

Selected Abstracts from Other Physical Review Journals

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Coherent production of hard dijets on nuclei in QCD. N. N. Nikolaev, *Institut für Kernphysik (Theorie), Forschungszentrum Jülich, D-52425 Jülich, Germany* and L. D. Landau Institute for Theoretical Physics, Chernogolovka, Moscow Region 142 432, Russia; W. Schäfer and G. Schwiete, *Institut für Kernphysik (Theorie), Forschungszentrum Jülich, D-52425 Jülich, Germany*. (Received 5 September 2000; published 11 December 2000)

We formulate the perturbative QCD approach to coherent diffractive dijet production in pion-nucleon and pion-nucleus collisions at high energy. For hard dijets the Pomeron splitting mechanism in which both helicity amplitudes are proportional to the unintegrated gluon structure function of the proton $\mathcal{F}(x, k^2)$ and pion distribution amplitude $\phi_\pi(z)$ is shown to dominate. In nuclear diffraction multiple Pomeron splitting components are found to give antishadowing contributions at large jet momentum k . To leading twist there is an exact cancellation of effects of nuclear attenuation and antishadowing or broadening of multiple Pomeron splitting contributions. The next-to-leading higher twist correction driven by nuclear rescatterings is calculable in hard QCD and proves to be numerically very large. We argue that large higher twist effects do not preclude the determination of gross features of $\phi_\pi(z)$. Our results on the atomic mass number and momentum dependence of dijet cross sections agree well with the preliminary findings from the E791 experiment. [Phys. Rev. D **63**, 014020 (2001)]

Atmospheric neutrino anomaly without maximal mixing? A. De Rújula, *Theory Division, CERN, 1211 Geneva 23, Switzerland*; M. B. Gavela, *Departamento de Física Teórica, Universidad Autónoma de Madrid, Spain*; P. Hernández, *Theory Division, CERN, 1211 Geneva 23, Switzerland*. (Received 7 June 2000; published 5 January 2001)

We consider a pattern of neutrino masses in which there is an approximate mass degeneracy between the two mass eigenstates most coupled to the ν_μ and ν_τ flavor eigenstates. Earth-matter effects can lift this degeneracy and induce an effectively maximal mixing between these two generations. This occurs if ν_e 's contain comparable admixtures of the degenerate eigenstates, even if they are not large. This provides an explanation of the atmospheric neutrino anomaly in which the *ab initio* introduction of a large mixing angle is not required. To test this possibility we perform a detailed analysis of the 52 kiloton-year SuperKamiokande data, and we find that in a large region of parameter space the corresponding confidence levels are excellent. The most recent results from the CHOOZ reactor experiment, however, severely curtail this region, so that the conventional scenario with nearly maximal mixing angles, which we also analyze in detail, is supported by the data. [Phys. Rev. D **63**, 033001 (2001)]

Short-baseline neutrino oscillations at a neutrino factory. V. Barger, *Department of Physics, University of Wisconsin, Madison, Wisconsin 53706*; S. Geer and R. Raja, *Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510*; K. Whisnant, *Department of Physics and Astronomy, Iowa State University, Ames, Iowa 50011*. (Received 18 July 2000; published 8 January 2001)

Within the framework of three-neutrino and four-neutrino scenarios that can describe the results of the LSND experiment, we consider the capabilities of short-baseline neutrino oscillation experiments at a neutrino factory. We find that, when short-baseline ($L \lesssim 100$ km) neutrino factory measurements are used together with other accelerator-based oscillation results, the complete three-neutrino parameter space can best be determined by measuring the rate of $\nu_e \rightarrow \nu_\tau$ oscillations, and measuring CP violation with either $\nu_e \rightarrow \nu_\mu$ or $\nu_\mu \rightarrow \nu_\tau$ oscillations (including the corresponding antineutrino channels). With measurements of CP violation in both $\nu_e \rightarrow \nu_\mu$ and $\nu_\mu \rightarrow \nu_\tau$ it may be possible to distinguish between the three- and four-neutrino cases. [Phys. Rev. D **63**, 033002 (2001)]

Off-diagonal structure of the neutrino mass matrix in the seesaw mechanism and electron-muon-tau lepton universality. Riazuddin, *National Center for Physics, Quaid-e-Azam University, Islamabad 45320, Pakistan*. (Received 13 July 2000; published 9 January 2001)

By a simple extension of the standard model in which $(e - \mu - \tau)$ universality is not conserved, we present a scenario within the framework of the seesaw mechanism in which the neutrino mass matrix is strictly off diagonal in the flavor basis. We show that a version of this scenario can accommodate the small angle Mikheyev-Smirnov-Wolfenstein (MSW) solution of the solar neutrino problem and $\nu_\mu - \nu_e$ oscillations claimed by the LSND Collaboration. Another version accommodates atmospheric $\nu_\mu - \nu_\tau$ oscillations and the large angle solution in solar neutrino experiments. [Phys. Rev. D **63**, 033003 (2001)]

Global three-neutrino oscillation analysis of neutrino data. M. C. Gonzalez-Garcia, M. Maltoni, C. Peña-Garay, and J. W. F. Valle, *Instituto de Física Corpuscular—C.S.I.C., Universitat de València, Edificio Institutos de Paterna, Apt. 22085, E-46071 València, Spain*. (Received 29 September 2000; published 10 January 2001)

A global analysis of the solar, atmospheric and reactor neutrino data is presented in terms of three-neutrino oscillations. We include

the most recent solar neutrino rates of Homestake, SAGE, GALLEX and GNO, as well as the recent 1117 day Super-Kamiokande data sample, including the recoil electron energy spectrum both for day and night periods, and we treat in a unified way the full parameter space for oscillations, correctly accounting for the transition from the matter enhanced to the vacuum oscillations regime. Likewise, we include in our description conversions with $\theta_{12} > \pi/4$. For the atmospheric data we perform our analysis of the contained events and the upward-going ν -induced muon fluxes, including the previous data samples of Frejus, IMB, Nusex, and Kamioka experiments as well as the full 71 kton yr (1144 days) Super-Kamiokande data set, the recent 5.1 kton yr contained events of Soudan2 and the results on upgoing muons from the MACRO detector. We first present the allowed regions of solar and atmospheric oscillation parameters θ_{12} , Δm_{21}^2 and θ_{23} , Δm_{32}^2 , respectively, as a function of θ_{13} . We determine the constraints from atmospheric and solar data on the mixing angle θ_{13} , common to solar and atmospheric analyses. The solar limit on θ_{13} , although relatively weak, is totally independent on the allowed range of the atmospheric mass difference Δm_{32}^2 . On the other hand, the atmospheric data analysis indicates an important complementarity with the reactor limits allowing for a stronger constraint on the allowed value of θ_{13} . We also obtain the allowed ranges of parameters from the full five-dimensional combined analysis of the solar, atmospheric and reactor data. [Phys. Rev. D **63**, 033005 (2001)]

Chiral symmetry and the parity-violating $NN\pi$ Yukawa coupling. Shi-Lin Zhu,¹ S. J. Puglia,¹ B. R. Holstein,³ and M. J. Ramsey-Musolf^{1,2} ¹*Department of Physics, University of Connecticut, Storrs, Connecticut 06269* ²*Theory Group, Thomas Jefferson National Accelerator Facility, Newport News, Virginia 23606* ³*Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01003.* (Received 30 May 2000; published 10 January 2001)

We construct the complete $SU(2)$ parity-violating (PV) π, N, Δ interaction Lagrangian with one derivative, and calculate the chiral corrections to the PV Yukawa $NN\pi$ coupling constant h_π through $\mathcal{O}(1/\Lambda_\chi^3)$ in the leading order of heavy baryon expansion. We discuss the relationship between the renormalized h_π , the measured value of h_π , and the corresponding quantity calculated microscopically from the standard model four-quark PV interaction. We observe that the renormalized h_π depends strongly on a number of *a priori* unknown parameters in the PV effective Lagrangian. [Phys. Rev. D **63**, 033006 (2001)]

Minijets and transverse energy flow in high energy collisions. Gösta Gustafson and Gabriela Miu, *Department of Theoretical Physics, Lund University, Sölvegatan 14A, S-223 62 Lund, Sweden.* (Received 3 March 2000; published 5 January 2001)

When studying the production of minijets and transverse energy flow in high energy hadron-hadron or nucleus-nucleus collisions, two essential points have to be taken into account. First, one has to account for the virtuality of the colliding partons and, second, it is important to avoid double counting, when many links in a parton chain can be interpreted as the momentum transfer in a hard sub-

collision. The linked dipole chain model, introduced for low- x DIS, is particularly suitable for a study of these problems. It describes (mini)jet production in a $k_\perp$ -factorizing formalism, which includes all links in a parton chain on an equal footing, avoiding double counting. In a “naive” calculation based on integrated structure functions, the cross section blows up for small $p_\perp$, which makes it necessary to introduce a soft cutoff. In our approach we find a dynamical suppression at low $p_\perp$, which makes it possible to extrapolate to higher energies and make more reliable predictions for BNL RHIC and CERN LHC. [Phys. Rev. D **63**, 034004 (2001)]

Chiral crystal in cold QCD matter at intermediate densities? Ralf Rapp, Edward Shuryak, and Ismail Zahed, *Department of Physics and Astronomy, State University of New York, Stony Brook, New York 11794-3800.* (Received 22 August 2000; published 8 January 2001)

The analogue of Overhauser (particle-hole) pairing in electronic systems (spin-density waves with non-zero total momentum Q) is analyzed in finite-density QCD for 3 colors and 2 flavors, and compared to the color-superconducting BCS ground state (particle-particle pairing, $Q=0$). The calculations are based on effective nonperturbative four-fermion interactions acting in both the scalar diquark as well as the scalar-isoscalar quark-hole (“ σ ”) channel. Within the Nambu-Gorkov formalism we set up the coupled channel problem, including multiple chiral density wave formation, and evaluate the resulting gaps and free energies. Employing medium-modified instanton-induced ’t Hooft interactions, as applicable around $\mu_q \approx 0.4$ GeV (or 4 times nuclear saturation density), we find the “chiral crystal phase” to be competitive with the color superconductor. [Phys. Rev. D **63**, 034008 (2001)]

Octet baryon charge radii, chiral symmetry, and decuplet intermediate states. S. J. Puglia, *Department of Physics, University of Connecticut, Storrs, Connecticut 06269*; M. J. Ramsey-Musolf, *Department of Physics, University of Connecticut, Storrs, Connecticut 06269 and Theory Group, Thomas Jefferson National Accelerator Facility, Newport News, Virginia 23606*; Shi-Lin Zhu, *Department of Physics, University of Connecticut, Storrs, Connecticut 06269.* (Received 16 August 2000; published 11 January 2001)

We compute the octet baryon charge radii to $\mathcal{O}(1/\Lambda_\chi^2 M_N)$ in heavy baryon chiral perturbation theory (HB χ PT). We examine the effect of including the decuplet of spin- $\frac{3}{2}$ baryons explicitly. We find that it does not improve the level of agreement between the HB χ PT and experimental values for the Σ^- charge radius. [Phys. Rev. D **63**, 034014 (2001)]

Polarized J/ψ production in deep inelastic scattering at DESY HERA. Feng Yuan, *Department of Physics, Peking University, Beijing 100871, People’s Republic of China*; Kuang-Ta Chao, *China Center of Advanced Science and Technology (World Laboratory), Beijing 100080, People’s Republic of China and Department of Physics, Peking University, Beijing 100871, People’s Republic of China.* (Received 30 August 2000; published 12 January 2001)

We perform a calculation on the polarization of J/ψ production in deep inelastic scattering in the DESY HERA energy range. For the inclusive production distributions, we find that the color-singlet contributions are consistent with the experimental data in the major region of z ($z > 0.4$). Only in low z regions are there some hints of the need for the color-octet contributions to describe the experimental data. For the polarization of J/ψ in deep inelastic scattering processes, we find the parameter α changes with Q^2 . Especially at higher Q^2 , the difference in α between color-singlet and color-octet contributions becomes more distinctive. In the two regions of lower and larger z , the polarization parameter α has different features. These properties can provide important information on the polarization mechanism for J/ψ production. [Phys. Rev. D **63**, 034017 (2001)]

Supersymmetric grand unification under siege: Proton lifetime upper bound. Radovan Dermisek, Arash Mafi, and Stuart Raby, *Department of Physics, The Ohio State University, Columbus, Ohio 43210*. (Received 15 August 2000; published 29 December 2000)

SO(10) supersymmetric (SUSY) grand unified theories provide a beautiful framework for physics beyond the standard model. Experimental measurements of the three gauge couplings are consistent with unification at a scale $M_G \sim 3 \times 10^{16}$ GeV. In addition, predictive models for fermion masses and mixing angles have been found which fit the low energy data, including the recent data for neutrino oscillations. SO(10) boundary conditions can be tested via the spectrum of superparticles. The simplest models also predict neutron and proton decay rates. In this paper we discuss nucleon decay rates and obtain reasonable upper bounds. A clear picture of the allowed SUSY spectra as constrained by nucleon decay is presented. [Phys. Rev. D **63**, 035001 (2001)]

Relaxing near the critical point. D. Boyanovsky and H. J. de Vega, *Department of Physics and Astronomy, University of Pittsburgh, Pittsburgh, Pennsylvania 15260 and LPTHE, Université Pierre et Marie Curie (Paris VI) et Denis Diderot (Paris VII), Tour 16, 1er. étage, 4, Place Jussieu, 75252 Paris cedex 05, France*; M. Simionato, *LP THE, Université Pierre et Marie Curie (Paris VI) et Denis Diderot (Paris VII), Tour 16, 1er. étage, 4, Place Jussieu, 75252 Paris cedex 05, France and INFN, Gruppo Collegato di Parma, Italy*. (Received 14 April 2000; published 22 January 2001)

Critical slowing down of the relaxation of the order parameter has phenomenological consequences in early universe cosmology and in ultrarelativistic heavy ion collisions. We study the relaxation rate of long-wavelength fluctuations of the order parameter in an $O(N)$ scalar theory near the critical point to model the non-equilibrium dynamics of critical fluctuations near the chiral phase transition. A lowest order perturbative calculation (two loops in the coupling λ) reveals the breakdown of perturbation theory for long-wavelength fluctuations in the critical region and the emergence of a hierarchy of scales with hard $q \gg T$, semisoft $T \gg q \gg \lambda T$ and soft $\lambda T \gg q$ loop momenta which are widely separated in the weak coupling limit. A

non-perturbative resummation is implemented to leading order in the large N limit which reveals the infrared renormalization of the static scattering amplitude and the crossover to an effective three dimensional theory for the soft loop momenta near the critical point. The effective three dimensional coupling is driven to the Wilson-Fisher three dimensional fixed point in the soft limit. This resummation provides an infrared screening and for critical fluctuations of the order parameter with wave vectors $\lambda T \gg k \gg k_{us}$ or near the critical temperature $\lambda T \gg m_T \gg k_{us}$ with the ultrasoft scale $k_{us} = (\lambda T/4\pi) \exp[-4\pi/\lambda]$ the relaxation rate is dominated by classical semisoft loop momentum leading to $\Gamma(k, T) = \lambda T/(2\pi N)$. For wave vectors $k \ll k_{us}$ the damping rate is dominated by hard loop momenta and given by $\Gamma(k, T) = 4\pi T/[3N \ln(T/k)]$. Analogously, for homogeneous fluctuations in the ultracritical region $m_T \ll k_{us}$ the damping rate is given by $\Gamma_0(m_T, T) = 4\pi T/[3N \ln(T/m_T)]$. Thus critical slowing down emerges for ultrasoft fluctuations. In such a regime the rate is independent of the coupling λ and both perturbation theory and the classical approximation within the large N limit break down. The strong coupling regime and the shortcomings of the quasiparticle interpretation are discussed. [Phys. Rev. D **63**, 045007 (2001)]

Use of nuclear β decay as a test of bulk neutrinos in extra dimensions. G. C. McLaughlin, *TRIUMF, 4004 Wesbrook Mall, Vancouver, British Columbia, Canada V6T 2A3*; J. N. Ng, *TRIUMF, 4004 Wesbrook Mall, Vancouver, British Columbia, Canada V6T 2A3 and National Center for Theoretical Sciences, P.O. Box 2-131, Hsinchu, Taiwan 300, Taiwan*. (Received 10 March 2000; revised manuscript received 6 October 2000; published 24 January 2001)

Theories which include neutrinos in large extra dimensions can be constrained by nuclear β decay experiments. We examine the universality of β decay strengths of Fermi transitions. From this we find that the extra dimensional Yukawa coupling for a higher-dimensional scale of 10 TeV and two extra dimensions can be constrained to $y \lesssim 1$. Kinematic implications are also discussed. In particular, an extra-dimensional scenario will produce a tritium decay end point spectrum with a different shape than that for just one massive state. [Phys. Rev. D **63**, 053002 (2001)]

Microscopic dynamics of disoriented chiral condensate formation. Julien Serreau, *LPT, Bâtiment 210, Université Paris-Sud, 91405 Orsay, France*. (Received 13 September 2000; published 19 January 2001)

The dynamics of the pion field after a quench is studied in the framework of the linear sigma model. Our aim is to determine to what extent the amplified pion field resembles the disoriented chiral condensate (DCC) picture originally proposed in the early 1990s. We present the result of a computer experiment where, among other things, we study in detail the correlation between isospin orientations of the distinct modes of the field. We show that this correlation is absent. In a sense, the distinct modes behave as distinct DCCs. The implications of this observation are discussed. [Phys. Rev. D **63**, 054003 (2001)]