

Selected Abstracts from Other Physical Review Journals

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Neutrino trapping and hybrid protoneutron star formation. S. Epsztein Grynberg and M. C. Nemes, *Departamento de Física, Universidade Federal de Minas Gerais, CP 702, 30161-970, Belo Horizonte, Brazil*; H. Rodrigues, *Centro Federal de Educação Tecnológica, Av. Maracanã 249, 20271-110, Rio de Janeiro, Brazil*; M. Chiapparini *Instituto de Física, Universidade do Estado do Rio de Janeiro, Rua São Francisco Xavier 524, 20559-900, Rio de Janeiro, Brazil*; S. B. Duarte, *Centro Brasileiro de Pesquisas Físicas, Centro Brasileiro de Pesquisas Físicas, Rua Dr. Xavier Sigaud 150, 22290-180, Rio de Janeiro, Brazil*; A. H. Blin and B. Hiller, *Centro de Física Teórica, Universidade de Coimbra, P-3004-516 Coimbra, Portugal*. (Received 25 January 2000; published 17 November 2000)

We consider a schematic semianalytical model for the dynamical calculation of collapse and explosion leading to the formation and composition of protoneutron stars. A hadron to quark phase transition is included in a scenario where neutrinos are trapped and interactions among hadrons as well as among quarks are taken into account. The main appeal of the model, other than its simplicity, is that it gives a quantitatively accurate description of all global features of the process such as ejected mass, the energy of the nascent shock wave, and the mass and radius of the remnant core. We present the time evolution of the system during the collapse-explosion process and we conclude that the formation of a hybrid remnant core is inhibited by neutrino trapping at the onset of the core bounce. [Phys. Rev. D **62**, 123003 (2000)]

Exact and approximate dynamics of the quantum mechanical $O(N)$ model. Bogdan Mihaila,^{1,2,3} Tara Athan,⁴ Fred Cooper,^{5,6} John Dawson,^{1,7} Salman Habib⁵ ¹*Department of Physics, University of New Hampshire, Durham, New Hampshire 03824* ²*Theoretical Nuclear Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee* ³*Chemistry and Physics Department, Coastal Carolina University, Conway, South Carolina 29526* ⁴*EES Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545* ⁵*Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545* ⁶*Department of Physics, Boston College, Chestnut Hill, Massachusetts 02167* ⁷*Institute of Nuclear Theory, University of Washington, Box 351550, Seattle, Washington 98195*. (Received 3 March 2000; published 27 November 2000)

We study the dynamics of the quantum mechanical $O(N)$ model as a specific example to investigate the systematics of a $1/N$ expansion. The closed time path formalism melded with an expansion in $1/N$ is used to derive time evolution equations valid to order $1/N$ (next-to-leading order). The effective potential is also obtained to this order and its properties are elucidated. In order to compare theoretical predictions against numerical solutions of the time-dependent Schrödinger equation, we consider two initial conditions consistent with $O(N)$ symmetry, one of them a quantum roll, the

other a wave packet initially to one side of the potential minimum, whose center has all coordinates equal. For the case of the quantum roll we map out the domain of validity of the large- N expansion. We also discuss the existence of unitarity violation in this expansion, a well-known problem faced by moment truncation techniques. The $1/N$ results, both static and dynamic, are contrasted with those given by a Hartree variational ansatz at given values of N . A comparison against numerical results leads us to conclude that late-time dynamical behavior, where nonlinear effects are significant, is not well described by either approximation. [Phys. Rev. D **62**, 125015 (2000)]

Color transparency in deeply inelastic diffraction. F. Hautmann, *Department of Physics, Pennsylvania State University, University Park, Pennsylvania 16802*; D. E. Soper, *Institute of Theoretical Science, University of Oregon, Eugene, Oregon 97403*. (Received 21 August 2000; published 21 November 2000)

We suggest a simple physical picture for the diffractive parton distributions that appear in diffractive deeply inelastic scattering. In this picture, partons impinging on the proton can have any transverse separation, but only when the separation is small can they penetrate the proton without breaking it up. By comparing the predictions from this picture with the diffractive data from DESY HERA, we determine rough values for the small separations that dominate the diffraction process. [Phys. Rev. D **63**, 011501 (2001)]

In-medium $\pi\pi$ correlation induced by partial restoration of chiral symmetry. D. Jido, *Consejo Superior de Investigaciones Científicas, Universitat de Valencia, IFIC, Institutos de Investigación de Peterna, Aptdo. Correos 2085, 46071 Valencia, Spain*; T. Hatsuda, *Department of Physics, University of Tokyo, Tokyo 113-0077 Japan*; T. Kunihiro, *Yukawa Institute for Theoretical Physics, Kyoto University, Kyoto 606-8502, Japan*. (Received 9 August 2000; published 30 November 2000)

We show that both the linear and the nonlinear chiral models give an enhancement of the $\pi\pi$ cross section near the 2π threshold in the scalar-isoscalar ($I=J=0$) channel in nuclear matter. The reduction of the chiral condensate, i.e., the partial chiral restoration in nuclear matter, is responsible for the enhancement in both cases. We extract an effective 4π -nucleon vertex, which is responsible for the enhancement but has not been considered in the nonlinear models for in-medium $\pi\pi$ interaction. The relation of this vertex and a next-to-leading order term in the heavy-baryon chiral Lagrangian $\mathcal{L}_{\pi N}^{(2)}$ is also discussed. [Phys. Rev. D **63**, 011901 (2001)]

Solar neutrino rates, spectrum, and its moments: An MSW analysis in the light of Super-Kamiokande results. Srubabati Goswami, *Saha Institute of Nuclear Physics, 1/AF Bidhannagar, Calcutta 700 064, India*; Debasish Majumdar, *Saha Institute of Nuclear Physics, 1/AF Bidhannagar, Calcutta 700 064, India and Department of Physics, University of Calcutta, 92 Acharya Prafulla Chandra Road, Calcutta 700 009, India*; Amitava Raychaudhuri, *Department of Physics, University of Calcutta, 92 Acharya Prafulla Chandra Road, Calcutta 700 009, India*. (Received 28 March 2000; revised manuscript received 23 August 2000; published 28 November 2000)

We reexamine Mikheyev-Smirnov-Wolfenstein (MSW) solutions of the solar neutrino problem in a two flavor scenario taking (a) the results on total rates and the electron energy spectrum from the 1117-day SuperKamiokande (SK) data and (b) those on total rates from the chlorine and gallium experiments. We find that the small mixing angle (SMA) solution gives the best fit to the total rates data from the different experiments. One new feature of our analysis is the use of the moments of the SK electron spectrum in a χ^2 analysis. The best-fit to the moments is broadly in agreement with that obtained from a direct fit to the spectrum data, and prefers a Δm^2 comparable to the rates of the SMA fit, but the required mixing angle is larger. In the combined rate and spectrum analysis, apart from varying the normalization of the ^8B flux as a free parameter and determining its best-fit value, we also obtain the best-fit parameters when correlations between the rates and the spectrum data are included, and the normalization of the ^8B flux is held fixed at its standard solar model (SSM) value. We observe that the correlations between the rates and spectrum data are important, and the goodness of fit worsens when these are included. In either case, the best-fit lies in the LMA region. [Phys. Rev. D **63**, 013003 (2001)]

Three flavor long-wavelength vacuum oscillation solution to the solar neutrino problem. A. M. Gago, *Instituto de Física, Universidade de São Paulo C. P. 66.318, 05315-970 São Paulo, Brazil and Sección Física, Departamento de Ciencias, Pontificia Universidad Católica del Perú, Apartado 1761, Lima, Perú*; H. Nunokawa, *Instituto de Física Gleb Wataghin, Universidade Estadual Campinas, UNICAMP 13083-970 – Campinas, Brazil*; R. Zukanovich Funchal, *Instituto de Física, Universidade de São Paulo C. P. 66.318, 05315-970 São Paulo, Brazil*. (Received 6 June 2000; revised manuscript received 19 July 2000; published 6 December 2000)

We investigate the current status of the long-wavelength vacuum oscillation solution to the solar neutrino problem and to what extent the presence of a third neutrino can affect and modify it. Assuming that the smaller mass squared difference that can induce such oscillations Δm_{12}^2 is in the range $10^{-11} - 10^{-8} \text{ eV}^2$ and the larger one, Δm_{23}^2 , in the range relevant to atmospheric neutrino observations, we analyze the most recent solar neutrino data coming from Homestake, SAGE, GALLEX, GNO, and Super-Kamiokande experiments in the context of three neutrino generations. We include in our vacuum oscillation analysis the Mikheyev-Smirnov-Wolfenstein (MSW) effect in the Sun, which is relevant for some of the parameter space scrutinized. We have also performed, as an extreme exercise, the fit without Homestake data. While we found that the MSW effect basically does not affect the best fitted parameters, it significantly modifies the allowed parameter space for

Δm_{12}^2 larger than $\sim 3 \times 10^{-10} \text{ eV}^2$, in good agreement with the result obtained by Friedland in the case of two generations. Although the presence of a third neutrino does not essentially improve the quality of the fit, the solar neutrino data alone can give an upper bound on θ_{13} , which is constrained to be less than $\sim 60^\circ$ at 95 % C.L. [Phys. Rev. D **63**, 013005 (2001)]

Weak decay of uniformly accelerated protons and related processes. Daniel A. T. Vanzella and George E. A. Matsas, *Instituto de Física Teórica, Universidade Estadual Paulista, Rua Pamplona 145, 01405-900, São Paulo, SP, Brazil*. (Received 31 January 2000; published 6 December 2000)

We investigate the weak interaction emission of spin-1/2 fermions from accelerated currents. As particular applications, we analyze the decay of uniformly accelerated protons and neutrons, and the neutrino-antineutrino emission from uniformly accelerated electrons. The possible relevance of our results to astrophysics is also discussed. [Phys. Rev. D **63**, 014010 (2001)]

Intrinsic and dynamically generated scalar meson states. C. M. Shakin and Huangsheng Wang, *Department of Physics and Center for Nuclear Theory, Brooklyn College of the City University of New York, Brooklyn, New York 11210*. (Received 12 June 2000; published 11 December 2000)

Recent work by Maltman has given us confidence that our assignment of scalar meson states to various nonets based upon our generalized Nambu–Jona-Lasinio (NJL) model is correct. [For example, in our model the $a_0(980)$ and the $f_0(980)$ are in the same nonet as the $K_0^*(1430)$.] In this work we make use of our model to provide a precise definition of “preexisting” resonances and “dynamically generated” resonances when considering various scalar mesons. [This distinction has been noted by Meissner in his characterization of the $f_0(400-1200)$ as nonpreexisting.] We define preexisting (or intrinsic) resonances as those that appear as singularities of the $q\bar{q}$ T matrix and are in correspondence with $q\bar{q}$ states bound in the confining field. [Additional singularities may be found when studying the T matrices describing $\pi\pi$ or πK scattering, for example. Such features may be seen to arise, in part, from t -channel and u -channel ρ exchange in the case of $\pi\pi$ scattering, leading to the introduction of the $\sigma(500-600)$. In addition, threshold effects in the $q\bar{q}$ T matrix can give rise to significant broad cross section enhancements. The latter is, in part, responsible for the introduction of the $\kappa(900)$ in a study of πK scattering, for example.] We suggest that it is only the *intrinsic* resonances which correspond to $q\bar{q}$ quark-model states, and it is only the *intrinsic* states that are to be used to form quark-model $q\bar{q}$ nonets of states. [While the $\kappa(900)$ and $\sigma(500-600)$ could be placed in a nonet of dynamically generated states, it is unclear whether there is evidence that requires the introduction of other members of such a nonet.] In this work we show how the phenomena related to the introduction of the $\sigma(500-600)$ and the $\kappa(900)$ are generated in studies of $\pi\pi$ and πK scattering, making use of our generalized Nambu–Jona-Lasinio model. We also calculate the decay constants for the a_0 and K_0^* mesons and compare our results with those obtained by Maltman. We find that the value obtained using QCD sum-rule tech-

niques for the $a_0(980)$ decay constant is smaller than the decay constant calculated using our generalized NJL model, which suggests that the $a_0(980)$ may have a significant $K\bar{K}$ component. We find rather good agreement with Maltman's values for the decay constants of the $a_0(1450)$ and $K_0^*(1430)$. Maltman suggests that the $a_0(980)$ and $K_0^*(1430)$ should be in the same nonet, a result in agreement with our analysis. [Phys. Rev. D **63**, 014019 (2001)]

Thermal and nonthermal pion enhancements with chiral symmetry restoration. Pengfei Zhuang and Zhenwei Yang, *Physics Department, Tsinghua University, Beijing 100084, China*. (Received 6 June 2000; published 5 December 2000)

The pion production by sigma decay and its relation with chiral symmetry restoration in hot and dense matter are investigated in the framework of the Nambu–Jona-Lasinio model. The decay rate for the process $\sigma \rightarrow 2\pi$ to the lowest order in a $1/N_c$ expansion is calculated as a function of temperature T and chemical potential μ . The thermal and nonthermal enhancements of pions generated by the decay before and after the freeze-out are present only in the crossover region of the chiral symmetry transition. The strongest nonthermal enhancement is located in the vicinity of the end point of the first-order transition. [Phys. Rev. D **63**, 016004 (2001)]

ω - ρ mixing and the $\omega \rightarrow \pi\pi\gamma$ decay. Dafne Guetta and Paul Singer, *Department of Physics, Technion-Israel Institute of Technology, Haifa 32000, Israel*. (Received 8 May 2000; published 6 December 2000)

We reexamine the $\omega \rightarrow \pi^0 \pi^0 \gamma$ decay, adding the effect of ω - ρ mixing to the amplitude calculated with the aid of chiral perturbation theory and vector meson dominance. We predict the neutral decay to occur with a width of $\Gamma(\omega \rightarrow \pi^0 \pi^0 \gamma) = (390 \pm 96)$ eV and also analyze the effect of the ω - ρ mixing on the $\Gamma(\omega \rightarrow \pi^0 \pi^0 \gamma)/\Gamma(\omega \rightarrow \pi^+ \pi^- \gamma)$ ratio. Several remarks on the effect of ω - ρ mixing on certain radiative decays of vector mesons are presented. [Phys. Rev. D **63**, 017502 (2001)]

Dependence of shower particle pseudorapidity and pseudorapidity gap distributions on multiplicity in high-energy neutrino-emulsion collisions. Fu-Hu Liu, *Institute of Modern Physics and Department of Physics, Shanxi Teachers University, Linfen, Shanxi 041004, China*. (Received 12 May 2000; revised manuscript received 20 July 2000; published 15 December 2000)

The pseudorapidity and pseudorapidity gap distributions of shower particles in different event groups selected by multiplicity in 3–210 GeV neutrino-emulsion collisions are reported and analyzed by the thermalized cylinder model. It is shown that the pseudorapidity distribution has a slight dependence on the multiplicity and the pseudorapidity gap distribution does not depend on the multiplicity. The calculated results by the thermalized cylinder model are compared and found to be in agreement with the experimental data. [Phys. Rev. D **63**, 032001 (2001)]