

Selected Abstracts from Physical Review D

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Pion decay constant and the ρ -meson mass at finite temperature in hidden local symmetry. Masayasu Harada, *Department of Physics, Syracuse University, Syracuse, New York 13244-1130*; Akihiro Shibata, *Computing Research Center, High Energy Accelerator Research Organization (KEK), Tsukuba 305, Japan*. (Received 13 December 1996)

We study the temperature dependence of the pion decay constant and ρ -meson mass in the hidden local symmetry model at one loop. Using the standard imaginary time formalism, we include the thermal effect of the ρ meson as well as that of the pion. We show that the pion gives a dominant contribution to the pion decay constant and the ρ -meson contribution slightly decreases the critical temperature. The ρ -meson pole mass increases as T^4/m_ρ^2 at low temperature, dominated by the pion-loop effect. At high temperature, although the pion-loop effect decreases the ρ -meson mass, the ρ -loop contribution overcomes the pion-loop contribution and the ρ -meson mass increases with temperature. We also show that the conventional parameter a is stable as the temperature increases. [S0556-2821(97)03911-8] [Phys. Rev. D **55**, 6716 (1997)]

Deep inelastic scattering of leptons from nuclear targets and the BFKL Pomeron. Andrzej Bialas and Wiesław Czyz, *Institute of Physics of the Jagellonian University, Reymonta 4, 30-059 Kraków, Poland*; Wojciech Florkowski, *H. Niewodniczański Institute of Nuclear Physics, Radzikowskiego 152, 31-342 Kraków, Poland*. (Received 23 December 1996)

We calculate shadowing in the process of deep inelastic interactions of leptons with nuclei in the perturbative regime of QCD. We find appreciable shadowing for heavy nuclei (e.g., Pb) in the region of a small Bjorken scaling variable $10^{-5} \leq x \leq 10^{-3}$. This shadowing depends weakly on Q^2 , but it may be strongly influenced, especially at $x \geq 10^{-3}$, by the existence of real parts of the forward scattering amplitudes. [S0556-2821(97)03709-0] [Phys. Rev. D **55**, 6830 (1997)]

Chiral multiplets of hadron currents. Thomas D. Cohen and Xiangdong Ji, *Department of Physics, University of Maryland, College Park, Maryland, 20742*. (Received 9 December 1996)

Using group theoretical methods, we enumerate possible chiral representations in which hadron interpolating currents can be classified. We give simple examples of currents in each representation, some of which are well known. The classification enables one to find relations among current vacuum correlators in a chirally and/or axial U(1) symmetric phase of QCD in a straightforward way. In addition to recovering many well-known relations among two-point correlation functions, a number of novel relations are found. [S0556-2821(97)01511-7] [Phys. Rev. D **55**, 6870 (1997)]

Preequilibrium evolution of a non-Abelian plasma. Gouranga C. Nayak and V. Ravishankar, *Department of Physics, Indian Institute of Technology, Kanpur – 208 016, India*. (Received 27 August 1996)

We study the production and the equilibration of a non-Abelian $q\bar{q}$ plasma in an external chromoelectric field by solving the Boltzmann equation with the non-Abelian features explicitly incorporated. We consider the gauge group SU(2) and show that the color degree of freedom has a major and dominant role in the dynamics of the system. It is seen that the assumption of the so-called Abelian dominance is not justified. Finally, it is also shown that many of the features of microscopic studies of the system appear naturally in our studies as well. [S0556-2821(97)04609-2] [Phys. Rev. D **55**, 6877 (1997)]

Coherent amplification of classical pion fields during the cooling of droplets of quark plasma. Abdellatif Abada and Michael C. Birse, *Theoretical Physics Group, Department of Physics and Astronomy, University of Manchester, Manchester M13 9PL, England*. (Received 3 December 1996)

In the framework of the linear σ model, we study the time evolution of a system of classical σ and pion fields coupled to quarks. For this purpose we solve numerically the classical transport equation for relativistic quarks coupled to the nonlinear Klein-Gordon equations for the meson fields. We examine evolution starting from variety of initial conditions corresponding to spherical droplets of hot quark matter, which might mimic the behavior of a quark plasma produced in high-energy nucleus-nucleus collisions. For large droplets we find a strong amplification of the pion field that oscillates in time. This leads to a coherent production of pions with a particular isospin and so would have similar observable effects to a disoriented chiral condensate which various authors have suggested might be a signal of the chiral phase transition. The mechanism for amplification of the pion field found here does not rely on this phase transition and is better thought of as a “pion laser” which is driven by large oscillations of the σ field. [S0556-2821(97)04411-1] [Phys. Rev. D **55**, 6887 (1997)]

Disoriented chiral condensate formation from a state with collective pion fields. Tamás S. Biró, *MTA KFKI RMKI Theory Division, H-1525 Budapest Pf. 49, Hungary*; Dénes Molnár, Zhonghan Feng, and László P. Csernai, *Department of Physics, University of Bergen, N-5007 Bergen, Allégaten 55, Norway*. (Received 10 June 1996; revised manuscript received 11 February 1997)

At high temperatures it is believed that one can create a highly excited state, the starting point of disoriented chiral condensate (DCC) formation, which is sitting at the top of a potential barrier. We study here instead the evolution of a state where energy is stored initially in the collective motion too, in particular, in chiral

rotations representing collective pion fields. We simulate the creation of such an initial state by letting the hot system evolve in time without cooling. It covers the microcanonically allowed phase space if the classical dynamics of the system is chaotic. We find the collective field dynamics chaotic in the linear σ model coupled to quarks with explicit symmetry breaking. A rapid linear expansion from such initial states leads eventually to DCC formation. [S0556-2821(97)01111-9] [Phys. Rev. D **55**, 6900 (1997)]

Polarized nucleon structure functions within a chiral soliton model. H. Weigel, L. Gamberg and H. Reinhardt, *Institute for Theoretical Physics, Tübingen University, Auf der Morgenstelle 14, D-72076 Tübingen, Germany*. (Received 3 September 1996; revised manuscript received 17 January 1997)

We study polarized-spin structure functions of the nucleon within the bosonized Nambu–Jona-Lasinio model where the nucleon emerges as a chiral soliton. We present the electromagnetic polarized structure functions $g_1(x)$ and $g_2(x)$ for ep scattering and discuss various sum rules in the valence quark approximation. This approximation is justified because in this model axial properties of the nucleon are dominated by their valence quark contributions. We find that these structure functions are well localized in the interval $0 \leq x \leq 1$. We compare the model predictions on the polarized structure functions with data from the E143 experiment by evolving them from the scale characteristic of the NJL model to the scale of the data. Additionally, a comparison is made with parametrized data at a momentum scale commensurate with the model calculation. [S0556-2821(97)05611-7] [Phys. Rev. D **55**, 6910 (1997)]

Photoproduction off nuclei and pointlike photon interactions. I. Cross sections and nuclear shadowing. R. Engel, *Universität Leipzig, Fachbereich Physik, D-04109 Leipzig, Germany and Universität Siegen, Fachbereich Physik, D-57068 Siegen, Germany*; J. Ranft, *Departamento de Física de Partículas, Universidade de Santiago de Compostela, E-15706 Santiago de Compostela, Spain*; S. Roesler, *Universität Siegen, Fachbereich Physik, D-57068 Siegen, Germany*. (Received 9 October 1996)

High energy photoproduction off nuclear targets is studied within the Glauber-Gribov approximation. The photon is assumed to interact as a $q\bar{q}$ system according to the generalized vector dominance model and as a “bare photon” in direct scattering processes with target nucleons. We calculate total cross sections for interactions of photons with nuclei taking into account coherence length effects and pointlike interactions of the photon. Results are compared to data on photon-nucleus cross sections, nuclear shadowing, and quasielastic ρ production. Extrapolations of cross sections and of the shadowing behavior to high energies are given. [S0556-2821(97)06511-9] [Phys. Rev. D **55**, 6957 (1997)]

Nucleon decay in a realistic SO(10) SUSY GUT. Vincent Lucas and Stuart Raby, *Department of Physics, The Ohio State University, 174 W. 18th Ave., Columbus, Ohio 43210*. (Received 11 October 1996)

In this paper, we calculate neutron and proton decay rates and branching ratios in a predictive SO(10) SUSY GUT which agrees well with low energy data. We show that the nucleon lifetimes are consistent with the experimental bounds. The nucleon decay rates are calculated using all one-loop chargino and gluino-dressed diagrams regardless of their chiral structure. We show that the four-fermion operator $C_{jk}(u_R d_{jR})(d_{kL} \nu_{\tau L})$, commonly neglected in previous nucleon decay calculations, not only contributes significantly to nucleon decay, but, for many values of the initial GUT parameters and for large $\tan \beta$, actually dominates the decay rate. As a consequence, we find that τ_p/τ_n is often substantially larger than the prediction obtained in small $\tan \beta$ models. We also find that gluino-dressed diagrams, often neglected in nucleon decay calculations, contribute significantly to nucleon decay. In addition we find that the branching ratios obtained from this realistic SO(10) SUSY GUT differ significantly from the predictions obtained from “generic” SU(5) SUSY GUT’s. Thus, nucleon decay branching ratios, when observed, can be used to test theories of fermion masses. [S0556-2821(97)06209-7] [Phys. Rev. D **55**, 6986 (1997)]

Deeply virtual Compton scattering. Xiangdong Ji, *Department of Physics, University of Maryland, College Park, Maryland 20742; Center for Theoretical Physics, Laboratory for Nuclear Science, and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139; and Institute for Nuclear Theory, University of Washington, Seattle, Washington 98195*. (Received 22 October 1996)

We study in QCD the physics of deeply virtual Compton scattering (DVCS)—the virtual Compton process in the large s and small t kinematic region. We show that DVCS can probe a new type of off-forward parton distributions. We derive an Altarelli-Parisi-type of evolution equations for these distributions. We also derive their sum rules in terms of nucleon form factors of the twist-two quark and gluon operators. In particular, we find that the second sum rule is related to fractions of the nucleon spin carried separately by quarks and gluons. We estimate the cross section for DVCS and compare it with the accompanying Bethe-Heitler process at CEBAF and HERMES kinematics. [S0556-2821(97)00811-4] [Phys. Rev. D **55**, 7114 (1997)]

Effective vector-boson approximation applied to hadron-hadron collisions. I. Kuss, *Fakultät für Physik, Universität Bielefeld, Postfach 10 01 31, D-33501 Bielefeld, Germany*. (Received 27 August 1996)

An improved effective vector-boson approximation is applied to hadron-hadron collisions. The effective vector-boson approximation in this form is accurate enough to reproduce the result of a complete perturbative calculation for the specific example of ZZ production within 10%. This is true even far away from a possible Higgs boson resonance and thus in a region where the transverse intermediate vector bosons give the dominant contribution. Simple approximate formulas which greatly reduce the calculational effort are derived. The full information about the kinematics is, however, lost in these approximations. A comparison between the improved, the approximate, and existing formulations is presented. [S0556-2821(97)03109-3] [Phys. Rev. D **55**, 7165 (1997)]

Independent domains of disoriented chiral condensate. Q. H. Zhang, *Institut für Thoretisch Physik, Universität Regensburg, D-93040 Regensburg, Germany*; X. Q. Li, *China Center of Advanced Science and Technology (World Laboratory), P.O. Box 8730, Beijing 100080, People's Republic of China and Physics Department, Nankai University, Tianjing 300071, People's Republic of China.* (Received 3 January 1997)

The probability distribution of a neutral pion fraction from independent domains of disoriented chiral condensate is characterized. The signal for the condensate is still clear for a large number of independent domains if one of them is predominant. [S0556-2821(97)04011-3] [Phys. Rev. D **55**, 7302 (1997)]

Production of η mesons in double Pomeron exchange. Alec J. Schramm and Daniel H. Reeves, *Department of Physics, Occidental College, Los Angeles, California 90041.* (Received 15 November 1996)

We estimate the production cross section for η_c and η_b mesons via Pomeron-Pomeron fusion in peripheral heavy-ion collisions. Total and elastic $\mathcal{PP}$ cross sections are calculated in an equivalent Pomeron approximation. [S0556-2821(97)04211-2] [Phys. Rev. D **55**, 7312 (1997)]