Selected Abstracts from Other Physical Review Journals

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IGEX ^{76}Ge neutrinoless double-beta decay experiment: Prospects for next generation experiments. C. E. Aalseth,[1] F. T. Avignone III,[1] R. L. Brodzinski,[2] S. Cebrian,[3] E. Garcia,[3] D. Gonzalez,[3] W. K. Hensley,[2] I. G. Irastorza,[3] I. V. Kirpichnikov,[4] A. A. Klimenko,[5] H. S. Miley,[2] A. Morales,[3] J. Morales,[3] A. Ortiz de Solorzano,[3] S. B. Osetrov,[5] V. S. Pogosov,[6] J. Puimedon,[3] J. H. Reeves,[2] M. L. Sarsa,[3] A. A. Smolnikov,[5] A. S. Starostin,[4] A. G. Tamanyan,[6] A. A. Vasenko,[4] S. I. Vasiliev,[5] and J. A. Villar[3] (IGEX Collaboration), [1]*University of South Carolina, Columbia, South Carolina 29208,* [2]*Pacific Northwest National Laboratory, Richland, Washington 99352,* [3]*University of Zaragoza, 50009 Zaragoza, Spain,* [4]*Institute for Theoretical and Experimental Physics, 117259 Moscow, Russia,* [5]*Institute for Nuclear Research, Baksan Neutrino Observatory, 361609 Neutrino, Russia,* [6]*Yerevan Physical Institute, 375036 Yerevan, Armenia.* (Received 29 October 2001; published 17 May 2002)

The International Germanium Experiment (IGEX) has analyzed 117 mol yr of ^{76}Ge data from its isotopically enriched (86% ^{76}Ge) germanium detectors. Applying pulse-shape discrimination to the more recent data, the lower bound on the half-life for neutrinoless double-beta decay of ^{76}Ge is $T_{1/2}(0\nu) > 1.57 \times 10^{25}$ yr (90% C.L.). This corresponds to an upper bound in the Majorana neutrino mass parameter, $\langle m_\nu \rangle$, between 0.33 and 1.35 eV, depending on the choice of theoretical nuclear matrix elements used in the analysis. [Phys. Rev. D **65**, 092007 (2002)]

Oscillation enhanced search for new interactions with neutrinos. Toshihiko Ota, *Department of Physics, Kyushu University, Hakozaki, Higashi-ku, Fukuoka 812-8581, Japan;* Joe Sato, *Research Center for Higher Education, Kyushu University, Ropponmatsu, Chuo-ku, Fukuoka 810-8560, Japan;* Nao-aki Yamashita, *Department of Physics, Kyushu University, Hakozaki, Higashi-ku, Fukuoka 812-8581, Japan.* (Received 28 December 2001; published 17 May 2002)

We discuss the measurement of new physics in long baseline neutrino oscillation experiments. Through neutrino oscillations, the probability to detect new physics effects such as flavor violation is enhanced by interference with the weak interaction. We carefully explain the situations in which interference can take place. Assuming a neutrino factory and an upgraded conventional beam, we estimate the feasibility to observe new physics numerically and point out that we can search new interactions using some channels, for example, $\nu_\mu \to \nu_\mu$, in these experiments. We also discuss several models which induce effective interactions interfering with the weak interaction, and show that some new physics effects are large enough to be observed in an oscillation enhanced way. [Phys. Rev. D **65**, 093015 (2002)]

Seesaw tau lepton mass and calculable neutrino masses in a 3-3-1 model. J. C. Montero, C. A. de S. Pires, and V. Pleitez, *Instituto de Física Teórica, Universidade Estadual Paulista, Rua Pamplona, 145, 01405-900, São Paulo, SP, Brazil.* (Received 14 December 2001; published 17 May 2002)

In this work we show that in a version of the 3-3-1 model proposed by Duong and Ma, in which the introduction of a scalar sextet is avoided by adding a singlet heavy charged lepton, the τ lepton gains mass through a seesawlike mechanism. We also show how to generate neutrino masses at the one-loop level, and give the respective Maki-Nakagawa-Sakata mixing matrices for a set of the parameters. We also consider the effect of adding a singlet right-handed neutrino. [Phys. Rev. D **65**, 093017 (2002)]

Large electric dipole moments of heavy neutrinos. Marc Sher, *Nuclear and Particle Theory Group, Physics Department, College of William and Mary, Williamsburg, Virginia 23187;* Shuquan Nie, *Physics Department, Concordia University, 1455 De Maisonneuve Blvd. W., Montreal, Quebec, Canada H3G 1M8.* (Received 29 January 2002; published 21 May 2002)

In many models of CP violation, the electric dipole moment (EDM) of a heavy charged or neutral lepton could be very large. We present an explicit model in which a heavy neutrino EDM can be as large as $10^{-16}\ e$cm, or even a factor of 10 larger if fine-tuning is allowed, and use an effective field theory argument to show that this result is fairly robust. We then look at the production cross section for these neutrinos, and by rederiving the Bethe-Block formula, show that they could leave an ionization track. It is then noted that the first signature of heavy neutrinos with a large EDM would come from $e^+e^- \to \bar{N}N\gamma$, leading to a very large rate for single photon plus missing energy events, and the rate and angular distribution are found. Finally, we look at some astrophysical consequences, including whether these neutrinos could constitute the UHE cosmic rays and whether their decays in the early universe could generate a net lepton asymmetry. [Phys. Rev. D **65**, 093018 (2002)]

Improved analysis for the baryon masses to order $\Lambda_{\mathrm{QCD}}/m_Q$ from QCD sum rules. Dao-Wei Wang, *Department of Applied Physics, National University of Defense Technology, Hunan 410073, China;* Ming-Qiu Huang, *Department of Applied Physics, National University of Defense Technology, Hunan 410073, China, and CCAST (World Laboratory), P.O. Box 8730, Beijing 100080, China;* Cheng-Zu Li, *Department of Applied Physics, National University of Defense Technology, Hunan 410073, China.* (Received 17 January 2002; published 15 May 2002)

We use the QCD sum rule approach to calculate the masses of the Λ_Q and Σ_Q baryons to $\Lambda_{\rm QCD}/m_Q$ order within the framework of heavy quark effective theory. We compare the direct approach and the covariant approach to this problem. Two forms of current have been adopted in our calculation and their effects on the results are discussed. Numerical results obtained in both the direct and covariant approaches are presented. The splitting between spin 1/2 and 3/2 doublets derived from our calculation is $\Sigma_Q^{*2}-\Sigma_Q^2 \simeq 0.35 \pm 0.03$ GeV^2, which is in good agreement with experiment. [Phys. Rev. D **65**, 094036 (2002)]

Quark-hadron duality in a relativistic, confining model. Sabine Jeschonnek, *Physics Department, The Ohio State University, Lima, Ohio 45804;* J. W. Van Orden, *Jefferson Lab, 12000 Jefferson Avenue, Newport News, Virginia 23606, and Department of Physics, Old Dominion University, Norfolk, Virginia 23529.* (Received 18 January 2002; published 17 May 2002)

Quark-hadron duality is an interesting and potentially very useful phenomenon, as it relates the properly averaged hadronic data to a perturbative QCD result in some kinematic regimes. While duality is well established experimentally, our current theoretical understanding is still incomplete. We employ a simple model to qualitatively reproduce all the features of the Bloom-Gilman duality as seen in electron scattering. In particular, we address the role of relativity, give an explicit analytic proof of the equality of the hadronic and partonic scaling curves, and show how the transition from coherent to incoherent scattering takes place. [Phys. Rev. D **65**, 094038 (2002)]

Continuum limit of quark number susceptibilities. Rajiv V. Gavai and Sourendu Gupta, *Department of Theoretical Physics, Tata Institute of Fundamental Research, Homi Bhabha Road, Mumbai 400005, India.* (Received 6 February 2002; revised manuscript received 15 March 2002; published 17 May 2002)

We report the continuum extrapolation of quark number susceptibilities in quenched QCD. Deviations from ideal gas behavior at temperature T increase as the lattice spacing is decreased from $1/4T$ to $1/8T$. The continuum extrapolation of the measured susceptibilities is 25% lower than the ideal gas values, and also 15% below the hard thermal loop (HTL) results. The off-diagonal susceptibility is several orders of magnitude smaller than the HTL results. We verify a strong correlation between the lowest screening mass and the susceptibility. We also show that the quark number susceptibilities give a reasonable account of the Wroblewski parameter, which measures the strangeness yield in a heavy-ion collision. [Phys. Rev. D **65**, 094515 (2002)]

Pion gas viscosity at low temperature and density. Antonio Dobado, *Departamento de Física Teórica, Universidad Complutense de Madrid, 28040 Madrid, Spain;* Silvia N. Santalla, *Departamento de Física, Universidad Carlos III de Madrid, 28911 Leganés, Spain.* (Received 24 December 2001; published 15 May 2002)

By using chiral perturbation theory and the Uehling-Uhlenbeck equation we compute the viscosity of a pion gas, in the low temperature and low density regime, in terms of the temperature and the pion fugacity. The viscosity turns out to be proportional to the square root of the temperature over the pion mass. Next to leading corrections are proportional to the temperature over the pion mass to 3/2. [Phys. Rev. D **65,** 096011 (2002)]

Measuring high energy neutrino-nucleon cross sections with future neutrino telescopes. Dan Hooper, *Department of Physics, University of Wisconsin, 1150 University Avenue, Madison, Wisconsin 53706.* (Received 26 March 2002; published 21 May 2002)

Next generation kilometer-scale neutrino telescopes, such as ICECUBE, can test standard model predictions for neutrino-nucleon cross sections at energies well beyond the reach of collider experiments. At energies near a PeV and higher, the Earth becomes opaque to neutrinos. At these energies, the ratio of upgoing and downgoing events can be used to measure the total neutrino-nucleon cross section given the presence of an adequate high energy neutrino flux. [Phys. Rev. D **65**, 097303 (2002)]

Limits on cosmological variation of strong interaction and quark masses from big bang nucleosynthesis, cosmic, laboratory and Oklo data. V. V. Flambaum, *School of Physics, The University of New South Wales, Sydney NSW 2052, Australia;* E. V. Shuryak, *Department of Physics and Astronomy, State University of New York, Stony Brook, New York 11794-3800.* (Received 15 February 2002; published 22 April 2002)

Recent data on the cosmological variation of the electromagnetic fine structure constant from distant quasar (QSO) absorption spectra have inspired a more general discussion of the possible variation of other constants. We discuss the variation of strong scale and quark masses. We derive limits on their relative change from (i) primordial big bang nucleosynthesis, (ii) the Oklo natural nuclear reactor, (iii) quasar absorption spectra, and (iv) laboratory measurements of hyperfine intervals. [Phys. Rev. D **65**, 103503 (2002)]

Gravitational signals emitted by a point mass orbiting a neutron star: Effects of stellar structure. J. A. Pons,[1] E. Berti,[2] L. Gualtieri,[1] G. Miniutti,[1] and V. Ferrari[1] [1]*Dipartimento di Fisica "G. Marconi," Università di Roma "La Sapienza" and Sezione INFN ROMA1, piazzale Aldo Moro 2, I-00185 Roma, Italy,* [2]*Department of Physics, Aristotle University of Thessaloniki, Thessaloniki 54006, Greece.* (Received 29 November 2001; published 8 May 2002)

The effects that the structure of a neutron star would have on the gravitational emission of a binary system are studied in a perturbative regime, and in the frequency domain. Assuming that a neutron star is perturbed by a point mass moving on a close, circular orbit, we solve the equations of stellar perturbations in general relativity to evaluate the energy lost by the system in gravitational waves. We compare the energy output obtained for different stellar models with that found by assuming that the perturbed object is a black hole

with the same mass, and we discuss the role played by the excitation of the stellar modes. Our results indicate that the stellar structure begins to affect the emitted power when the orbital velocity is $v \gtrsim 0.2\ c$ ($\nu_{GW} \gtrsim 185$ Hz for a binary system composed of two $1.4 M_\odot$ neutron stars). We show that the differences between different stellar models and a black hole are due mainly to the excitation of the quasinormal modes of the star. Finally, we discuss to what extent and up to which distance the perturbative approach can be used to describe the interaction of a star and a pointlike massive body. [Phys. Rev. D **65**, 104021 (2002)]

Probing the Planck scale with neutrino oscillations. Ram Brustein, David Eichler, and Stefano Foffa, *Department of Physics, Ben-Gurion University, Beer-Sheva 84105, Israel.* (Received 27 June 2001; revised manuscript received 10 October 2001; published 24 April 2002)

Quantum gravity ''foam,'' among its various generic Lorentz noninvariant effects, would cause neutrino mixing. It is shown here that, if the foam is manifested as a nonrenormalizable effect at scale M, the oscillation length generically decreases with energy E as $(E/M)^{-2}$. Neutrino observatories and long-baseline experiments should have therefore already observed foam-induced oscillations, even if M is as high as the Planck energy scale. The null results, which can be further strengthened by better analysis of current data and future experiments, can be taken as experimental evidence that Lorentz invariance is fully preserved at the Planck scale, as is the case in critical string theory. [Phys. Rev. D **65**, 105006 (2002)]

Constraints on large extra dimensions from neutrino oscillation experiments. H. Davoudiasl and P. Langacker, *School of Natural Sciences, Institute for Advanced Study, Princeton, New Jersey 08540;* M. Perelstein, *Theoretical Physics Group, Lawrence Berkeley National Laboratory, Berkeley, California 94720.* (Received 24 January 2002; published 10 May 2002)

The existence of bulk sterile neutrinos in theories with large extra dimensions can naturally explain small 4-dimensional Dirac masses for the active neutrinos. We study a model with 3 bulk neutrinos and derive various constraints on the size of the extra dimensions from neutrino oscillation experiments. Our analysis includes recent solar and atmospheric data from SNO and Super-Kamiokande, respectively, as well as various reactor and accelerator experiments. In addition, we comment on possible extensions of the model that could accommodate the LSND results, using natural parameters only. Our most conservative bound, obtained from the atmospheric data in the hierarchical mass scheme, constrains the largest extra dimension to have a radius $R < 0.82\ \mu$m. Thus, in the context of the model studied here, future gravitational experiments are unlikely to observe the effects of extra dimensions. [Phys. Rev. D **65**, 105015 (2002)]

Nonperturbative bound on high multiplicity cross sections in ϕ^4 theory in three dimensions from lattice simulation. Y. -Y. Charng, *Institute of Physics, Academia Sinica, Taipei, Taiwan 115, Republic of China;* R. S. Willey, *Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15260.* (Received 5 November 2001; published 10 May 2002)

We look for evidence of large cross sections at large multiplicities in weakly coupled scalar field theory in three dimensions. We use spectral function sum rules to derive bounds on total cross sections where the sum can be expressed in terms of a quantity which can be measured by Monte Carlo simulation in Euclidean space. We find that high multiplicity cross sections remain small for energies and multiplicities for which large effects had been suggested. [Phys. Rev. D **65**, 105018 (2002)]

Neutrinos vis-à-vis the six-dimensional standard model. Thomas Appelquist, Bogdan A. Dobrescu, Eduardo Pontón, and Ho-Ung Yee, *Department of Physics, Yale University, New Haven, Connecticut 06520.* (Received 16 January 2002; published 14 May 2002)

We examine the origin of neutrino masses and oscillations in the context of the six-dimensional standard model. The space-time symmetries of this model explain proton stability and forbid Majorana neutrino masses. The consistency of the six-dimensional theory requires three right-handed neutrinos, and therefore Dirac neutrino masses are allowed. We employ the idea that the smallness of these masses is due to the propagation of the right-handed neutrinos in a seventh, warped dimension. We argue that this class of theories is free of gravitational anomalies. Although an exponential hierarchy arises between the neutrino masses and the electroweak scale, we find that the mass hierarchy among the three neutrino masses is limited by higher-dimension operators. All current neutrino oscillation data, except for the LSND result, are naturally accommodated by our model. In the case of the solar neutrinos, the model leads to the large mixing angle, MSW solution. The mechanism employed, involving three right-handed neutrinos coupled to a scalar in an extra dimension, may explain the features of the neutrino spectrum in a more general class of theories that forbid Majorana masses. [Phys. Rev. D **65**, 105019 (2002)]

Upper limits for neutrino oscillations $\bar{\nu}_\mu \rightarrow \bar{\nu}_e$ from muon decay at rest. B. Armbruster,[1] I. M. Blair,[2] B. A. Bodmann,[3] N. E. Booth,[4] G. Drexlin,[1] J. A. Edgington,[2] C. Eichner,[5] K. Eitel,[1] E. Finckh,[3] H. Gemmeke,[6] J. Hößl,[3] T. Jannakos,[1] P. Jünger,[3] M. Kleifges,[6] J. Kleinfeller,[1] W. Kretschmer,[3] R. Maschuw,[1,5] C. Oehler,[1] P. Plischke,[1] J. Reichenbacher,[1] C. Ruf,[5] M. Steidl,[1] J. Wolf,[7] and B. Zeitnitz[1,7] (KARMEN Collaboration), [1]*Institut für Kernphysik, Forschungszentrum Karlsruhe, Postfach 3640, D-76021 Karlsruhe, Germany,* [2]*Physics Department, Queen Mary, University of London, Mile End Road, London E1 4NS, United Kingdom,* [3]*Physikalisches Institut, Universität Erlangen-Nürnberg, Erwin Rommel Strasse 1, D-91058 Erlangen, Germany,* [4]*Department of Physics, University of Oxford, Keble Road, Oxford OX1 3RH, United Kingdom,* [5]*Institut für Strahlen und Kernphysik, Universität Bonn, Nußallee 14-16, D-53115 Bonn, Germany,* [6]*Institut für Prozessdatenverarbeitung und Elektronik, Forschungszentrum Karlsruhe, Postfach 3640, D-76021 Karlsruhe, Germany,* [7]*Institut für experimentelle Kernphysik, Universität Karlsruhe, Gaedestrasse 1, D-76128 Karlsruhe, Germany.* (Received 8 March 2002; published 5 June 2002)

The KARMEN experiment at the spallation neutron source ISIS used $\bar{\nu}_\mu$ from μ^+ decay at rest for the search of neutrino oscilla-

tions $\bar{\nu}_\mu \to \bar{\nu}_e$ in the appearance mode, with $p(\bar{\nu}_e, e^+)n$ as a detection reaction of $\bar{\nu}_e$. In total, 15 candidates satisfy all conditions for the $\bar{\nu}_e$ signature, in agreement with the background expectation of 15.8 ± 0.5 events, yielding no indication for oscillations. A single event based likelihood analysis leads to upper limits on the oscillation parameters $\sin^2(2\Theta) < 1.7 \times 10^{-3}$ for $\Delta m^2 \geqslant 100$ eV^2 and $\Delta m^2 < 0.055$ eV^2 for $\sin^2(2\Theta) = 1$ at 90% confidence. Thus, KARMEN does not confirm the LSND experiment and restricts significantly its favored parameter region for $\bar{\nu}_\mu \to \bar{\nu}_e$. [Phys. Rev. D **65**, 112001 (2002)]

Leptonic unitarity triangle and *CP* violation. Y. Farzan, *Scuola Internazionale Superiore di Studi Avanzati, SISSA, I-34014, Trieste, Italy, and Stanford Linear Accelerator Center, Stanford University, Menlo Park, California 94025;* A. Yu. Smirnov, *The Abdus Salam International Centre for Theoretical Physics, I-34100 Trieste, Italy, and Institute for Nuclear Research, Russian Academy of Sciences, Moscow, Russia.* (Received 31 January 2002; published 4 June 2002)

The area of the unitarity triangle is a measure of CP violation. We introduce the leptonic unitarity triangles and study their properties. We consider the possibility of reconstructing the unitarity triangle in future oscillation and nonoscillation experiments. A set of measurements is suggested which will, in principle, allow us to measure all sides of the triangle, and consequently to establish CP violation. For different values of the CP-violating phase δ_D, the required accuracy of measurements is estimated. The key elements of the method are the determination of $|U_{e3}|$ and studying the $\nu_\mu - \nu_\mu$ survival probability in the oscillations driven by the solar mass splitting Δm^2_{sun}. We suggest additional astrophysical measurements which may help to reconstruct the triangle. The method of the unitarity triangle is complementary to the direct measurements of CP asymmetry. It requires mainly studies of the *survival* probabilities and processes where oscillations are averaged or the coherence of the state is lost. [Phys. Rev. D **65**, 113001 (2002)]

Neutrino induced upward going muons from a gamma ray burst in a neutrino telescope of km^2 area. Nayantara Gupta, *Department of Theoretical Physics, Indian Association for the Cultivation of Science, Jadavpur, Calcutta 700 032, India.* (Received 21 November 2001; published 13 June 2002)

The number of neutrino induced upward going muons from a single gamma ray burst (GRB) expected to be detected by the proposed kilometer scale IceCube detector at the South Pole is calculated. The effects of the Lorentz factor, total energy of the GRB emitted in neutrinos and its distance from the observer (redshift) on the number of neutrino events from that GRB are examined. The present investigation reveals that there is the possibility of exploring the physical processes of the early universe with the proposed kilometer scale IceCube neutrino telescope. [Phys. Rev. D **65**, 113005 (2002)]

Can the lepton flavor mixing matrix be symmetric? Zhi-zhong Xing, *CCAST (World Laboratory), P.O. Box 8730, Beijing 100080, China, and Institute of High Energy Physics, P.O. Box 918 (4), Beijing 100039, China.* (Received 4 April 2002; published 24 June 2002)

Current neutrino oscillation data indicate that the 3×3 lepton flavor mixing matrix V is likely to be symmetric about its V_{e3}-$V_{\mu 2}$-$V_{\tau 1}$ axis. This off-diagonal symmetry corresponds to three pairs of *congruent* unitarity triangles in the complex plane. Terrestrial matter effects can substantially modify the genuine CP-violating parameter and off-diagonal asymmetries of V in realistic long-baseline experiments of neutrino oscillations. [Phys. Rev. D **65**, 113010 (2002)]

Principle of balance and the sea content of the proton. Yong-Jun Zhang, *Department of Physics, Peking University, Beijing 100871, China, and Department of Basic Science, Liaoning Technical University, Fuxin, Liaoning 123000, China;* Wei-Zhen Deng, *Department of Physics, Peking University, Beijing 100871, China;* Bo-Qiang Ma, *CCAST (World Laboratory), P.O. Box 8730, Beijing 100080, China, and Department of Physics, Peking University, Beijing 100871, China.* (Received 27 March 2002; published 7 June 2002)

In this study, the proton is taken as an ensemble of quark-gluon Fock states. Using the principle of balance that every Fock state should be balanced with all of the nearby Fock states (denoted as the balance model), instead of the principle of detailed balance that any two nearby Fock states should be balanced with each other (denoted as the detailed balance model), the probabilities of finding every Fock state of the proton are obtained. The balance model can be taken as a revised version of the detailed balance model, which can give an excellent description of the light flavor sea asymmetry (i.e., $\bar{u} \neq \bar{d}$) without any parameter. In the case when $g \Leftrightarrow gg$ subprocesses are not considered, the balance model and the detailed balance model give the same results. In the case when $g \Leftrightarrow gg$ subprocesses are considered, there is about a 10 percent difference between the results of these models. We also calculate the strange content of the proton using the balance model under the equal probability assumption. [Phys. Rev. D **65**, 114005 (2002)]

Small-x behavior of the singlet polarized structure function g_2 in the double logarithmic approximation. J. Bartels, *II.Institut f. Theoretische Physik, Universität Hamburg, D-20355 Hamburg, Germany;* M. G. Ryskin, *Petersburg Nuclear Physics Institute, Gatchina, S.-Petersburg 188300, Russia.* (Received 20 February 2002; published 20 June 2002)

The small-x behavior of the singlet contributions to the polarized structure function $g_2(x, Q^2)$ is calculated in the double-logarithmic approximation of perturbative QCD. The dominant contribution is due to the gluons which, in contrast with the unpolarized case, mix with the fermions also in the small-x domain. We find a powerlike growth in $1/x$ in the odd-signature parts of the amplitude with the same power as in the singlet function $g_1(x, Q^2)$ at $x \ll 1$. [Phys. Rev. D **65**, 114012 (2002)]

Polarized virtual photon structure function g_2^γ and twist-3 effects in QCD. Hideshi Baba, *Graduate School of Human and Environmental Studies, Kyoto University, Kyoto 606-8501, Japan;* Ken Sasaki, *Department of Physics, Faculty of Engineering, Yokohama National University, Yokohama 240-8501, Japan;* Tsuneo Uematsu, *Department of Fundamental Sciences, Faculty of Integrated Human Studies, Kyoto University, Kyoto 606-8501, Japan.* (Received 17 February 2002; published 24 June 2002)

We investigate twist-3 effects in the polarized virtual photon structure. The structure functions g_1^γ and g_2^γ of a polarized photon could be experimentally studied in future polarized *ep* or e^+e^- colliders. The leading contributions to g_1^γ are twist-2 effects, while another structure function g_2^γ, which exists only for the virtual photon target, receives not only twist-2 but also twist-3 contributions. We first show that twist-3 effects actually exist in the box-diagram contributions and we extract the twist-3 part, which can also be reproduced by the pure QED operator product expansion. We then calculate the nontrivial lowest moment ($n=3$) of the twist-3 contribution to g_2^γ in QCD. For large N_c (the number of colors), the QCD analysis of twist-3 effects in the flavor nonsinglet part of g_2^γ becomes tractable and we can obtain its moments in a compact form for all *n*. [Phys. Rev. D **65**, 114018 (2002)]

Unitarity corrections to the structure functions through the dipole picture. M. B. Gay Ducati and M. V. T. Machado, *Instituto de Física, Universidade Federal do Rio Grande do Sul, Caixa Postal 15051, CEP 91501-970, Porto Alegre, RS, Brazil.* (Received 8 November 2001; published 24 June 2002)

We study the dipole picture for the description of deep inelastic scattering, focusing on the structure functions which are driven directly by the gluon distribution. One performs estimates using the effective dipole cross section given by the Glauber-Mueller approach in QCD, which encodes the corrections due to the unitarity effects associated with the saturation phenomenon. We also address issues about frame invariance of the calculations when analyzing the observables. [Phys. Rev. D **65**, 114019 (2002)]

Overlap quark propagator in the Landau gauge. Frédéric D. R. Bonnet,[1] Patrick O. Bowman,[2] Derek B. Leinweber,[1] Anthony G. Williams,[1] and J. B. Zhang[1] (CSSM Lattice Collaboration), [1]*Special Research Center for the Subatomic Structure of Matter (CSSM) and Department of Physics and Mathematical Physics, University of Adelaide 5005, Australia,* [2]*Department of Physics and School for Computational Science and Information Technology, Florida State University, Tallahasse, Florida 32306.* (Received 3 February 2002; revised manuscript received 9 April 2002; published 7 June 2002)

The properties of the quark propagator in the Landau gauge in quenched QCD are examined for the overlap quark action. The overlap quark action satisfies the Ginsparg-Wilson relation and as such provides an exact lattice realization of chiral symmetry. This in turn implies that the quark action is free of $\mathcal{O}(a)$ errors. We present results using the standard Wilson fermion kernel in the overlap formalism on a $12^3\times 24$ lattice at a spacing of 0.125 fm. We obtain the nonperturbative momentum-dependent wave function renormalization function $Z(p)$ and the nonperturbative mass function $M(p)$ for a variety of bare masses. We perform a simple extrapolation to the chiral limit for these functions. We clearly observe the dynamically generated infrared mass and confirm the qualitative behavior found for the Landau gauge quark propagator in earlier studies. We attempt to extract the quark condensate from the asymptotic behavior of the mass function in the chiral limit. [Phys. Rev. D **65**, 114503 (2002)]

Forward Compton scattering using real analytic amplitudes. M. M. Block, *Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60208.* (Received 4 April 2002; published 19 June 2002)

We analyze forward Compton scattering, using real analytic amplitudes. By fitting the total γp scattering cross section data in the high energy region 5 GeV$\leqslant\sqrt{s}\leqslant$200 GeV, using a cross section rising as $\ln^2 s$, we calculate $\rho_{\gamma p}$, the ratio of the real to the imaginary portion of the forward Compton scattering amplitude, and compare this to ρ_{nn}, the ratio of the *even* portions of the pp and $\bar{p}p$ forward scattering amplitudes. We find that the two ρ values are, within errors, the same in the c.m.s. energy region 5 GeV$\leqslant\sqrt{s}\leqslant$200 GeV, as predicted by a factorization theorem of Block and Kaidalov. [Phys. Rev. D **65**, 116005 (2002)]

Addendum to "Model-dependent and -independent implications of the first Sudbury Neutrino Observatory results". G. L. Fogli,[1] E. Lisi,[1] D. Montanino,[2] and A. Palazzo[1] [1]*Dipartimento di Fisica and Sezione INFN di Bari Via Amendola 173, 70126 Bari, Italy,* [2]*Dipartimento di Scienza dei Materiali and Sezione INFN di Lecce Via Arnesano, 73100 Lecce, Italy.* (Received 15 March 2002; published 6 June 2002)

In the light of recent experimental and theoretical improvements, we review our previous model-independent comparison of the Super-Kamiokande (SK) and Sudbury Neutrino Observatory (SNO) solar neutrino event rates, including updated values for the "equalized" SK datum and for the reference standard solar model (SSM) ^{8}B neutrino flux. We find that the joint SK + SNO evidence for active neutrino flavor transitions is confirmed at the level of 3.3 standard deviations, independently of possible transitions to sterile states. Barring sterile neutrinos, we estimate the $\pm 3\sigma$ range for the ^{8}B neutrino flux (normalized to SSM) as $f_B=0.96^{+0.54}_{-0.55}$. Accordingly, the $\pm 3\sigma$ range for the energy-averaged ν_e survival probability is found to be $\langle P_{ee}\rangle=0.31^{+0.55}_{-0.16}$, independently of the functional form of P_{ee}. An increase of the reference $\nu_e+d\rightarrow p+p+e^-$ cross section by $\sim$3%, as suggested by recent theoretical calculations, would slightly shift the central values of f_B and of $\langle P_{ee}\rangle$ to $\sim$1.00 and $\sim$0.29, respectively, and would strengthen the model-independent evidence for ν_e transitions into active states at the level of $\sim 3.6\sigma$. [Phys. Rev. D **65**, 117301 (2002)]

Is cosmology consistent? Xiaomin Wang and Max Tegmark, *Department of Physics, University of Pennsylvania, Philadelphia,*

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We perform a detailed analysis of the latest cosmic microwave background (CMB) measurements (including BOOMERaNG, DASI, Maxima and CBI), both alone and jointly with other cosmological data sets involving, e.g., galaxy clustering and the Lyman Alpha Forest. We first address the question of whether the CMB data are internally consistent once calibration and beam uncertainties are taken into account, performing a series of statistical tests. With a few minor caveats, our answer is yes, and we compress all data into a single set of 24 bandpowers with associated covariance matrix and window functions. We then compute joint constraints on the 11 parameters of the ''standard'' adiabatic inflationary cosmological model. Our best fit model passes a series of physical consistency checks and agrees with essentially all currently available cosmological data. In addition to sharp constraints on the cosmic matter budget in good agreement with those of the BOOMERaNG, DASI and Maxima teams, we obtain a heaviest neutrino mass range $0.04-4.2$ eV and the sharpest constraints to date on gravity waves which (together with preference for a slight red-tilt) favor ''small-field'' inflation models. [Phys. Rev. D **65**, 123001 (2002)]

Constraining strong baryon–dark-matter interactions with primordial nucleosynthesis and cosmic rays. Richard H. Cyburt, *Department of Physics, University of Illinois, Urbana, Illinois 61801;* Brian D. Fields and Vasiliki Pavlidou, *Department of Astronomy, University of Illinois, Urbana, Illinois 61801;* Benjamin Wandelt, *Department of Astronomy and Department of Physics, University of Illinois, Urbana, Illinois 61801, and Department of Physics, Princeton University, Princeton, New Jersey 08544.* (Received 8 January 2002; published 28 May 2002)

Self-interacting dark matter (SIDM) was introduced by Spergel and Steinhardt to address possible discrepancies between collisionless dark matter simulations and observations on scales of less than 1 Mpc. We examine the case in which dark matter particles not only have strong self-interactions but also have strong interactions with baryons. The presence of such interactions will have direct implications for nuclear and particle astrophysics. Among these are a change in the predicted abundances from big bang nucleosynthesis (BBN) and the flux of γ rays produced by the decay of neutral pions which originate in collisions between dark matter and galactic cosmic rays (CR). From these effects we constrain the strength of the baryon–dark-matter interactions through the ratio of baryon–dark-matter interaction cross section to dark matter mass, s. We find that BBN places a weak upper limit on this ratio $\lesssim 10^{8}$ cm^{2} g^{-1}. CR-SIDM interactions, however, limit the possible DM-baryon cross section to $\lesssim 5\times 10^{-3}$ cm^{2} g^{-1}; this rules out an energy-independent interaction, but not one which falls with center-of-mass velocity $s \propto 1/v$ or steeper. [Phys. Rev. D **65**, 123503 (2002)]