

Selected Abstracts from Other Physical Review Journals

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Oscillations of recoil particles against mixed states. H. Burkhardt, J. Lowe, G. J. Stephenson, Jr., *Physics Department, University of New Mexico, Albuquerque, New Mexico 87131*; T. Goldman, *Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545*. (Received 17 March 1998; published 8 February 1999)

Some consequences of the oscillations of neutral kaons and neutrinos are discussed, in particular, the possibility of oscillations of particles recoiling against kaons or neutrinos from the production process. We show that there are no stationary oscillations of these recoil particles in any order, and that the apparent long-wavelength oscillations, which might appear to result when an earlier treatment of ours was taken to higher order, are spurious. We show that the recoil particles may show a travelling interference pattern. It may be possible to observe this pattern for Λ 's produced in a reaction, but there seems to be little hope of observing this for the case of neutrinos from muon decay. [S0556-2821(99)00907-8] [Phys. Rev. D **59**, 054018 (1999)]

Pulsar kicks from neutrino oscillations. Alexander Kusenko, *Department of Physics and Astronomy, UCLA, Los Angeles, California 90095-1547*; Gino Segrè, *Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104*. (Received 10 November 1998; published 25 February 1999)

Neutrino oscillations can explain the observed motion of pulsars. We show that two different models of neutrino emission from a cooling neutron star are in good quantitative agreement and predict the same order of magnitude for the pulsar kick velocity, consistent with the data. [S0556-2821(99)50206-3] [Phys. Rev. D **59**, 061302 (1999)]

Finite dimensional systems with random external fields and neutrino propagation in fluctuating media. E. Torrente-Lujan, *IFIC-Dpto., Física Teórica, CSIC-Universitat de Valencia, Dr. Moliner 50, E-46100, Burjassot, Valencia, Spain*. (Received 17 July 1998; published 2 March 1999)

We develop the general formalism for the study of neutrino propagation in the presence of stochastic media. This formalism allows the systematic derivation of evolution equations for averaged quantities as survival probabilities and higher order distribution moments. The formalism equally applies to any finite-dimensional Schrödinger equation in the presence of a stochastic external field. New integrodifferential equations valid for finite correlated processes are obtained for the first time. For the particular case of exponentially correlated processes a second order ordinary equation is obtained. As a consequence, the Redfield equation valid for

Gaussian delta-correlated noise is rederived in a simple way: it has been obtained directly and as the zero-order term of an asymptotic expansion in the inverse of the correlation length. The formalism, together with the quantum correlation theorem is applied to the computation of higher moments and correlation functions of practical interest in forthcoming high precision neutrino experiments. It is shown that equal and unequal time correlators follow similar differential equations. [S0556-2821(99)05105-X] [Phys. Rev. D **59**, 073001 (1999)]

LSND, solar and atmospheric neutrino oscillation experiments, and R-parity violating supersymmetry. Rathin Adhikari, *The Institute of Mathematical Sciences, C.I.T. Campus, Taramani Chennai-600 113, India*; Gordana Omanović, *International Centre for Theoretical Physics, Strada Costiera 11, I-34013 Trieste, Italy*. (Received 25 February 1998; revised manuscript received 19 October 1998; published 8 March 1999)

With only three flavors it is possible to account for various neutrino oscillation experiments. The masses and mixing angles for three neutrinos can be determined from the available experimental data on neutrino oscillation and from astrophysical arguments. We have shown here that such masses and mixing angles which can explain the atmospheric neutrino anomaly, LSND result, and the solar neutrino experimental data, can be reconciled with the R-parity violating supersymmetric models through lepton-number-violating interactions. We have estimated the order of magnitude for some lepton-number-violating couplings. Our analysis indicates that lepton number violation is likely to be observed in near future experiments. From the data on neutrino oscillation and the electric dipole moment of electron, under some circumstances it is possible to obtain a constraint on the complex phase of some supersymmetry breaking parameters in R-parity-violating supersymmetric models. [S0556-2821(99)04405-7] [Phys. Rev. D **59**, 073003 (1999)]

Current status of the solar neutrino problem with Super-Kamiokande. Hisakazu Minakata, *Department of Physics, Tokyo Metropolitan University, 1-1 Minami-Osawa, Hachioji, Tokyo 192-0397, Japan*; Hiroshi Nunokawa, *Instituto de Física Gleb Wataghin, Universidade Estadual de Campinas - UNICAMP, P.O. Box 6165, 13083-970 Campinas SP, Brazil*. (Received 14 October 1998; published 8 March 1999)

We perform an updated model-independent analysis using the latest solar neutrino data obtained by ^{37}Cl and ^{71}Ga radiochemical experiments, and most notably by a large water-Cherenkov detector SuperKamiokande with their 504 days of data taking. We confirm that the astrophysical solutions to the solar neutrino problem are

extremely disfavored by the data and a low-temperature modification of the standard solar model is excluded by more than 5σ . We also propose a new way of illuminating the suppression pattern of various solar neutrino fluxes without invoking detailed flavor conversion mechanisms. It indicates that the strong suppression of ${}^7\text{Be}$ neutrinos is no more true when the neutrino flavor conversion is taken into account. [S0556-2821(99)03007-6] [Phys. Rev. D **59**, 073004 (1999)]

Implications of color gauge symmetry for nucleon spin structure. Pervez Hoodbhoy, Xiangdong Ji, and Wei Lu, *Department of Physics, University of Maryland, College Park, Maryland 20742*. (Received 3 September 1998; published 26 February 1999)

We study the chromodynamical gauge symmetry in relation to the internal spin structure of the nucleon. We show that (1) even in the helicity eigenstates the gauge-dependent spin and orbital angular momentum operators do not have gauge-independent matrix element, (2) the evolution equations for the gluon spin take very different forms in the Feynman and axial gauges, but yield the same leading behavior in the asymptotic limit, and (3) the complete evolution of the gauge-dependent orbital angular momenta appears intractable in the light-cone gauge. We define a new gluon orbital angular momentum distribution $L_g(x)$ which is an experimental observable and has a simple scale evolution. However, its physical interpretation makes sense only in the light-cone gauge just like the gluon helicity distribution $\Delta g(x)$. [S0556-2821(99)02207-9] [Phys. Rev. D **59**, 074010 (1999)]

Soft-gluon resummation for heavy quark production in hadronic collisions. Nikolaos Kidonakis, *Department of Physics and Astronomy, University of Edinburgh, Edinburgh EH9 3JZ, Scotland, United Kingdom*; Ramona Vogt, *Nuclear Science Division, Lawrence Berkeley National Laboratory, Berkeley, California 94720 and Physics Department, University of California at Davis, Davis, California 95616*. (Received 6 November 1998; published 3 March 1999)

We discuss the heavy quark production cross section near partonic threshold in hadronic collisions, including the resummation of leading and next-to-leading logarithms arising from soft gluon emission. We show how to handle the complications due to the non-universal non-leading logarithms. We give analytical results for the $q\bar{q}$ partonic subprocess and numerical results in the DIS scheme for top quark production at the Fermilab Tevatron where the $q\bar{q}$ channel dominates. [S0556-2821(99)01707-5] [Phys. Rev. D **59**, 074014 (1999)]

Renormalized effective QCD Hamiltonian: Gluonic sector. D. G. Robertson,¹ E. S. Swanson,^{1,2} A. P. Szczepaniak,³ Chueng-Ryong Ji,¹ and S. R. Cotanch,¹ ¹*Department of Physics, North Carolina State University, Raleigh, North Carolina 27695-8202* ²*Jefferson Laboratory, 12000 Jefferson Ave., Newport News, Virginia, 23606* ³*Department of Physics and Nuclear Theory Center, Indiana University, Bloomington, Indiana 47405*. (Received 26 October 1998; published 8 March 1999)

Extending previous QCD Hamiltonian studies, we present a new renormalization procedure which generates an effective Hamiltonian for the gluon sector. The formulation is in the Coulomb gauge where the QCD Hamiltonian is renormalizable and the Gribov problem can be resolved. We utilize elements of the Głazek and Wilson regularization method but now introduce a continuous cut-off procedure which eliminates non-local counterterms. The effective Hamiltonian is then derived to second order in the strong coupling constant. The resulting renormalized Hamiltonian provides a realistic starting point for approximate many-body calculations of hadronic properties for systems with explicit gluon degrees of freedom. [S0556-2821(99)01807-X] [Phys. Rev. D **59**, 074019 (1999)]

Vector meson dominance and the ρ meson. M. Benayoun, *LP-NHE des Universités Paris VI et VII-IN2P3, Paris, France*; H. B. O'Connell, *Department of Physics and Astronomy, University of Kentucky, Lexington, Kentucky 40506-0055*; A. G. Williams, *Department of Physics and Mathematical Physics and Special Research Centre for the Subatomic Structure of Matter, University of Adelaide 5005, Australia*. (Received 29 July 1998; published 8 March 1999)

We discuss the properties of vector mesons, in particular the ρ^0 , in the context of the hidden local symmetry (HLS) model. This provides a unified framework to study several aspects of the low energy QCD sector. First, we show that in the HLS model the physical photon is massless, without requiring off field diagonalization. We then demonstrate the equivalence of HLS and the two existing representations of vector meson dominance, VMD1 and VMD2, at both the tree level and one loop order. Finally the S matrix pole position is shown to provide a model and process independent means of specifying the ρ mass and width, in contrast with the real axis prescription currently used in the Particle Data Group tables. [S0556-2821(99)02807-6] [Phys. Rev. D **59**, 074020 (1999)]

Evidence for charge symmetry violation in parton distributions. C. Boros, *Department of Physics and Mathematical Physics, and Special Research Center for the Subatomic Structure of Matter, University of Adelaide, Adelaide 5005, Australia*; J. T. Londergan, *Department of Physics and Nuclear Theory Center, Indiana University, Bloomington, Indiana 47405*; 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 2 October 1998; published 9 March 1999)

By comparing structure functions measured in neutrino and charged lepton deep inelastic scattering, one can test the validity of parton charge symmetry. New experiments allow us to make such tests, which set rather tight upper limits on parton charge symmetry violation (CSV) for intermediate Bjorken x , but which appear to show sizable CSV effects at small x . We show that neither nuclear shadowing nor contributions from strange and antistrange quark distributions can account for the experimentally observed difference between the two structure functions. We are therefore forced to consider the possibility of a large CSV effect in the nucleon sea quark distributions. We discuss the consequences of this effect for other observables, and we propose an experiment which could de-

tect a large CSV component in the nucleon sea. [S0556-2821(99)03507-9] [Phys. Rev. D **59**, 074021 (1999)]

Is bimaximal mixing compatible with the large angle MSW solution of the solar neutrino problem? C. Giunti, *INFN, Sezione di Torino, and Dipartimento di Fisica Teorica, Università di Torino, Via P. Giuria 1, I-10125 Torino, Italy*. (Received 9 October 1998; published 3 March 1999)

It is shown that the large angle MSW solution of the solar neutrino problem with a bimaximal neutrino mixing matrix implies an energy-independent suppression of the solar ν_e flux. The present solar neutrino data exclude this solution of the solar neutrino problem at 99.6% C.L. [S0556-2821(99)02007-X] [Phys. Rev. D **59**, 077301 (1999)]

Resonant spin flavor precession constraints on neutrino parameters and solar magnetic fields from solar neutrino data. B. C. Chauhan, U. C. Pandey, and S. Dev, *Department of Physics, Himachal Pradesh University, Shimla-171005, India*. (Received 17 July 1998; published 12 March 1999)

The resonant spin flavor precession (RSFP) constraints on neutrino parameters have been updated in light of the latest solar neutrino data. The standard solar model, in spite of its enormous success in predicting the thermal and nuclear evolution of the Sun, is unable to throw enough light on solar magnetic activity. In the absence of a reliable theory of the solar dynamo believed to be responsible for solar magnetic activity and insufficient astrophysical data on solar magnetic activity, it may be worthwhile to constrain the solar magnetic fields from the solar neutrino observations assuming the RSFP to be responsible for the solar neutrino deficit and the possible time variation of solar neutrino flux. The configuration of the solar magnetic field consistent with the solar neutrino observations has been derived and found to be in reasonably good agreement with the distribution proposed by Akhmedov and Bychuk [Sov. Phys. JETP **68**, 250 (1989)]. However, this work ruled out the magnetic field distribution in the radiation zone used by Pulido [Phys. Rep. **211**, 187 (1992)]. The magnitude of the magnetic field in the radiation and the convective zone of the Sun are very sensitive to the value chosen for the neutrino magnetic moment. [S0556-2821(99)02204-3] [Phys. Rev. D **59**, 083002 (1999)]

Prospects for detecting supernova neutrino flavor oscillations. George M. Fuller, *Department of Physics, University of California, San Diego, La Jolla, California 92093-0319*; Wick C. Haxton and Gail C. McLaughlin, *Institute for Nuclear Theory, Box 351550, and Department of Physics, Box 351560, University of Washington, Seattle, Washington 98195*. (Received 15 September 1998; published 16 March 1999)

The neutrinos from a type II supernova provide perhaps our best opportunity to probe cosmologically interesting muon and/or tauon neutrino masses. This is because matter enhanced neutrino oscillations can lead to an anomalously hot ν_e spectrum, and thus to enhanced charged current cross sections in terrestrial detectors. Two recently proposed supernova neutrino observatories, OMNIS

and LAND, will detect neutrons spalled from target nuclei by neutral and charged current neutrino interactions. As this signal is not flavor specific, it is not immediately clear whether a convincing neutrino oscillation signal can be extracted from such experiments. To address this issue we examine the responses of a series of possible light and heavy mass targets, ^9Be , ^{23}Na , ^{35}Cl , and ^{208}Pb . We find that strategies for detecting oscillations which use only neutron count rates are problematic at best, even if cross sections are determined by ancillary experiments. Plausible uncertainties in supernova neutrino spectra tend to obscure rate enhancements due to oscillations. However, in the case of ^{208}Pb , a signal emerges that is largely flavor specific and extraordinarily sensitive to the ν_e temperature, the emission of two neutrons. This signal and its flavor specificity are associated with the strength and location of the first-forbidden responses for neutral and charge current reactions, aspects of the ^{208}Pb neutrino cross section that have not been discussed previously. Hadronic spin transfer experiments might be helpful in confirming some of the nuclear structure physics underlying our conclusions. [S0556-2821(99)04906-1] [Phys. Rev. D **59**, 085005 (1999)]

R-parity-violating trilinear couplings and recent neutrino data. Subhendu Rakshit,¹ Gautam Bhattacharyya,² and Amitava Raychaudhuri,¹ ¹*Department of Physics, University of Calcutta, 92 Acharya Prafulla Chandra Road, Calcutta 700009, India* ²*Saha Institute of Nuclear Physics, 1/AF Bidhan Nagar, Calcutta 700064, India*. (Received 30 November 1998; published 18 March 1999)

The nontrivial structure of the neutrino mass matrix, suggested by the recent Super-Kamiokande results and data from other neutrino experiments, can be reproduced in R-parity-violating supersymmetric theories. This requires sets of products of R-parity-violating trilinear couplings to take appropriately chosen values. It is shown that the existing constraints on these couplings are satisfied by these choices. [S0556-2821(99)50307-X] [Phys. Rev. D **59**, 091701 (1999)]

B_c mesons in a Bethe-Salpeter model. A. Abd El-Hady, *Department of Physics, Zagazig University, Zagazig, Egypt*; M. A. K. Lodhi, *Department of Physics, Texas Tech University, Lubbock, Texas 79409*; J. P. Vary, *Department of Physics and Astronomy, Iowa State University, Ames, Iowa 50011*. (Received 2 July 1998; published 16 March 1999)

We apply our Bethe-Salpeter model for mesons to the B_c family with parameters fixed in our previous investigation. We evaluate the mass of the pseudoscalar B_c meson as 6.356 and 6.380 GeV/ c^2 and the lifetime as 0.47 and 0.46 ps, respectively, in two reductions of the Bethe-Salpeter equation, in good agreement with the recently reported mass of 6.40 ± 0.39 (stat) ± 0.13 (syst) GeV/ c^2 and lifetime of $0.46_{-0.16}^{+0.18}$ (stat) ± 0.03 (syst) ps by the CDF Collaboration.

We evaluate the decay constant of the B_c meson and compare different contributions to its decay width. [S0556-2821(99)02203-1] [Phys. Rev. D **59**, 094001 (1999)]

Fock space distributions, structure functions, higher twists, and small x . Larry McLerran, *Theoretical Physics Institute, University of Minnesota, Minneapolis, Minnesota 55455*; Raju Venugopalan, *Niels Bohr Institute, Blegdamsvej 17, Copenhagen, DK-2100, Denmark*. (Received 18 September 1998; published 16 March 1999)

We compute quark structure functions and the intrinsic Fock space distribution of sea quarks in a hadron wave function at small x . The computation is performed in an effective theory at small x where the gluon field is treated classically. At Q^2 large compared to an intrinsic scale associated with the density of gluons μ^2 , large compared to the QCD scale Λ_{QCD}^2 , and large compared to the quark mass squared M^2 , the Fock space distribution of quarks is identical to the distribution function measured in deep inelastic scattering. For $Q^2 \leq M^2$ but $Q^2 \gg \mu^2$, the quark distribution is computed in terms of the gluon distribution function and explicit expressions are obtained. For $Q^2 \leq \mu^2$ but $Q^2 \gg \Lambda_{QCD}^2$ we obtain formal expressions for the quark distribution functions in terms of the glue. An evaluation of these requires a renormalization group analysis of the gluon distribution function in the regime of high parton density. For light quarks at high Q^2 , the DGLAP flavor singlet evolution equations for the parton distributions are recovered. Explicit expressions are given for heavy quark structure functions at small x . [S0556-2821(99)02305-X] [Phys. Rev. D **59**, 094002 (1999)]

Non-Markovian effects in strong-field pair creation. S. Schmidt, D. Blaschke, and G. Röpke, *Fachbereich Physik, Universität Rostock, D-18051 Rostock, Germany*; A. V. Prozorkevich and S. A. Smolyansky, *Physics Department, Saratov State University, Saratov, Russian Federation*; V. D. Toneev, *Bogoliubov Laboratory of Theoretical Physics, Joint Institute for Nuclear Research, 141980 Dubna, Russian Federation*. (Received 22 October 1998; published 16 March 1999)

We analyze a quantum kinetic equation describing both boson and fermion pair production and explore analytically and numerically the solution of the non-Markovian kinetic equation. In the low density limit of the kinetic equation we find an analytical solution for the single particle distribution function of bosons and fermions. The numerical investigation for a homogeneous, constant electric field shows an enhancement (bosons) or a suppression (fermions) of the pair creation rate according to the symmetry character of the produced particles. For strong fields non-Markovian effects are important while they disappear for weak fields. Hence it is sufficient to apply the low density limit for weak fields but necessary to take into account memory effects for strong fields. [S0556-2821(99)04607-X] [Phys. Rev. D **59**, 094005 (1999)]

Positivity constraints on chiral perturbation theory pion-pion scattering amplitudes. Petre Diță, *National Institute of Physics & Nuclear Engineering, Bucharest, P.O. Box MG6, Romania*. (Received 5 October 1998; revised manuscript received 25 November 1998; published 18 March 1999)

We test the positivity property of the chiral perturbation theory (ChPT) pion-pion scattering amplitudes within the Mandelstam triangle. In the one-loop approximation $\mathcal{O}(p^4)$ the positivity constrains only the coefficients b_3 and b_4 ; namely, one obtains that b_4 and the linear combination $b_3 + 3b_4$ are positive quantities. The two-loop approximation gives inequalities involving all six arbitrary parameters entering ChPT amplitude, but the corrections to the one-loop approximation results are small. ChPT amplitudes pass unexpectedly well all the positivity tests, giving strong support to the idea that ChPT is a good theory of low-energy pion-pion scattering. [S0556-2821(99)04407-0] [Phys. Rev. D **59**, 094007 (1999)]