

Selected Abstracts from Other Physical Review Journals

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Constraints on Ω_b from nucleosynthesis of ${}^7\text{Li}$ in the standard big bang model. Alain Coc, *Centre de Spectrométrie Nucléaire et de Spectrométrie de Masse, IN2P3-CNRS and Université Paris Sud, Bâtiment 104, 91405 Orsay Campus, France*; Elisabeth Vangioni-Flam, *Institut d'Astrophysique de Paris, 98 bis Bd Arago, 75014 Paris, France*; Michel Cassé, *Service d'Astrophysique, DAPNIA, DSM, CEA, Orme des Merisiers, 91191 Gif sur Yvette CEDEX, France*, and Institut d'Astrophysique de Paris, 98 bis Bd Arago, 75014 Paris, France; Marc Rabiet, *Institut d'Astrophysique de Paris, 98 bis Bd Arago, 75014 Paris, France*. (Received 1 October 2001; published 24 January 2002)

We update standard big bang nucleosynthesis (SBBN) calculations on the basis of recent nuclear physics compilations (NACRE in particular), experimental and theoretical works. By a Monte Carlo technique, we calculate the uncertainties on the light element yields (${}^4\text{He}$, D, ${}^3\text{He}$ and ${}^7\text{Li}$) related to nuclear reactions. The results are compared to observations that are thought to be representative of the corresponding primordial abundances. It is found that ${}^7\text{Li}$ could lead to more stringent constraints on the baryonic density of the universe ($\Omega_b h^2$) than deuterium, because of much higher observation statistics and an easier extrapolation to primordial values. The confrontation of SBBN results with ${}^7\text{Li}$ observations is of special interest since other independent approaches have also recently provided $\Omega_b h^2$ values: (i) the anisotropies of the cosmic microwave background by the BOOMERANG, CBI, DASI and MAXIMA experiments and (ii) the Lyman- α forest at high redshift. A comparison between these results obtained by different methods provides a test of their consistency and could provide a better determination of the baryonic density in the universe. However, the agreement between $\Omega_b h^2$ values deduced from SBBN calculation and ${}^7\text{Li}$ observation on the one hand and CMB observations on the other hand is only marginal. [Phys. Rev. D **65**, 043510 (2002)]

Probing an extended region of Δm^2 with rapidly oscillating ${}^7\text{Be}$ solar neutrinos. A. J. Baltz, *Physics Department, Brookhaven National Laboratory, Upton, New York 11973*. (Received 29 June 2001; published 28 January 2002)

If ${}^7\text{Be}$ solar neutrinos can be observed in real time experiments, then an extended region of Δm^2 can be probed by a proper analysis of the rapidly changing phase of vacuum oscillations due to the eccentricity of the Earth's orbit about the Sun. For the case of maximal vacuum mixing, a kind of Fourier analysis of expected data for one year's time could uniquely pick out Δm^2 if it lies in the region $\sim 10^{-10} - (6 \times 10^{-9}) \text{ (eV)}^2$. [Phys. Rev. D **65**, 053005 (2002)]

In quest of neutrino masses at O(eV) scale. M. Czakon, *Institut für Theoretische Physik, Universität Karlsruhe, D-76128 Karlsruhe, Germany*; J. Gluza, J. Studnik, and M. Zralek, *Department of Field Theory and Particle Physics, Institute of Physics, University of Silesia, Uniwersytecka 4, PL-40-007 Katowice, Poland*. (Received 20 July 2001; published 31 January 2002)

Neutrino oscillation and tritium beta decay experiments taken simultaneously into account are able to access the so far imperceptible absolute neutrino masses at the electronvolt level. The neutrino mass spectrum derived in this way is independent of the nature of neutrinos (Dirac or Majorana). Furthermore, the lack of neutrinoless double beta decay gives additional constraints on the Majorana neutrino mass spectrum. A case of three neutrinos is examined. The influence of different solutions to the solar neutrino deficit problem on the results is discussed. Apart from the present situation, four qualitatively distinct experimental situations which are possible in the future are investigated: when the two decay experiments give only upper bounds on effective neutrino masses, when either one of them gives a positive result, and when both give positive results. The discussion is carried out by taking into account the present experimental errors of relevant neutrino parameters as well as their much more precise expected estimations (e.g., by ν factories). It is shown in which cases the upgraded decay experiments simultaneously with neutrino oscillation data may be able to fix the absolute scale of the neutrino mass spectrum, answer the question of the neutrino nature, and put some light on CP phases in the lepton sector. [Phys. Rev. D **65**, 053008 (2002)]

CP violation in a supersymmetric $SO(10) \times U(2)_F$ model. Mu-Chun Chen and K. T. Mahanthappa, *Department of Physics, University of Colorado, Boulder, Colorado 80309-0390*. (Received 18 June 2001; published 5 February 2002)

A model based on SUSY $SO(10)$ combined with $U(2)$ family symmetry constructed recently by the authors is generalized to include phases in the mass matrices leading to CP violation. In contrast with the commonly used effective operator approach, 126-dimensional Higgs fields are utilized to construct the Yukawa sector. R-parity symmetry is thus preserved at low energies. The symmetric mass textures arising from the left-right symmetry breaking chain of $SO(10)$ give rise to very good predictions for quark and lepton masses and mixings. The prediction for $\sin 2\beta$ agrees with the average of current bounds from BaBar and Belle. In the neutrino sector, our predictions are in good agreement with results from atmospheric neutrino experiments. Our model accommodates both the LOW and QVO solutions to the solar neutrino anomaly; the matrix element for neutrinoless double beta decay is highly suppressed. The leptonic analogue of the Jarlskog invariant, J_{CP}^l , is predicted to be $O(10^{-2})$. [Phys. Rev. D **65**, 053010 (2002)]

Physics of synchronized neutrino oscillations caused by self-interactions. Sergio Pastor and Georg Raffelt, *Max-Planck-Institut für Physik (Werner-Heisenberg-Institut), Föhringer Ring 6, 80805 München, Germany*; Dmitry V. Semikoz, *Max-Planck-Institut für Physik (Werner-Heisenberg-Institut), Föhringer Ring 6, 80805 München, Germany*, and *Institute for Nuclear Research of the Academy of Sciences of Russia, 60th October Anniversary Prospect 7a, Moscow 117312, Russia*. (Received 5 September 2001; published 5 February 2002)

In the early universe or in some regions of supernovas, the neutrino refractive index is dominated by the neutrinos themselves. Several previous studies have found numerically that these self-interactions have the effect of coupling different neutrino modes in such a way as to synchronize the flavor oscillations which otherwise would depend on the energy of a given mode. We provide a simple explanation for this baffling phenomenon in analogy to a system of magnetic dipoles which are coupled by their self-interactions to form one large magnetic dipole which then precesses coherently in a weak external magnetic field. In this picture the synchronized neutrino oscillations are perfectly analogous to the weak-field Zeeman effect in atoms. [Phys. Rev. D **65**, 053011 (2002)]

Seesaw mechanisms for Dirac and Majorana neutrino masses. Manfred Lindner, Tommy Ohlsson, and Gerhart Seidl, *Institut für Theoretische Physik, Physik-Department, Technische Universität München (TUM), James-Frank-Straße, 85748 Garching bei München, Germany*. (Received 27 September 2001; published 7 February 2002)

We investigate the seesaw mechanism for generally non-fine-tuned $n \times n$ mass matrices involving both Dirac and Majorana neutrinos. We specifically show that the number of naturally light neutrinos cannot exceed half of the dimension of the considered mass matrix. Furthermore, we determine a criterion for mass matrix textures leading to light Dirac neutrinos with the seesaw mechanism. In particular, we study 4×4 and 6×6 mass matrix textures and give some examples in order to highlight these types of texture. Next, we present a model scheme based on non-Abelian and discrete symmetries satisfying the above mentioned criterion for light Dirac neutrinos. Finally, we investigate the connection between symmetries and the invariants of a mass matrix on a formal level. [Phys. Rev. D **65**, 053014 (2002)]

Neutrino oscillation parameters from MINOS, ICARUS, and OPERA combined. V. Barger,¹ A. M. Gago,^{2,3,4} D. Marfatia,^{1,5} W. J. C. Teves,³ B. P. Wood,¹ and R. Zukanovich Funchal³
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We perform a detailed analysis of the capabilities of the MINOS, ICARUS and OPERA experiments to measure neutrino oscillation parameters at the atmospheric scale with their data taken separately and in combination. MINOS will determine Δm_{32}^2 and $\sin^2 2\theta_{23}$ to within 10% at the 99% C.L. with 10 kton-years of data. While no one experiment will determine $\sin^2 2\theta_{13}$ with much precision, if its value lies in the combined sensitivity region of the three experiments, it will be possible to place a lower bound of $\mathcal{O}(0.01)$ at the 95% C.L. on this parameter by combining the data from the three experiments. The same bound can be placed with a combination of MINOS and ICARUS data alone. [Phys. Rev. D **65**, 053016 (2002)]

Spin-dependent twist-4 matrix elements from the instanton vacuum: Flavor-singlet and nonsinglet. Nam-Young Lee and K. Goeke, *Institut für Theoretische Physik II, Ruhr-Universität Bochum, D-44780 Bochum, Germany*; C. Weiss, *Institut für Theoretische Physik, Universität Regensburg, D-93053 Regensburg, Germany*. (Received 27 June 2001; published 30 January 2002)

We estimate the twist-4 spin-1 nucleon matrix element f_2 in an instanton-based description of the QCD vacuum. In addition to the flavor-nonsinglet we compute also the flavor-singlet matrix element, which appears in next-to-leading order of the $1/N_c$ -expansion. The corresponding twist-3 spin-2 matrix elements d_2 are suppressed in the packing fraction of the instanton medium, $\bar{\rho}/R \ll 1$. We use our results to estimate the leading $1/Q^2$ power corrections to the first moment of the proton and neutron spin structure functions G_1 , as well as the intrinsic charm contribution to the nucleon spin. [Phys. Rev. D **65**, 054008 (2002)]

Disoriented chiral condensate dynamics in the (2+1)D $O(3)$ model. G. Holzwarth, *Fachbereich Physik, Universität Siegen, D-57068 Siegen, Germany*. (Received 18 July 2001; published 30 January 2002)

The dynamics of symmetry breaking after a quench is numerically simulated on a lattice for the (2+1)-dimensional $O(3)$ model. In addition to the standard sigma model with a temperature-dependent Φ^4 potential the energy functional includes a four-derivative current-current coupling to stabilize the size of the emerging extended topological textures. The total winding number can be conserved by constraint. As a model for the chiral phase transition during the cooling phase after a hadronic collision this allows us to investigate the interference of “baryon-antibaryon” production with the developing disoriented aligned domains. The growth of angular correlations, condensate, and average orientation is studied in dependence of texture size, quench rate, and symmetry breaking. The classical dissipative dynamics determines the rate of energy emitted from the relaxing source for each component of the 3-vector field which provides a possible signature for the domains of disoriented chiral condensate (DCC). We find that the “pions” are emitted in two distinct pulses; for sufficiently small lattice size the second one carries the DCC signal, but it is strongly suppressed as compared to simultaneous “sigma”-meson emission. We compare the resulting anomalies in the distributions of DCC pions with

probabilities derived within the commonly used coherent state formalism. [Phys. Rev. D **65**, 054013 (2002)]

Influence of an external chromomagnetic field on color superconductivity. D. Ebert, *Research Center for Nuclear Physics (RCNP), Osaka University, Ibaraki, Osaka 567, Japan, and Institut für Physik, Humboldt-Universität zu Berlin, 10115 Berlin, Germany*; V. V. Khudiyakov and V. Ch. Zhukovsky, *Faculty of Physics, Department of Theoretical Physics, Moscow State University, 119899, Moscow, Russia*; K. G. Klimenko, *Institute of High Energy Physics, 142284, Protvino, Moscow Region, Russia*. (Received 13 June 2001; revised manuscript received 26 November 2001; published 12 February 2002)

We study the competition of quark-antiquark and diquark condensates under the influence of an external chromomagnetic field modeling the gluon condensate and its dependence on the chemical potential and temperature. As our results indicate, an external chromomagnetic field might produce remarkable qualitative changes in the picture of the color superconducting (CSC) phase formation. This concerns, in particular, the possibility of a transition to the CSC phase and diquark condensation at finite temperature. [Phys. Rev. D **65**, 054024 (2002)]

Rare K decays in a model of quark and lepton masses. P. Q. Hung and Andrea Soddu, *Department of Physics, University of Virginia, 382 McCormick Road, P.O. Box 400714, Charlottesville, Virginia 22904-4714*. (Received 17 October 2001; published 15 February 2002)

An extension of a model of neutrino masses to the quark sector provides an interesting link between these two sectors. A parameter which is important to describe neutrino oscillations and masses is found to be a crucial one appearing in various “penguin” operators, in particular the so-called Z penguin. This parameter is severely constrained by the rare decay process $K_L \rightarrow \mu^+ \mu^-$. This in turn has interesting implications on the decay rates of other rare processes such as $K_L \rightarrow \mu e$, etc., as well as on the masses of the neutrinos and the masses of the vectorlike quarks and leptons which appear in our model. [Phys. Rev. D **65**, 054035 (2002)]

Kinetic approach to η' production from a CP -odd phase. D. B. Blaschke, *Fachbereich Physik, Universität Rostock, Universitätsplatz 1, D-18051 Rostock, Germany, and Bogoliubov Laboratory for Theoretical Physics, Joint Institute for Nuclear Research, 141980 Dubna, Russia*; F. M. Saradzhev, *Institute of Physics, National Academy of Sciences of Azerbaijan, H. Javid pr. 33, 370143 Baku, Azerbaijan*; S. M. Schmidt and D. V. Vinnik, *Institut für Theoretische Physik, Auf der Morgenstelle 14, Universität Tübingen, D-72076 Tübingen, Germany*. (Received 8 October 2001; published 20 February 2002)

The production of (η, η') mesons during the decay of a CP -odd phase is studied within an evolution operator approach. We derive a quantum kinetic equation starting from the Witten–Di Vecchia–

Veneziano Lagrangian for pseudoscalar mesons containing a $U_A(1)$ symmetry breaking term. The nonlinear vacuum mean field for the flavor singlet pseudoscalar meson is treated as a classical, self-interacting background field with fluctuations assumed to be small. The numerical solution provides the time evolution of the momentum distribution function of the produced η' mesons after a quench at the deconfinement phase transition. We show that the time evolution of the momentum distribution of the produced mesons depends strongly on the shape of the effective potential at the end of the quench, exhibiting either parametric or tachyonic resonances. Quantum statistical effects are essential and lead to a pronounced Bose enhancement of the low-momentum states. [Phys. Rev. D **65**, 054039 (2002)]

Novel phases and transitions in color flavor locked matter. David B. Kaplan and Sanjay Reddy, *Institute for Nuclear Theory, University of Washington, Box 351550, Seattle, Washington 98195-1550*. (Received 14 August 2001; published 22 February 2002)

We analyze the phases of dense quark matter at nonzero quark masses. We map out the phase diagrams for charged quark matter as well as charge neutral matter containing leptons. We find that, in color flavor locked quark matter, the symmetric phase with equal numbers of u , d , and s quarks is unlikely to occur in nature. Various less symmetric phases with additional meson condensates may play a role in neutron star cores, however, in agreement with the analysis of Bedaque and Schäfer. We discuss the implications of these novel color superconducting quark matter phases and their transitions for neutron stars. [Phys. Rev. D **65**, 054042 (2002)]

Phenomenological study of lepton mass matrix textures. Chun Liu, *Institute of Theoretical Physics, Chinese Academy of Sciences, P.O. Box 2735, Beijing 100080, China*; Jeonghyeon Song, *Korea Institute for Advanced Study, 207-43 Cheongryangri-dong, Dongdaemun-gu, Seoul 130-012, Korea*. (Received 31 October 2001; published 20 February 2002)

The three active light neutrinos are used to explain neutrino oscillations. The inherently bilarge mixing neutrino mass matrix and the Fritzsch-type, bismall mixing charged lepton mass matrix are assumed. By requiring a maximal ν_μ - ν_τ mixing for the atmospheric neutrino problem and a mass-squared difference appropriate for the almost maximal mixing solution to the solar neutrino problem, the following quantities are predicted: ν_e - ν_μ mixing, V_{e3} , CP violation in neutrino oscillations, and the effective electron-neutrino mass relevant to neutrinoless double beta decays. [Phys. Rev. D **65**, 057303 (2002)]

Comment on “Intrinsic and dynamically generated scalar meson states”. George Rupp, *Centro de Física das Interações Fundamentais, Instituto Superior Técnico, Edifício Ciência, P-1096 Lisboa Codex, Portugal*; Eef van Beveren, *Centro de Física Teórica, Departamento de Física, Universidade de Coimbra,*

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The scalar-meson assignments of Shakin and Wang in a generalized Nambu–Jona-Lasinio model are contradicted by recent experimental information. Also the strict distinction made by these authors between “intrinsic” and “dynamically generated” states is contested. [Phys. Rev. D **65**, 078501 (2002)]

Reply to “Comment on ‘Intrinsic and dynamically generated scalar meson states’ ”. C. M. Shakin and Huangsheng Wang, *Department of Physics and Center for Nuclear Theory, Brooklyn Col-*

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We suggest that a QCD-based chiral model, such as our generalized Nambu–Jona-Lasinio model, provides the best context in which one may study the structure of the $q\bar{q}$ states which are coupled to the meson continuum and that give rise to a resonance such as the $f_0(980)$. Our characterization of this resonance is intimately related to the chiral symmetry of the Lagrangian of our model. In our model the 't Hooft interaction leads to an excellent description of the decay constants and mixing angles of the $\eta(547)$ and $\eta'(958)$. In our recent work we have found that the $f_0(980)$ is a flavor singlet. [Phys. Rev. D **65**, 078502 (2002)]