

Selected Abstracts from Other Physical Review Journals

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Scalar density fluctuation at the critical end point in the Nambu–Jona-Lasinio model. H. Fujii, *Institute of Physics, University of Tokyo, Komaba 3-8-1, Meguro, Tokyo 153-8902, Japan.* (Received 19 February 2003; published 22 May 2003)

The soft mode near the critical end point in the phase diagram of the two-flavor Nambu–Jona-Lasinio model is investigated within the leading $1/N_c$ approximation, with N_c being the number of colors. It is explicitly shown by studying the spectral function of the scalar channel that the relevant soft mode is the scalar density fluctuation, which is coupled with the quark number density, while the sigma meson mode stays massive. [Phys. Rev. D **67**, 094018 (2003)]

Excited baryons in large N_c QCD reexamined: The resonance picture versus single-quark excitations. Thomas D. Cohen, *Department of Physics, University of Maryland, College Park, Maryland 20742-4111, USA;* Richard F. Lebed, *Department of Physics and Astronomy, Arizona State University, Tempe, Arizona 85287-1504, USA.* (Received 3 February 2003; published 29 May 2003)

We analyze excited baryon properties via a $1/N_c$ expansion from two perspectives: as resonances in meson-nucleon scattering, and as single-quark excitations in the context of a simple quark model. For both types of analysis one can derive novel patterns of degeneracy that emerge as $N_c \rightarrow \infty$, and that are shown to be compatible with one another. This helps justify the single-quark excitation picture and may give some insight into its successes. We also find that in the large N_c limit one of the S_{11} baryons does not couple to the π - N channel but couples to the η - N channel. This is empirically observed in the $N(1535)$, which couples very weakly to the π - N channel and quite strongly to the η - N channel. The comparatively strong coupling of the $N(1650)$ to the π - N channel and weak coupling to η - N channel is also predicted. In the context of the simple quark model picture we reproduce expressions for mixing angles that are accurate up to $O(1/N_c)$ corrections and are in good agreement with mixing angles extracted phenomenologically. [Phys. Rev. D **67**, 096008 (2003)]

Nonstrange hybrid compact stars with color superconducting matter. Igor Shovkovy, Matthias Hanauske, and Mei Huang, *Institut für Theoretische Physik, J. W. Goethe-Universität, D-60054 Frankfurt/Main, Germany.* (Received 7 March 2003; published 21 May 2003)

Realistic nonstrange hybrid compact stars with color superconducting quark matter in their interior are constructed. It is shown that a positively charged two-flavor color superconducting phase could naturally appear in the core of a hybrid star as one of the components of a globally neutral mixed phase. The negatively

charged normal quark phase is the other component of the mixed phase. The quark core of the star is surrounded by another mixed phase made of hadronic and normal quark matter. The two mixed phases are separated by a sharp interface. Finally, the lowest density regions of the star are made of pure hadronic matter and a crust. [Phys. Rev. D **67**, 103004 (2003)]

Pressure of hot QCD up to $g^6 \ln(1/g)$. K. Kajantie,¹ M. Laine,² K. Rummukainen,¹ and Y. Schröder³ ¹*Department of Physics, P.O. Box 64, FIN-00014 University of Helsinki, Finland,* ²*Theory Division, CERN, CH-1211 Geneva 23, Switzerland,* ³*Center for Theoretical Physics, MIT, Cambridge, Massachusetts 02139.* (Received 21 November 2002; published 19 May 2003)

The free energy density, or pressure, of QCD has at high temperatures an expansion in the coupling constant g , known so far up to order g^5 . We compute here the last contribution which can be determined perturbatively, $g^6 \ln(1/g)$, by summing together results for the 4-loop vacuum energy densities of two different three-dimensional effective field theories. We also demonstrate that the inclusion of the new perturbative $g^6 \ln(1/g)$ terms, once they are summed together with the so far unknown perturbative and nonperturbative g^6 terms, could potentially extend the applicability of the coupling constant series down to surprisingly low temperatures. [Phys. Rev. D **67**, 105008 (2003)]

Charge symmetry violation corrections to determination of the Weinberg angle in neutrino reactions. J. T. Londergan, *Department of Physics and Nuclear Theory Center, Indiana University, Bloomington, Indiana 47405, USA;* A. W. Thomas, *Department of Physics and Mathematical Physics, and Special Research Center for the Subatomic Structure of Matter, University of Adelaide, Adelaide 5005, Australia.* (Received 6 March 2003; published 23 June 2003)

We show that the correction to the Paschos-Wolfenstein relation associated with charge symmetry violation in the valence quark distributions is essentially model independent. It is proportional to a ratio of quark momenta that is independent of Q^2 . This result provides a natural explanation of the surprisingly good agreement found between our earlier estimates within several different models. When applied to the recent NuTeV measurement, this effect significantly reduces the discrepancy with other determinations of the Weinberg angle. [Phys. Rev. D **67**, 111901 (2003)]

Neutrinoless double beta decay from singlet neutrinos in extra dimensions. G. Bhattacharyya,¹ H. V. Klapdor-Kleingrothaus,² H. Päs,³ and A. Pilaftsis⁴ ¹*Saha Institute of Nuclear Physics, 1/AF Bidhan Nagar, Kolkata 700064, India,* ²*Max-Planck-Institut für Kernphysik, P. O. Box 103980, D-69029 Heidelberg, Germany,*

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We study the model-building conditions under which a sizable $0\nu\beta\beta$ -decay signal to the recently reported level of 0.4 eV is due to Kaluza-Klein singlet neutrinos in theories with large extra dimensions. Our analysis is based on 5-dimensional singlet-neutrino models compactified on an S^1/Z_2 orbifold, where the standard-model fields are localized on a 3-brane. We show that a successful interpretation of a positive signal within the above minimal 5-dimensional framework would require a non-vanishing shift of the 3-brane from the orbifold fixed points by an amount smaller than the typical scale $(100 \text{ MeV})^{-1}$ characterizing the Fermi nuclear momentum. The resulting 5-dimensional models predict a sizable effective Majorana-neutrino mass that could be several orders of magnitude larger than the light neutrino masses. Most interestingly, the brane-shifted models with only one bulk sterile neutrino also predict novel trigonometric textures leading to mass scenarios with hierarchical active neutrinos and large ν_μ - ν_τ and ν_e - ν_μ mixings that can fully explain the current atmospheric and solar neutrino data. [Phys. Rev. D **67**, 113001 (2003)]

Generalized parton distributions and double distributions for $q\bar{q}$ pions. B. C. Tiburzi and G. A. Miller, *Department of Physics, University of Washington, Box 351560, Seattle, Washington 98195-1560, USA.* (Received 3 January 2003; published 12 June 2003)

We consider two simple covariant models for pions (one with scalar and the other with spin- $\frac{1}{2}$ constituents). Pion generalized parton distributions are derived by integration over the light-cone energy. The model distributions are consistent with all known properties of generalized parton distributions, including positivity. We also construct corresponding double distributions by appealing to the Lorentz invariance of the form factor. These ostensibly constructed double distributions lead to incorrect generalized parton distributions that need not respect the positivity constraints. This inconsistency arises from the ambiguity inherent in defining double distributions in the standard one-component formalism (even in the absence of the Polyakov-Weiss term). We demonstrate that the correct model double distributions can be calculated from nondiagonal matrix elements of twist-two operators. [Phys. Rev. D **67**, 113004 (2003)]

Exploring the sensitivity of current and future experiments to $\theta_\odot$. Abhijit Bandyopadhyay, *Theory Group, Saha Institute of Nuclear Physics, 1/AF, Bidhannagar, Calcutta 700 064, India;* Sandhya Choubey, *INFN, Sezione di Trieste and Scuola Internazionale Superiore di Studi Avanzati, I-34014, Trieste, Italy;* Srubabati Goswami, *Harish-Chandra Research Institute, Chhatnag Road, Jhusi, Allahabad 211 019, India.* (Received 3 March 2003; revised manuscript received 14 April 2003; published 30 June 2003)

The first results from the KamLAND experiment in conjunction with the global solar neutrino data have demonstrated the striking ability to constrain the $\Delta m_\odot^2$ (Δm_{21}^2) very precisely. However the allowed range of $\theta_\odot$ (θ_{12}) did not change much with the inclusion of the KamLAND results. In this paper we probe if future data from

KamLAND can increase the accuracy of the allowed range in $\theta_\odot$ and conclude that even after 3 kton yr of statistics and with the most optimistic error estimates, KamLAND may find it hard to significantly improve the bounds on the mixing angle obtained from the solar neutrino data. We discuss the θ_{12} sensitivity of the survival probabilities in matter (vacuum) as relevant for the solar (KamLAND) experiments. We find that the presence of matter effects in the survival probabilities for ^8B neutrinos gives the solar neutrino experiments SK and SNO an edge over KamLAND, as far as θ_{12} sensitivity is concerned, particularly near the maximal mixing. Among solar neutrino experiments we identify SNO as a most promising candidate for constraining θ_{12} and make a projected sensitivity test for the mixing angle by reducing the error in the neutral current measurement at SNO. Finally, we argue that the most accurate bounds on θ_{12} can be achieved in a reactor experiment, if the corresponding baseline and energy can be tuned to a minimum in the survival probability. We propose a new reactor experiment that can give the value of $\tan^2\theta_{12}$ to within 14%. We also discuss the future Borexino and LowNu experiments. [Phys. Rev. D **67**, 113011 (2003)]

Chiral susceptibility in the hard thermal loop approximation. Purnendu Chakraborty,¹ Munshi G. Mustafa,^{1,2} and Markus H. Thoma³ ¹*Theory Group, Saha Institute of Nuclear Physics, 1/AF Bidhan Nagar, Kolkata 700 064, India,* ²*Institut für Theoretische Physik, Universität Giessen, 35392 Giessen, Germany,* ³*Centre for Interdisciplinary Plasma Science, Max-Planck-Institut für extraterrestrische Physik, P.O. Box 1312, 85741 Garching, Germany.* (Received 11 October 2002; revised manuscript received 25 March 2003; published 2 June 2003)

The static and dynamic chiral susceptibilities in the quark-gluon plasma are calculated within lowest order perturbative QCD at finite temperature and the hard thermal loop resummation technique using an effective quark propagator. After regularization of ultraviolet divergences, the hard thermal loop results are compared to QCD lattice simulations. [Phys. Rev. D **67**, 114004 (2003)]

Chirally-odd twist-3 distribution function $e^a(x)$ in the chiral quark-soliton model. P. Schweitzer, *Dipartimento di Fisica Nucleare e Teorica, Università degli Studi di Pavia, Pavia, Italy.* (Received 4 March 2003; published 9 June 2003)

The chirally-odd twist-3 nucleon distribution $e^a(x)$ is studied in the large- N_c limit in the framework of the chiral quark-soliton model at a low normalization point of about 0.6 GeV. The remarkable result is that in the model $e^a(x)$ contains a δ -function-type singularity at $x=0$. The regular part of $e^a(x)$ is found to be sizable at the low scale of the model and in qualitative agreement with bag model calculations. [Phys. Rev. D **67**, 114010 (2003)]

Azimuthal asymmetries at CLAS: Extraction of $e^a(x)$ and prediction of A_{UL} . A. V. Efremov, *Joint Institute for Nuclear Research, Dubna, 141980 Russia;* K. Goeke, *Institut für Theoretische Physik II, Ruhr-Universität Bochum, D-44780 Bochum, Germany;* P. Schweitzer, *Dipartimento di Fisica Nucleare e Teorica, Università degli Studi di Pavia, I-27100 Pavia, Italy.* (Received 28 February 2003; published 17 June 2003)

The first information on the chirally odd twist-3 proton distribution function $e^a(x)$ is extracted from the azimuthal asymmetry A_{LU} in the electroproduction of pions from deeply inelastic scattering of longitudinally polarized electrons off unpolarized protons, which has been recently measured by the CLAS Collaboration. Furthermore parameter-free predictions are made for the azimuthal asymmetries A_{UL} from scattering of an unpolarized beam on a polarized proton target for CLAS kinematics. [Phys. Rev. D **67**, 114014 (2003)]

Angular conditions, relations between the Breit and light-front frames, and subleading power corrections. Carl E. Carlson, *Thomas Jefferson National Accelerator Facility, 12000 Jefferson Avenue, Newport News, Virginia 23606, USA, and Nuclear and Particle Theory Group, Physics Department, College of William and Mary, Williamsburg, Virginia 23187-8795, USA*; Chueng-Ryong Ji, *Department of Physics, North Carolina State University, Raleigh, North Carolina 27695-8202, USA*. (Received 29 January 2003; published 5 June 2003)

We analyze the current matrix elements in the general collinear (Breit) frames and find the relation between the ordinary (or canonical) helicity amplitudes and the light-front helicity amplitudes. Using the conservation of angular momentum, we derive a general angular condition which should be satisfied by the light-front helicity amplitudes for any spin system. In addition, we obtain the light-front parity and time-reversal relations for the light-front helicity amplitudes. Applying these relations to the spin-1 form factor analysis, we note that the general angular condition relating the five helicity amplitudes is reduced to the usual angular condition relating the four helicity amplitudes due to the light-front time-reversal condition. We make some comments on the consequences of the angular condition for the analysis of the high- Q^2 deuteron electromagnetic form factors, and we further apply the general angular condition to the electromagnetic transition between spin-1/2 and spin-3/2 systems and find a relation useful for the analysis of the N - Δ transition form factors. We also discuss the scaling law and the subleading power corrections in the Breit and light-front frames. [Phys. Rev. D **67**, 116002 (2003)]