.0019}_{-0.0026}$ and $Y_p = 0.250^{+0.010}_{-0.014}$ (fraction of baryon mass as ^4He) using CMB data alone, in agreement with ^4He abundance observations. The determination of Y_p allows us to constrain the relativistic degrees of freedom during BBN, measured through the effective number of light neutrino species, $N_{\nu,eff} = 3.02^{+0.85}_{-0.79}$, in accord with the standard model of particle physics. With this concordance established we show that the inclusion of standard, $N_{\nu,eff} \equiv 3$, BBN theory priors significantly reduces the volume of parameter space. In this case, we find $\Omega_B h^2 = 0.0245^{+0.0015}_{-0.0028}$ and $Y_p = 0.2493^{+0.0007}_{-0.0010}$. We also find that the inclusion of deuterium abundance observations reduces the Y_p and $\Omega_B h^2$ ranges by a factor of ~ 2 . Further light element observations and CMB anisotropy experiments will refine this concordance and sharpen BBN and the CMB as tools for precision cosmology. [Phys. Rev. D **69**, 103503 (2004)]

Medium-induced gluon radiation off massive quarks fills the dead cone. Néstor Armesto, Carlos A. Salgado, and Urs Achim Wiedemann, *Theory Division, CERN, CH-1211 Geneva 23, Switzerland*. (Received 8 December 2003; published 1 June 2004)

We calculate the transverse momentum dependence of the medium-induced gluon energy distribution radiated off massive

quarks in spatially extended QCD matter. In the absence of a medium, the distribution shows a characteristic mass-dependent depletion of the gluon radiation for angles $\theta < m/E$, the so-called dead cone effect. Medium modifications of this spectrum are calculated as a function of quark mass m , initial quark energy E , in-medium path length and density. Generically, medium-induced gluon radiation is found to fill the dead cone, but it is reduced at large gluon energies compared to the radiation off light quarks. We quantify the resulting mass dependence for momentum-averaged quantities (gluon energy distribution and average parton energy loss), compare it to simple approximation schemes and discuss its observable consequences for nucleus-nucleus collisions at the BNL RHIC and CERN LHC. In particular, our analysis does not favor the complete disappearance of energy loss effects from leading open charm spectra at the RHIC. [Phys. Rev. D **69**, 114003 (2004)]

Hamiltonian lattice quantum chromodynamics at finite density with Wilson fermions. Yi-Zhong Fang, *Department of Physics, Zhongshan (Sun Yat-Sen) University, Guangzhou 510275, China*; Xiang-Qian Luo, *CCAST (World Laboratory), P.O. Box 8730, Beijing 100080, China* and, *Department of Physics, Zhongshan (Sun Yat-Sen) University, Guangzhou 510275, China*. (Received 21 October 2002; revised manuscript received 17 February 2004; published 1 June 2004)

Quantum chromodynamics (QCD) at sufficiently high density is expected to undergo a chiral phase transition. Understanding such a transition is of particular importance for neutron star or quark star physics. In Lagrangian SU(3) lattice gauge theory, the standard approach breaks down at large chemical potential μ , due to the complex action problem. The Hamiltonian formulation of lattice QCD does not encounter such a problem. In a previous work, we developed a Hamiltonian approach at finite chemical potential μ and obtained reasonable results in the strong-coupling regime. In this paper, we extend the previous work to Wilson fermions. We study the chiral behavior and calculate the vacuum energy, chiral condensate, and quark number density, as well as the masses of light hadrons. There is a first-order chiral phase transition at zero temperature. [Phys. Rev. D **69**, 114501 (2004)]