

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.

Charge-conjugation violating neutrino interactions in supernovae. C. J. Horowitz and Gang Li, *Department of Physics and Nuclear Theory Center, Indiana University, Bloomington, Indiana 47405*. (Received 20 August 1999; published 24 February 2000)

The well known charge conjugation violating interactions in the standard model increase neutrino- and decrease antineutrino-nucleon cross sections. This impacts neutrino transport in core collapse supernovae through “recoil” corrections of order the neutrino energy k over the nucleon mass M . All k/M corrections to neutrino transport deep inside a protoneutron star are calculated from angular integrals of the Boltzmann equation. We find these corrections significantly modify neutrino currents at high temperatures. This produces a large μ and τ number for the protoneutron star and can change the ratio of neutrons to protons. In addition, the relative size of neutrino mean free paths changes at high temperatures. [Phys. Rev. D **61**, 063002 (2000)]

Tests for randomness of spontaneous quantum decay. M. P. Silverman, Wayne Strange, Chris Silverman, and T. C. Lipscombe, *Department of Physics, Trinity College, Hartford, Connecticut 06106*. (Received 16 July 1999; published 17 March 2000)

Analyses of the runs (i.e., uninterrupted sequences of identical outcomes) were made of the temporal succession of decays from three nuclear processes: (1) β decay of ^{137}Cs , (2) electron capture decay of ^{54}Mn , and (3) β decay of ^{214}Bi followed by α decay of ^{214}Po . Sample half lives vary widely from about 30 yr (^{137}Cs) to 20 min (^{214}Bi). For each process, the numbers of runs of length k ($1 \leq k \leq 20$) were determined from three distinct types of generating procedures: (a) runs with respect to a target value, (b) runs with respect to parity, and (c) runs with respect to sequential differences. Comparison of experimental results with those predicted by the theory of runs (on the assumption that every distinguishable arrangement of a temporal sequence of disintegrations is equally likely) provides comprehensive support of the hypothesis that the spontaneous decay of a nucleus is a random occurrence unaffected by past history. [Phys. Rev. A **61**, 042106 (2000)]

Supersymmetric solution to the solar and atmospheric neutrino problems. J. C. Romão,¹ M. A. Díaz,² M. Hirsch,³ W. Porod,³ and J. W. F. Valle,³ ¹*Departamento de Física, Instituto Superior Técnico, A. Rovisco Pais, 1049-001 Lisboa, Portugal* ²*High Energy Physics, Florida State University, Tallahassee, Florida 32306* ³*Instituto de Física Corpuscular - IFIC/CSIC, Departamento de Física Teórica, Universitat de València, 46100 Burjassot, València, Spain*. (Received 27 July 1999; published 7 March 2000)

The simplest unified extension of the minimal supersymmetric standard model with bi-linear R -parity violation provides a predictive scheme for neutrino masses which can account for the observed

atmospheric and solar neutrino anomalies in terms of bi-maximal neutrino mixing. The maximality of the atmospheric mixing angle arises dynamically, by minimizing the scalar potential, while the solar neutrino problem can be accounted for either by large or by small mixing oscillations. One neutrino picks up mass by mixing with neutralinos, while the degeneracy and masslessness of the other two is lifted only by loop corrections. Despite the smallness of neutrino masses R -parity violation is observable at present and future high-energy colliders, providing an unambiguous cross check of the model. [Phys. Rev. D **61**, 071703(R) (2000)]

Coherence of neutrino flavor mixing in quantum field theory. Christian Y. Cardall, *Department of Physics & Astronomy, State University of New York at Stony Brook, Stony Brook, New York 11794-3800*. (Received 13 September 1999; published 6 March 2000)

In the simplistic quantum mechanical picture of flavor mixing, conditions on the maximum size and minimum coherence time of the source and detector regions for the observation of interference—as well as the very viability of the approach—can only be argued in an *ad hoc* way from principles external to the formalism itself. To examine these conditions in a more fundamental way, the quantum field theoretical S -matrix approach is employed in this paper, without the unrealistic assumption of microscopic stationarity. The fully normalized, time-dependent neutrino flavor mixing event rates presented here automatically reveal the coherence conditions in a natural, self-contained, and physically unambiguous way, while quantitatively describing the transition to their failure. [Phys. Rev. D **61**, 073006 (2000)]

Testing solar neutrino MSW oscillations at low δm^2 through time variations of event rates in GNO and BOREXINO. 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, I-70126 Bari, Italy* ²*Dipartimento di Scienza dei Materiali dell'Università di Lecce, Via Arnesano, Collegio Fiorini, I-73100 Lecce, Italy*. (Received 21 October 1999; published 7 March 2000)

The Mikheyev-Smirnov-Wolfenstein (MSW) explanation of the solar neutrino problem is currently compatible with three distinct regions of the two-neutrino oscillation parameter space ($\delta m^2, \sin^2 2\theta$). We focus on the region with the lowest value of δm^2 ($\sim 10^{-7} \text{ eV}^2$), which implies significant Earth regeneration effects for low-energy solar neutrinos. We point out that such effects are not only observable as *day-night* variations of neutrino event rates in the real-time BOREXINO experiment, but also as *seasonal* variations in the radiochemical Gallium Neutrino Observatory (GNO) at Gran Sasso. We present detailed calculations of the difference between winter and summer rates in GNO (six months averages) in

excess of the trivial seasonal variation due to the Earth orbital eccentricity. We show that, within the low- δm^2 MSW solution, the net winter-summer GNO rate difference amounts to 4–6 SNU, with a dominant contribution from pp neutrinos. We also give analytical expressions for the winter and summer solar exposure functions at the Gran Sasso site. [Phys. Rev. D **61**, 073009 (2000)]

Matter effects in four-neutrino mixing. David Dooling, *Department of Physics, Brown University, Providence, Rhode Island 02912 and School of Physics, Korea Institute for Advanced Study, Seoul 130-012, Korea*; Carlo Giunti, *INFN, Sez. di Torino, and Dip. di Fisica Teorica, Univ. di Torino, I-10125 Torino, Italy and School of Physics, Korea Institute for Advanced Study, Seoul 130-012, Korea*; Kyungsik Kang, *Department of Physics, Brown University, Providence, Rhode Island 02912 and School of Physics, Korea Institute for Advanced Study, Seoul 130-012, Korea*; Chung W. Kim, *School of Physics, Korea Institute for Advanced Study, Seoul 130-012, Korea and Department of Physics & Astronomy, The Johns Hopkins University, Baltimore, Maryland 21218*. (Received 31 August 1999; published 8 March 2000)

The evidence in favor of neutrino oscillations implies the existence of at least three independent neutrino mass-squared differences. If the Liquid Scintillation Neutrino Detector (LSND) results are confirmed, transitions into active and sterile neutrinos can take place simultaneously for both solar and atmospheric neutrinos. In this paper we present a formalism for the calculation of the transition probabilities into active and sterile neutrinos for solar ν_e 's and atmospheric ν_μ 's, taking into account the matter effects in the Sun and in the Earth. We find that the solar neutrino transition probabilities depend on just one single additional parameter compared to that of the standard two-generation analysis, while for atmospheric neutrinos two additional mixing angles are necessary to analyze the data in addition to those of the usual two-generation analysis. [Phys. Rev. D **61**, 073011 (2000)]

Effects of neutrino temperatures and mass hierarchies on the detection of supernova neutrinos. Shao-Hsuan Chiu and T. K. Kuo, *Department of Physics, Purdue University, West Lafayette, Indiana 47907*. (Received 22 September 1999; published 9 March 2000)

The possible outcomes of neutrino events at both Super-Kamiokande and SNO for a type-II supernova are analyzed considering the uncertainties in supernova neutrino spectra (temperature) at emission, which may complicate the interpretation of the observed events. With the input of parameters deduced from the current solar and atmospheric experiments, the consequences of direct-mass hierarchy $m_{\nu_e} \gg m_{\nu_\mu} > m_{\nu_\tau}$ and inverted-mass hierarchy $m_{\nu_e} > m_{\nu_\mu} \gg m_{\nu_\tau}$ are investigated. Even if the ν temperatures are not precisely known, we find that future experiments are likely to be able to separate the currently accepted solutions to the solar neutrino problem, large-angle Mikheyev-Smirnov-Wolfenstein (MSW), small-angle MSW, and the vacuum oscillation, as well as to distinguish between the direct and inverted mass hierarchies of the neutrinos. [Phys. Rev. D **61**, 073015 (2000)]

Light-quark mesons and four-quark condensates at finite temperature. Mikkel B. Johnson, *Los Alamos National Laboratory, Los Alamos, New Mexico 87545*; Leonard S. Kisslinger, *Department of Physics, Carnegie Mellon University, Pittsburgh, Pennsylvania 15213*. (Received 23 August 1999; published 24 February 2000)

We propose an analogue of the familiar gap equation for the case of four-quark condensates at finite temperature. The condensates of interest correspond to scalar, vector, pseudoscalar, axial vector, and tensor Dirac structures. Working with correlators at zero chemical potential without factorization, we arrive at coupled equations for these four-quark condensates and the masses of certain light-quark mesons. We study the temperature dependence of the four-quark condensates and masses; in one of our models, factorization of the four-quark condensates is shown to be increasingly violated as the temperature is increased toward T_c . The 2^{++} tensor mesons $a_2(1320)$ - $f_2(1270)$ are identified as especially sensitive probes of the four-quark condensates. [Phys. Rev. D **61**, 074014 (2000)]

Color superconductivity in weak coupling. Robert D. Pisarski, *Department of Physics, Brookhaven National Laboratory, Upton, New York 11973*; Dirk H. Rischke, *RIKEN-BNL Research Center, Brookhaven National Laboratory, Upton, New York 11973*. (Received 21 October 1999; published 6 March 2000)

We derive perturbatively the gap equations for a color-superconducting condensate with total spin $J=0$ in dense QCD. At zero temperature, we confirm the results of Son for the dependence of the condensate on the coupling constant, and compute the prefactor to leading logarithmic accuracy. At nonzero temperature, we find that to leading order in weak coupling, the temperature dependence of the condensate is identical to that in BCS-like theories. The condensates for total spin $J=1$ are classified; to leading logarithmic accuracy these condensates are of the same order as those of spin $J=0$. [Phys. Rev. D **61**, 074017 (2000)]

Unitarization of the BFKL Pomeron on a nucleus. Yuri V. Kovchegov, *Theory Division, CERN, CH-1211, Geneva, Switzerland and School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455*. (Received 13 September 1999; published 6 March 2000)

We analyze the evolution equation describing all multiple hard Pomeron exchanges in hadronic or nuclear structure functions that was proposed earlier in Phys. Rev. D **60**, 034008 (1999). We construct a perturbation series providing us with an exact solution to the equation outside of the saturation region. The series demonstrates how at moderately high energies the corrections to the single BFKL Pomeron exchange contribution, which are due to the multiple Pomeron exchanges, start unitarizing the total deep inelastic scattering cross section. We show that as the energy increases the scattering cross section of the quark-antiquark pair of a fixed transverse separation on a hadron or nucleus given by the solution of our equation inside of the saturation region unitarizes and becomes independent of energy. The corresponding F_2 structure function also unitarizes and becomes linearly proportional to $\ln s$. We also

discuss possible applications of the developed technique to diffraction. [Phys. Rev. D **61**, 074018 (2000)]

Event by event analysis and entropy of multiparticle systems. A. Bialas and W. Czyz, *M. Smoluchowski Institute of Physics, Jagellonian University, Cracow, Reymonta 4, 30-059 Krakow, Poland and H. Niewodniczanski Institute of Nuclear Physics, Radzikowskiego 152, Krakow, Poland.* (Received 1 September 1999; published 7 March 2000)

The coincidence method of measuring the entropy of a system, proposed some time ago by Ma, is generalized to include systems out of equilibrium. It is suggested that the method can be adapted to analyze multiparticle states produced in high-energy collisions. [Phys. Rev. D **61**, 074021 (2000)]

Lifetime of collective isospin rotations of a quantum meson field. Y. Tsue and D. Vautherin, *L.P.N.H.E., L.P.T.P.E., Universités Paris VI/VII, F-75252, Paris Cedex 05, France;* T. Matsui, *Institute of Physics, University of Tokyo, Komaba, Meguro-ku, Tokyo 153, Japan.* (Received 7 October 1999; published 9 March 2000)

We calculate the lifetime of the collective isospin rotating solutions which have been found recently in the case of a quantum N -component meson field with exact $O(N)$ symmetry. For this purpose we take into account the small breaking of the $O(N)$ symmetry associated with the nonvanishing mass of the pion. This term induces a coupling between collective rotations and intrinsic meson excitations. We evaluate the associated damping time in the framework of linear response theory. We find damping times of about 40 fm/c, i.e., substantially longer than reaction times. [Phys. Rev. D **61**, 076006 (2000)]