Selected Abstracts from Other Physical Review Journals

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Observation of the shadowing of cosmic rays by the Moon using a deep underground detector. M. Ambrosio,[12] R. Antolini,[7] C. Aramo,[7] G. Auriemma,[14] A. Baldini,[13] G. C. Barbarino,[12] B. C. Barish,[4] G. Battistoni,[6,] R. Bellotti,[1] C. Bemporad,[13] P. Bernardini,[10] H. Bilokon,[6] V. Bisi,[16] C. Bloise,[6] C. Bower,[8] S. Bussino,[14] F. Cafagna,[1] M. Calicchio,[1] D. Campana,[12] M. Carboni,[6] M. Castellano,[1] S. Cecchini,[2] F. Cei,[11,13] V. Chiarella,[6] B. C. Choudhary,[4] S. Coutu,[11] L. De Benedictis,[1] G. De Cataldo,[1] H. Dekhissi,[2,17] C. De Marzo,[1] I. De Mitri,[9] J. Derkaoui,[2,17] M. De Vincenzi,[14] A. Di Credico,[7] O. Erriquez,[1] C. Favuzzi,[1] C. Forti,[6] P. Fusco,[1] G. Giacomelli,[2] G. Giannini,[13] N. Giglietto,[1] M. Giorgini,[2] M. Grassi,[13] L. Gray,[4,7] A. Grillo,[7] F. Guarino,[12] P. Guarnaccia,[1] C. Gustavino,[7] A. Habig,[3] K. Hanson,[11] R. Heinz,[8] Y. Huang,[4] E. Iarocci,[6] E. Katsavounidis,[4] E. Kearns,[3] H. Kim,[4] S. Kyriazopoulou,[4] E. Lamanna,[14] C. Lane,[5] D. S. Levin,[11] P. Lipari,[14] N. P. Longley,[4] M. J. Longo,[11] F. Maaroufi,[2,17] G. Mancarella,[10] G. Mandrioli,[2] S. Manzoor,[2] A. Margiotta Neri,[2] A. Marini,[6] D. Martello,[10] A. Marzari-Chiesa,[16] M. N. Mazziotta,[1] C. Mazzotta,[10] D. G. Michael,[4] S. Mikheyev,[4,7] L. Miller,[8] P. Monacelli,[9] T. Montaruli,[1] M. Monteno,[16] S. Mufson,[8] J. Musser,[8] D. Nicoló,[13] C. Orth,[3] G. Osteria,[12] M. Ouchrif,[2,17] O. Palamara,[10] V. Patera,[6] L. Patrizii,[2] R. Pazzi,[13] C. W. Peck,[4] S. Petrera,[9] P. Pistilli,[14] V. Popa,[2] V. Pugliese,[14] A. Rainò,[1] J. Reynoldson,[7] F. Ronga,[6] U. Rubizzo,[12] C. Satriano,[14] L. Satta,[6] E. Scapparone,[7] K. Scholberg,[3] A. Sciubba,[6] P. Serra-Lugaresi,[2] M. Severi,[14] M. Sioli,[2] M. Sitta,[16] P. Spinelli,[1] M. Spinetti,[6] M. Spurio,[2] R. Steinberg,[5] J. L. Stone,[3] L. R. Sulak,[3] A. Surdo,[10] G. Tarlè,[11] V. Togo,[2] D. Ugolotti,[2] M. Vakili,[15] C. W. Walter,[3] and R. Webb,[15] [1]*Dipartimento di Fisica dell'Università di Bari and INFN, 70126 Bari, Italy* [2]*Dipartimento di Fisica dell'Università di Bologna and INFN, 40126 Bologna, Italy* [3]*Physics Department, Boston University, Boston, Massachusetts 02215* [4]*California Institute of Technology, Pasadena, California 91125* [5]*Department of Physics, Drexel University, Philadelphia, Pennsylvania 19104* [6]*Laboratori Nazionali di Frascati dell'INFN, 00044 Frascati (Roma), Italy* [7]*Laboratori Nazionali del Gran Sasso dell'INFN, 67010 Assergi (L'Aquila), Italy* [8]*Department of Physics and Department of Astronomy, Indiana University, Bloomington, Indiana 47405* [9]*Dipartimento di Fisica dell'Università dell'Aquila and INFN, 67100 L'Aquila, Italy* [10]*Dipartimento di Fisica dell'Università di Lecce and INFN, 73100 Lecce, Italy* [11]*Department of Physics, University of Michigan, Ann Arbor, Michigan 48109* [12]*Dipartimento di Fisica dell'Università di Napoli and INFN, 80125 Napoli, Italy* [13]*Dipartimento di Fisica dell'Università di Pisa and INFN, 56010 Pisa, Italy* [14]*Dipartimento di Fisica dell'Università di Roma ''La Sapienza'' and INFN, 00185 Roma, Italy* [15]*Physics Department, Texas A&M University, College Station, Texas 77843* [16]*Dipartimento di Fisica Sperimentale dell'Università di Torino and INFN, 10125 Torino, Italy* [17]*Also at Faculty of Sciences, University Mohamed I, B.P. 424 Oujda, Morocco* (MACRO Collaboration). (Received 11 June 1998; published 20 November 1998)

Using data collected by the MACRO experiment during the years 1989–1996, we show evidence for the shadow of the Moon in the underground cosmic ray flux with a significance of 3.6σ. This detection of the shadowing effect is the first by an underground detector. A maximum-likelihood analysis is used to determine that the angular resolution of the apparatus is $0.9° \pm 0.3°$. These results demonstrate MACRO's capabilities as a muon telescope by confirming its absolute pointing ability and quantifying its angular resolution. [S0556-2821(98)04723-7] [Phys. Rev. D **59**, 012003 (1998)]

Solar neutrino interactions: Using charged currents at SNO to tell neutral currents at Super-Kamiokande. F. L. Villante and G. Fiorentini, *Dipartimento di Fisica and Sezione INFN di Ferrara, Via del Paradiso 12, I-44100 Ferrara, Italy;* E. Lisi, *Dipartimento di Fisica and Sezione INFN di Bari, Via Amendola 173, I-70126 Bari, Italy.* (Received 15 July 1998; published 30 November 1998)

In the presence of flavor oscillations, muon and tau neutrinos can contribute to the Super-Kamiokande (SK) solar neutrino signal through the neutral current process $\nu_{\mu,\tau}e^- \rightarrow \nu_{\mu,\tau}e^-$. We show how to separate the ν_e and $\nu_{\mu,\tau}$ event rates in SK in a model independent way, by using the rate of the charged current process $\nu_e d \rightarrow ppe^-$ from the Sudbury Neutrino Observatory (SNO) experiment, with an appropriate choice of the SK and SNO energy thresholds. Under the additional hypothesis of no oscillations into sterile states, we also show how to determine the absolute ^{8}B neutrino flux from the same data set, independently of the ν_e survival probability.
[S0556-2821(99)03401-3] [Phys. Rev. D **59**, 013006 (1999)]

Neutrino magnetic moments in left-right symmetric models. M. Czakon, J. Gluza, and M. Zrałek, *Department of Field Theory and Particle Physics, Institute of Physics, University of Silesia, Uniwersytecka 4, PL-40-007 Katowice, Poland.* (Received 12 May 1998; published 4 December 1998)

A closer analysis of the neutrino magnetic moment is provided for various instances of the left-right (LR) symmetric model. We show that it is impossible to generate important Dirac neutrino magnetic moments because of model self-consistency problems. Majorana neutrinos are discussed in the frame of the most natural version of the LR model (with left- and right-handed triplets and a bidoublet in the Higgs sector). We consider two limiting $W_L - W_R$ mixing ξ angles. In the case of a maximal value, the obtained transition magnetic moments could be interesting from an experimental point

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of view. On the other hand, a vanishing ξ could make the Higgs particle contributions dominate the gauge boson ones. Thus we calculate gauge-Higgs and Higgs-Higgs diagrams, showing that, contrary to naive expectations, they are smaller than those of the standard model. [S0556-2821(98)02923-3] [Phys. Rev. D **59**, 013010 (1998)]

Field-theoretical approach to coherence in neutrino oscillations. W. Grimus and P. Stockinger, *Institute for Theoretical Physics, University of Vienna, Boltzmanngasse 5, A-1090, Vienna, Austria;* S. Mohanty, *Theory Group, Physical Research Laboratory, Ahmedabad-380 009, India.* (Received 27 July 1998; published 7 December 1998)

We study the conditions for the existence of neutrino oscillations in the field-theoretical approach which combines neutrino production and detection processes in a single Feynman graph. The ''oscillating neutrino'' is represented by an inner line of this graph where, due to the macroscopic distance L between source and detector, the neutrino propagators for neutrinos with definite mass are replaced by the projection operators into the neutrino states on mass shell. We use as a concrete model reaction the neutrino source and detector as given in the LSND experiment and we carefully take into account the finite lifetime of the stopped muons which provide the $\overline{\nu}_\mu$ beam. We show that the field-theoretical approach provides a solid method to locate all possible conditions and allows one to separate unambiguously their different origins. Some of these conditions are independent of L whereas others state that coherence is lost when L exceeds a certain ''coherence length.'' Also it turns out that, at least in the concrete situation considered here, the concept of neutrino wave packets is not supported by the field-theoretical approach for realistic experimental conditions, i.e., the neutrino energy spread is incoherent in origin. [S0556-2821(99)04201-0] [Phys. Rev. D **59**, 013011 (1999)]

Chiral phase transition of QCD at finite temperature and density from the Schwinger-Dyson equation. Masayasu Harada, *Department of Physics and Astronomy, University of North Carolina, Chapel Hill, North Carolina 27599-3255;* Akihiro Shibata, *Computing Research Center, High Energy Accelerator Research Organization (KEK), Tsukuba 305-0181, Japan.* (Received 17 July 1998; published 23 November 1998)

We study the chiral phase transition of QCD at finite temperature and density by numerically solving the Schwinger-Dyson equation for the quark propagator with the improved ladder approximation in the Landau gauge. Using the solution we calculate a pion decay constant from a generalized version of the Pagels-Stokar formula. The chiral phase transition point is determined by analyzing an effective potential for the quark propagator. We find solutions for which chiral symmetry is broken while the value of the effective potential is larger than that for the chiral symmetric vacuum. These solutions correspond to metastable states, and the chiral symmetric vacuum is energetically favored. We present a phase diagram on the general temperature-chemical potential plane, and show that phase transitions are of first order in wide range.
[S0556-2821(98)04923-6] [Phys. Rev. D **59**, 014010 (1998)]

Quark orbital-angular-momentum distribution in the nucleon. Pervez Hoodbhoy, Xiangdong Ji, and Wei Lu, *Department of Physics, University of Maryland, College Park, Maryland 20742.* (Received 12 August 1998; published 25 November 1998)

We introduce gauge-invariant quark and gluon angular momentum distributions after making a generalization of the angular momentum density operators. From the quark angular momentum distribution, we define the gauge-invariant and leading-twist quark *orbital* angular momentum distribution $L_q(x)$. The latter can be extracted from data on the polarized and unpolarized quark distributions and the off-forward distribution $E(x)$ in the forward limit. We comment upon the evolution equations obeyed by this as well as other orbital distributions considered in the literature. [S0556-2821(99)02501-1] [Phys. Rev. D **59**, 014013 (1999)]

Inelasticity in hadron-nucleus collisions from emulsion chamber studies. G. Wilk, *The Andrzej Sołtan Institute for Nuclear Studies, Hoża 69; 00-689 Warsaw, Poland;* Z. Włodarczyk, *Institute of Physics, Pedagogical University, Konopnickiej 15, 25-405 Kielce, Poland.* (Received 10 March 1998; published 3 December 1998)

The inelasticity of hadron-carbon nucleus collisions in the energy region exceeding 100 TeV is estimated from the carbon-emulsion chamber data at Pamirs to be $\langle K_C \rangle = 0.65 \pm 0.08$. When combined with the recently presented data on hadron-lead nucleus collisions taken at the same energy range it results in the $K \sim A^{0.086}$ mass number dependence of inelasticity. The evaluated partial inelasticity for secondary ($\nu > 1$) interactions, $K_{\nu>1} \simeq 0.2$, suggests that the second and higher interactions of the excited hadron inside the nucleus proceed with only slight energy losses.
[S0556-2821(99)00301-X] [Phys. Rev. D **59**, 014025 (1999)]

Δ isobar masses, large N_c relations, and the quark model. Simon Capstick, *Department of Physics and Supercomputer Computations Research Institute, Florida State University, Tallahassee, Florida 32306;* Ron Workman, *Department of Physics, Virginia Tech, Blacksburg, Virginia 24061.* (Received 9 July 1998; revised manuscript received 24 August 1998; published 8 December 1998)

Motivated by recent remarks on the Δ^+ mass and comparisons between the quark model and relations based on large-N_c with perturbative flavor breaking, two sets of Δ masses consistent with these constraints are constructed. These two sets, based either on an experimentally determined mass splitting or a quark model of isospin symmetry breaking, are shown to be inconsistent. The model dependence of this inconsistency is examined, and suggestions for improved experiments are made. An explicit quark model calculation and mass relations based on the large-N_c limit with perturbative flavor breaking are compared. The expected level of accuracy of such relations is realized in the quark model, except for mass relations derived by combining others which correspond to different SU(6) representations. It is shown that the Δ^0 and Δ^{++} pole masses and $\Delta^0 - \Delta^+ = (\Delta^- - \Delta^{++})/3 \simeq 1.5$ MeV are more consistent with model expectations than the analogous Breit-Wigner masses and their splittings. [S0556-2821(99)02301-2] [Phys. Rev. D **59**, 014032 (1999)]

Dynamics of light antiquarks in the proton. W. Melnitchouk, *Institut für Kernphysik, Forschungszentrum Jülich, D-52425 Jülich, Germany;* J. Speth, *Institut für Kernphysik, Forschungszentrum Jülich, D-52425 Jülich, Germany;* A. W. Thomas, *Department of Physics and Mathematical Physics, and Special Research Centre for the Subatomic Structure of Matter, University of Adelaide, Adelaide 5005, Australia.* (Received 4 June 1998; published 8 December 1998)

We present a comprehensive analysis of the recent data from the E866 experiment at Fermilab on Drell-Yan production in pD and pp collisions, which indicates a non-trivial x dependence for the asymmetry between $\bar{u}$ and $\bar{d}$ quark distributions in the proton. The relatively fast decrease of the asymmetry at large x suggests the important role played by the chiral structure of the nucleon, in particular the πN and $\pi\Delta$ components of the nucleon wave function. At small x the data require an additional non-chiral component, which may be attributed to the Pauli exclusion principle, as first suggested by Field and Feynman. [S0556-2821(99)05701-X] [Phys. Rev. D **59**, 014033 (1999)]

Supernova neutrino oscillations: Adiabaticity improvement by Majoron fields. Luís Bento, *Centro de Física Nuclear da Universidade de Lisboa, Avenida Prof. Gama Pinto 2, 1699 Lisboa-codex, Portugal.* (Received 8 June 1998; published 7 December 1998)

If the lepton numbers are associated with global symmetries spontaneously broken at a scale below 1 TeV, neutrino oscillations in supernovae produce classic Majoron fields that perturb the neutrino propagation itself and may change the oscillation patterns in the periods of largest ν fluxes. The impact of the Majoron fields on the same transitions as $\nu_e \rightarrow \nu_X$ that presumably occur in the Sun is studied in the case of the nonadiabatic MSW solution. It is shown how the back reaction of the Majoron fields may improve the adiabaticity of these oscillations in a supernova environment which has implications on the outgoing ν_e spectrum.
[S0556-2821(99)01101-7] [Phys. Rev. D **59**, 015013 (1999)]

Vacuum neutrino oscillations of solar neutrinos and lepton mass matrices. Morimitsu Tanimoto, *Science Education Laboratory, Ehime University, 790-8577 Matsuyama, Japan.* (Received 8 July 1998; published 11 December 1998)

We consider the case that the solar neutrino deficit is due to vacuum oscillations. The lepton mass matrices with nearly bimaximal mixings are needed in order to explain both the solar and atmospheric neutrino deficit. A texture with the symmetry of flavor democracy or S_3 has been investigated by taking account of the symmetry breaking terms of the charged lepton mass matrix. It is found that predicted mixings can be considerably changed from the neutrino mixings $\sin^2 2\theta_{\odot} \simeq 1$ and $\sin^2 2\theta_{\rm atm} \simeq 8/9$ at the symmetric limit. The correlation between $|U_{e3}|$ and $|U_{e1}U_{e2}^*|$ is also presented. The test of the model is discussed by focusing on the three flavor analyses in the solar neutrinos, atmospheric neutrinos, and long baseline experiments.
[S0556-2821(99)07501-3] [Phys. Rev. D **59**, 017304 (1999)]