

Selected Abstracts from Other Physical Review Journals

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Heavy nuclei at the end of the cosmic-ray spectrum? L. A. Anchordoqui, *Departamento de Física, Universidad Nacional de La Plata, C.C. 67, 1900 La Plata, Argentina*; G. E. Romero and J. A. Combi, *Instituto Argentino de Radioastronomía, C.C. 5, 1894 Villa Elisa, Argentina*. (Received 10 March 1999; published 25 October 1999)

We provide an account of the possible acceleration of iron nuclei up to energies ~ 300 EeV in the nearby, metal-rich starburst galaxy NGC 253. It is suggested that particles can escape from the nuclear region with energies of $\sim 10^{15}$ eV and can then be reaccelerated at the terminal shock of the galactic superwind generated by the starburst, avoiding the photodisintegration expected if the nuclei were accelerated in the central region of high photon density. We have also made estimates of the expected arrival spectrum, which displays a strong dependence on the energy cutoff at the source. [S0556-2821(99)03020-9] [Phys. Rev. D **60**, 103001 (1999)]

Describing a_1 and b_1 decays. J. C. R. Bloch,¹ Yu. L. Kalinovsky,² C. D. Roberts,¹ and S. M. Schmidt,¹ ¹*Physics Division, Building 203, Argonne National Laboratory, Argonne, Illinois 60439-4843* ²*Laboratory of Computing Techniques and Automation, Joint Institute for Nuclear Research, 141980 Dubna, Russia*. (Received 14 June 1999; published 25 October 1999)

Two-body pion-radiating and weak decays of light axial-vector mesons and the ρ are studied as an application of the Dyson-Schwinger equations. Models based on the rainbow-ladder truncation are capable of providing a good description, and yield the correct sign and magnitude of the $a_1 \rightarrow \rho\pi$ and $b_1 \rightarrow \omega\pi$ D/S ratios, with no additional mechanism necessary. [S0556-2821(99)50321-4] [Phys. Rev. D **60**, 111502 (1999)]

Signatures of the efficiency of solar nuclear reactions in the neutrino experiments. H. Schlattl,¹ A. Bonanno,^{2,3} and L. Paternò,² ¹*Max-Planck-Institut für Astrophysik, Karl-Schwarzschild-Strasse 1, 85740 Garching, Germany* ²*Istituto di Astronomia dell'Università, Viale A. Doria 6, 95125 Catania, Italy* ³*INFN, Sezione di Catania, Corso Italia 57, 95128 Catania, Italy*. (Received 19 February 1999; published 2 November 1999)

In the framework of the neutrino oscillation scenario, we discuss the influence of the uncertainty on the efficiency of the neutrino emitting reactions $^1\text{H}(p, e^+ \nu_e)^2\text{H}$ and $^7\text{Be}(p, \gamma)^8\text{B}$ for the neutrino oscillation parameters. We consider solar models with zero-energy astrophysical S factors S_{11} and S_{17} varied within nuclear physics uncertainties, and we test them by means of helioseismic data. We then analyze the neutrino mixing parameters and recoil electron spectra for the presently operating neutrino experiments and predict

the results which can be obtained from the recoil electron spectra in Sudbury Neutrino Observatory and Borexino experiments. We suggest that it should be possible to determine tight bounds to S_{17} from the results of the future neutrino experiment, in the case of matter-enhanced oscillations of active neutrinos.

[S0556-2821(99)00821-8] [Phys. Rev. D **60**, 113002 (1999)]

Bimaximal mixing from the leptonic new texture for triangular mass matrices. H. B. Benaoum, *Institut für Physik, Theoretische Elementarteilchenphysik, Johannes Gutenberg-Universität, D-55099 Mainz, Germany*; S. Nasri, *Department of Physics, Syracuse University, Syracuse, New York 13244-1130*. (Received 4 June 1999; published 2 November 1999)

An analysis of the leptonic texture of the new triangular mass matrices is carried out. In particular, it is shown that both bimaximal and nearly bimaximal solutions for solar and atmospheric neutrino anomalies can be generated within this pattern. We have also derived an exact and compact parametrization of the leptonic mixing matrix in terms of the lepton masses and the parameters α , β' , and δ . Consistency with the CHOOZ reactor result for V_{m13} and a small Jarlskog's invariant parameter are obtained.

[S0556-2821(99)00523-8] [Phys. Rev. D **60**, 113003 (1999)]

Flux tube zero-point motion, hadronic charge radii, and hybrid meson production cross sections. Nathan Isgur, *Jefferson Lab, 12000 Jefferson Avenue, Newport News, Virginia 23606*. (Received 28 May 1999; published 5 November 1999)

Flux tube zero-point motion produces quark displacements transverse to the flux tube which make significant contributions to hadronic charge radii. In heavy quark systems, these contributions can be related by Bjorken's sum rule to the rates for semileptonic decay to hybrid mesons. This connection can be generalized to other leptonproduction processes, where transverse contributions to elastic form factor slopes are related to the cross sections for the production of the associated hybrid states. I identify the flux tube overlap integral responsible for these effects as the strong QCD analogue of the Sudakov form factor of perturbative QCD.

[S0556-2821(99)05121-8] [Phys. Rev. D **60**, 114016 (1999)]

Skewed and double distributions in the pion and the nucleon. M. V. Polyakov and C. Weiss *Institut für Theoretische Physik II, Ruhr-Universität Bochum, D-44780 Bochum, Germany*. (Received 29 April 1999; published 5 November 1999)

We study the non-forward matrix elements of twist-2 QCD light-ray operators and their representations in terms of skewed and double distributions, considering the pion as well as the nucleon. We point out the importance of explicitly including all twist-2 structures in the double distribution representation, which naturally leads to a “two-component” structure of the skewed distribution, with different contributions in the regions $|X| > \xi/2$ and $|X| < \xi/2$. We compute the skewed and double quark distributions in the pion at a low normalization point in the effective chiral theory based on the instanton vacuum. Also, we derive the crossing relations expressing the skewed quark distribution in the pion through the distribution amplitude for two-pion production. Measurement of the latter in two-pion production in $\gamma^* \gamma$ and $\gamma^* N$ reactions could provide direct information about the skewed as well as the usual quark-antiquark distribution in the pion. [S0556-2821(99)00423-3] [Phys. Rev. D **60**, 114017 (1999)]

Event-by-event fluctuations in heavy ion collisions and the QCD critical point. M. Stephanov, *Institute for Theoretical Physics, State University of New York, Stony Brook, New York 11794-3840*; K. Rajagopal, *Center for Theoretical Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139*; E. Shuryak, *Department of Physics and Astronomy, State University of New York, Stony Brook, New York 11794-3800*. (Received 23 March 1999; published 10 November 1999)

The event-by-event fluctuations of suitably chosen observables in heavy ion collisions at CERN SPS, BNL RHIC, and CERN LHC can tell us about the thermodynamic properties of the hadronic system at freeze-out. By studying these fluctuations as a function of varying control parameters, it is possible to learn much about the phase diagram of QCD. As a timely example, we stress the methods by which present experiments at the CERN SPS can locate the second-order critical end point of the first-order transition between quark-gluon plasma and hadron matter. Those event-by-event signatures which are characteristic of freeze-out in the vicinity of the critical point will exhibit nonmonotonic dependence on control parameters. We focus on observables constructed from the multiplicity and transverse momenta of charged pions. We first consider how the event-by-event fluctuations of such observables are affected by Bose-Einstein correlations, by resonances which decay after freeze-out, and by fluctuations in the transverse flow velocity. We compare our thermodynamic predictions for such noncritical event-by-event fluctuations with NA49 data, finding broad agreement. We then focus on effects due to thermal contact between the observed pions and a heat bath with a given (possibly singular) specific heat, due to the direct coupling between the critical fluctuations of the sigma field and the observed pions. We also discuss the effect of the pions produced in the decay of sigma particles just above threshold after freeze-out on the inclusive pion spectrum and on multiplicity fluctuations. We estimate the size of these nonmonotonic effects, which appear near the critical point, including restrictions imposed by finite size and finite time, and conclude that they should be easily observable. [S0556-2821(99)04121-1] [Phys. Rev. D **60**, 114028 (1999)]

Hadronic atoms and effective interactions. Barry R. Holstein, *Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01003*. (Received 8 January 1999; published 11 November 1999)

We examine the problem of hadronic atom energy shifts using the technique of effective interactions and demonstrate the equivalence with the conventional quantum mechanical approach. [S0556-2821(99)05921-4] [Phys. Rev. D **60**, 114030 (1999)]

Does the gluon spin contribute in a gauge-invariant way to nucleon spin? Pervez Hoodbhoy and Xiangdong Ji, *Department of Physics, University of Maryland, College Park, Maryland 20742*. (Received 12 August 1999; published 12 November 1999)

Although the matrix element of the gluon spin operator in nucleon helicity states is known to be independent of some special choices of gauge, we show that it is not invariant under a general gauge transformation. We find that there exists a simple means of obtaining the matrix element in a different choice of gauge from a calculation made in one specific gauge. Similar conclusions hold for other manifestly gauge-dependent operators present in the QCD angular momentum operator. [S0556-2821(99)05123-1] [Phys. Rev. D **60**, 114042 (1999)]

Real time dynamics of colliding gauge fields and the “glue burst”. W. Pöschl and B. Müller, *Department of Physics, Duke University, Durham, North Carolina 27708-0305*. (Received 22 December 1998; published 3 November 1999)

The Yang-Mills equations provide a classical mean field description of gauge fields. In view of developing a coherent description of the formation of the quark gluon plasma in high energetic nucleus-nucleus collisions we study pure gauge field dynamics in 3+1 dimensions. In collisions of wave packets, numerically simulated on a SU(2) gauge lattice, we study transverse and longitudinal energy currents. For wave packets with different polarizations in color space, we observe a time-delayed fragmentation after the collision resulting in a rapid expansion into transverse directions. We call this phenomenon the “glue burst.” An analysis of the Yang-Mills equations reveals the explanation for this behavior. It is pointed out that this effect could play a role in ultrarelativistic heavy-ion collisions. [S0556-2821(99)00521-4] [Phys. Rev. D **60**, 114505 (1999)]

Grand unified theory constrained supersymmetry and neutrinoless double β decay. Andrzej Wodecki and Wiesław A. Kamiński, *Department of Theoretical Physics, Maria Curie-Skłodowska University, PL-20 031 Lublin, Poland*; Fedor Simkovic, *Department of Nuclear Physics, Comenius University, Mlynská dolina F1, SK-842 15 Bratislava, Slovakia*. (Received 4 March 1999; published 5 November 1999)

We analyze the contributions to the neutrinoless double β decay ($0\nu\beta\beta$ decay) coming from the grand unified theory (GUT) constrained minimal supersymmetric standard model (MSSM) with tri-

linear R -parity breaking. We discuss the importance of two-nucleon and pion-exchange realizations of the quark-level $0\nu\beta\beta$ -decay transitions. In this context, the questions of reliability of the calculated relevant nuclear matrix elements within the renormalized quasiparticle random phase approximation for several medium and heavy open-shell nuclei are addressed. The importance of gluino and neutralino contributions to $0\nu\beta\beta$ decay is also analyzed. We review the present experiments and deduce limits on the trilinear R -parity breaking parameter λ'_{111} from the nonobservability of $0\nu\beta\beta$ decay for different GUT constrained supersymmetry scenarios. In addition, a detailed study of limits on the MSSM parameter space coming from the $B \rightarrow X_s \gamma$ processes by using the recent CLEO and OPAL results is performed. Some studies in respect to the future $0\nu\beta\beta$ -decay project GENIUS are also presented. [S0556-2821(99)02819-2] [Phys. Rev. D **60**, 115007 (1999)]

Erratum: Cross sections for the production of high-mass muon pairs from 800 GeV proton bombardment of ^2H [Phys. Rev. D **50**, 3038 (1994)]. P. L. McGaughey, J. M. Moss, D. M. Alde, H. W. Baer, T. A. Carey, G. T. Garvey, A. Klein, C. Lee, M. J. Leitch, J. Lillberg, C. S. Mishra, C. N. Brown, W. E. Cooper, Y. B. Hsiung, M. R. Adams, R. Guo, D. M. Kaplan, R. L. McCarthy, G. Danner, M. Wang, M. Barlett, and G. Hoffmann (Received 21 July 1999; published 25 October 1999) [S0556-2821(99)05421-1] [Phys. Rev. D **60**, 119903 (1999)]

Dynamical viscosity of nucleating bubbles. S. Alamoudi,¹ D. G. Barci,² D. Boyanovsky,¹ C. A. A. de Carvalho,³ E. S. Fraga,³ S. E. Jorás,³ and F. I. Takakura,⁴ ¹Department of Physics and Astronomy, University of Pittsburgh, Pittsburgh, Pennsylvania 15260 ²Instituto de Física, Universidade Estadual do Rio de Janeiro, Rio de Janeiro, RJ, 20559-900, Brazil ³Instituto de Física, Universidade Federal do Rio de Janeiro, C.P. 68528, Rio de Janeiro, RJ, 21945-970 Brazil ⁴Departamento de Física, Instituto de Ciências Exatas, Universidade Federal de Juiz de Fora, Juiz de Fora, MG, 36036-330, Brazil. (Received 19 April 1999; published 1 November 1999)

We study the viscosity corrections to the growth rate of nucleating bubbles in a slightly supercooled first order phase transition in (1+1)- and (3+1)-dimensional scalar field theory. We propose a *microscopic* approach that leads to the nonequilibrium equation of motion of the coordinate that describes small departures from the critical bubble and allows us to extract the growth rate consistently in a weak coupling expansion and in the thin wall limit. Viscosity effects arise from the interaction of this coordinate with the stable quantum and thermal fluctuations around a critical bubble. In the case of 1+1 dimensions we provide an estimate for the growth rate that depends on the details of the free energy functional. In 3+1 dimensions we recognize robust features that are a direct consequence of the thin wall approximation that transcend a particular model. These are long-wavelength hydrodynamic fluctuations that describe surface waves. We identify these low energy modes with quasi Goldstone modes which are related to surface waves on interfaces in phase ordered Ising-like systems. In the thin wall limit the coupling of this coordinate to these hydrodynamic modes results in the largest contribution to the viscosity corrections to the growth rate. For a ϕ^4 scalar field theory at temperature $T < T_c$, the growth rate to lowest order in the quartic self-coupling λ is $\Omega = (\sqrt{2}/R_c) [1 - 0.003\lambda T \xi (R_c/\xi)^2]$ with R_c, ξ the critical radius and the width of the bubble wall, respectively. We obtain the effective non-Markovian Langevin equation for the radial coordinate and derive the generalized fluctuation dissipation relation. The noise is correlated on time scales Ω^{-1} as a result of the coupling to the slow hydrodynamic modes. We discuss the applicability of our results to describe the growth rate of hadron bubbles in a quark-hadron first order transition. [S0556-2821(99)07120-9] [Phys. Rev. D **60**, 125003 (1999)]

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