

Selected Abstracts from Other Physical Review Journals

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Magneto-optical trapping of radioactive ^{82}Rb atoms. R. Guckert,^{1,2} X. Zhao,¹ S. G. Crane,^{1,3} A. Hime,¹ W. A. Taylor,¹ D. Tupa,¹ D. J. Vieira,¹ and H. Wollnik,^{1,2} ¹*Los Alamos National Laboratory, Los Alamos, New Mexico 87545* ²*II. Physikalisches Institut, Justus-Liebig-Universität Giessen, 35392 Giessen, Germany* ³*Physics Department, Utah State University, Logan, Utah 84322.* (Received 10 December 1997)

We report the successful trapping of 6×10^6 ^{82}Rb ($t_{1/2} = 75$ s) atoms with a trap lifetime of ~ 30 s in a magneto-optical trap that is coupled to an off-line mass separator. Efficient sample introduction is achieved by implanting ^{82}Rb ions into a small yttrium catcher foil located inside the trapping cell. Upon heating, the radioactive atoms are released from the foil and trapped without significant gas loading. This advancement makes a variety of high-precision electroweak interaction experiments possible, including the measurement of β -decay correlations associated with spin-polarized ^{82}Rb nuclei. [S1050-2947(98)50309-5] [*Phys. Rev. A* **58**, 1637 (1998)]

Influence of the left-handed part of the neutrino mass matrix on the lepton number violating $e^-e^- \rightarrow W^-W^-$ process. P. Duka, J. Gluza, and M. Zralek, *Department of Field Theory and Particle Physics, Institute of Physics, University of Silesia, Uniwersytecka 4, PL-40-007 Katowice, Poland.* (Received 5 February 1998; published 6 August 1998)

The influence of the neutrino mass submatrix M_L on the $e^-e^- \rightarrow W^-W^-$ process is discussed. Taking into account various possible CP signatures of heavy neutrinos it is shown that, in some cases, a nonzero M_L substantially changes predictions for maximum possible values of the $e^-e^- \rightarrow W^-W^-$ cross section. The direct role of the ω^2 parameter (coming from neutrinoless double-beta decay) is clarified. The consequences of doubly charged Higgs particles (δ^{--}) with resonances still far away from energies of the future linear lepton collider ($\sqrt{s} = 0.5\text{--}1$ TeV) are studied. [S0556-2821(98)02717-9] [*Phys. Rev. D* **58**, 053009 (1998)]

Helicity-flip off-forward parton distributions of the nucleon. Pervez Hoodbhoy and Xiangdong Ji, *Department of Physics, University of Maryland, College Park, Maryland 20742.* (Received 24 February 1998; published 29 July 1998)

We identify quark and gluon helicity-flip distributions defined between nucleon states of unequal momenta. The evolution of these distributions with a change of renormalization scale is calculated in the leading-logarithmic approximation. The helicity-flip gluon distributions do not mix with any quark distribution and are thus a unique signature of gluons in the nucleon. Their contribution to the generalized virtual Compton process is obtained both in the form of a factorization theorem and an operator product expansion. In

deeply virtual Compton scattering, they can be probed through the distinct angular dependence of the cross section. [S0556-2821(98)04815-2] [*Phys. Rev. D* **58**, 054006 (1998)]

Measuring polarized gluon and quark distributions with meson photoproduction. Andrei Afanasev, *Thomas Jefferson National Accelerator Facility, 12000 Jefferson Avenue, Newport News, Virginia 23606 and Department of Physics, Hampton University, Hampton, Virginia 23668;* Carl E. Carlson and Christian Wahlquist, *Department of Physics, College of William and Mary, Williamsburg, Virginia 23187.* (Received 26 September 1997; published 29 July 1998)

We calculate polarization asymmetries in the photoproduction of high transverse momentum mesons, focusing on charged pions, considering the direct, fragmentation, and resolved photon processes. The results at very high meson momentum measure the polarized quark distributions and are sensitive to differences among the existing models. The results at moderate meson momentum are sensitive to the polarized gluon distribution and can provide a good way to measure it. Suitable data may come as a by-product of deep inelastic experiments to measure g_1 or from dedicated experiments. [S0556-2821(98)05015-2] [*Phys. Rev. D* **58**, 054007 (1998)]

Evidence for a scalar $\kappa(900)$ resonance in πK scattering. Deirdre Black,¹ Amir H. Fariborz,¹ Francesco Sannino,² and Joseph Schechter,¹ ¹*Department of Physics, Syracuse University, Syracuse, New York 13244-1130* ²*Department of Physics, Yale University, New Haven, Connecticut 06520-8120.* (Received 10 April 1998; published 5 August 1998)

Motivated by the $1/N_c$ expansion, we study a simple model in which the πK scattering amplitude is the sum of a *current-algebra* contact term and resonance pole exchanges. This phenomenological model is crossing symmetric and, when a putative light strange scalar meson κ is included, satisfies the unitarity bounds to well above 1 GeV. The model also features chiral dynamics, vector meson dominance and appropriate interference between the established $K_0^*(1430)$ resonance and its predicted background. We briefly discuss the physical significance of the results and directions for further work. [S0556-2821(98)00817-0] [*Phys. Rev. D* **58**, 054012 (1998)]

Chiral odd structure functions from a chiral soliton. L. Gamberg, *Department of Physics and Astronomy, University of Oklahoma, 440 West Brooks Avenue, Norman, Oklahoma 73019-0225;* H. Reinhardt and H. Weigel, *Institute for Theoretical Physics, Tübingen University, Auf der Morgenstelle 14, D-72076 Tübingen, Germany.* (Received 21 January 1998; published 7 August 1998)

We calculate the chiral odd quark distributions and the corresponding structure functions $h_T(x, Q^2)$ and $h_L(x, Q^2)$ within the Nambu–Jona-Lasinio chiral soliton model for the nucleon. The Q^2 evolution of the twist-2 contributions is performed according to the standard GLAP formalism while the twist-3 piece $\bar{h}_L(x)$ is evolved according to the large N_C scheme. We carry out a comparison between the chiral odd structure functions of the proton and the neutron. At the low model scale (Q_0^2) we find that the leading twist effective quark distributions $f_1^{(q)}(x, Q_0^2)$, $g_1^{(q)}(x, Q_0^2)$ and $h_T^{(q)}(x, Q_0^2)$ satisfy Soffer's inequality for both quark flavors $q = u, d$. [S0556-2821(98)02517-X] [Phys. Rev. D **58**, 054014 (1998)]

Almost degenerate neutrinos in a left-right symmetric model with discrete symmetries. Asim K. Ray and Saswati Sarkar, *Department of Physics, Visva-Bharati University, Santiniketan-731235, India*. (Received 18 August 1997; published 6 August 1998)

We obtain almost degenerate Dirac neutrinos of three flavors of mass of a few eV in an $SU(2)_L \times SU(2)_R \times U(1)_{B-L} \times S_3 \times D$ model with appropriate Higgs fields, which can fit the neutrino oscillation solutions to the solar neutrino deficit, combined LSND data, and constraints on the mass of the neutrino as a component in the mixed dark matter model. Presently available data indicating flavor oscillation of atmospheric neutrinos, which are somewhat less reliable, can be reconciled with the model if the parameter $\delta m_{\mu\kappa}^2 = (0.2 - 0.4) \text{ eV}^2$ is an order of magnitude larger than the reported value. [S0556-2821(98)04915-7] [Phys. Rev. D **58**, 055010 (1998)]

New constraints on dispersive form factor parametrizations from the timelike region. W. W. Buck, *The Nuclear/High Energy Physics Research Center, Hampton University, Hampton, Virginia 23668 and The Jefferson Lab, 12000 Jefferson Avenue, Newport News, Virginia 23606*; Richard F. Lebed, *The Jefferson Lab, 12000 Jefferson Avenue, Newport News, Virginia 23606*. (Received 23 February 1998; published 15 July 1998)

We generalize a recent model-independent form factor parametrization derived from rigorous dispersion relations to include constraints from data in the timelike region. These constraints dictate the convergence properties of the parametrization and appear as sum rules on the parameters. We further develop a new parametrization that takes into account finiteness and asymptotic conditions on the form factor, and use it to fit to the elastic π electromagnetic form factor. We find that the existing world sample of timelike data gives only loose bounds on the form factor in the spacelike region, but we explain how the acquisition of additional timelike data and fits to other form factors are expected to give much better results. The same parametrization is seen to fit spacelike data extremely well. [S0556-2821(98)01217-X] [Phys. Rev. D **58**, 056001 (1998)]

Longitudinal distribution of fast charged particles traversing through matter. Takao Nakatsuka, *Okayama Shoka University, Okayama, Japan*. (Received 19 June 1997; published 31 July 1998)

The Yang equation describing the excess-path-length distribution under the multiple Coulomb scattering process is improved to take

into account the continuous energy loss by ionization. The equation gives the simultaneous distribution of the direction of motion, lateral displacement, and longitudinal distribution of fast charged particles traversing through matter. The equation is analytically solved completely in the image space of Laplace transforms and the excess-path-length distributions corresponding to the most general conditions of geometry are obtained by the inverse Laplace transforms, exactly in series expansion or asymptotically through the saddle point method. The distributions after receiving ionization loss are indicated in figures and the effect of including ionization loss is discussed. The means and the variances of the distribution are also tabulated. [S0556-2821(98)02613-7] [Phys. Rev. D **58**, 056002 (1998)]

Lorentz symmetry and the internal structure of the nucleon. Xiangdong Ji, *Department of Physics, University of Maryland, College Park, Maryland 20742*. (Received 3 October 1997; published 31 July 1998)

To investigate the internal structure of the nucleon, it is useful to introduce quantities that do not transform properly under Lorentz symmetry, such as the four-momentum of the quarks in the nucleon, the amount of the nucleon spin contributed by quark spin, etc. In this paper, we discuss to what extent these quantities provide Lorentz-invariant descriptions of the nucleon structure. [S0556-2821(98)06715-0] [Phys. Rev. D **58**, 056003 (1998)]

Finite-size effects on multibody neutrino exchange. A. Abada, *Theory Division, CERN, CH-1211 Geneva 23, Switzerland*; O. Pène, *Laboratoire de Physique Théorique et Hautes Energies, Université de Paris XI, Bâtiment 211, 91405 Orsay Cedex, France*; J. Rodriguez-Quintero, *Departamento de Física Atómica, Molecular y Nuclear, Universidad de Sevilla, P.O. Box 1065, 41080 Sevilla, Spain*. (Received 24 February 1998; published 13 August 1998)

We use an effective Lagrangian to study the multibody massless neutrino exchange inside a finite neutron star. Following Schwinger, we show how the total interaction energy density is computed by comparing the values of the zero-point energy of the neutrino sea with and without the star. Here we extend a previous one-dimensional toy computation by using a three-dimensional spherical model of the star. We find that there is a nonvanishing of the zero-point energy density difference between the inside and the outside due to the refraction index at the stellar boundary and the resulting nonpenetrating waves. This effect is shown analytically and numerically to be the dominant one and to lead to an infrared-safe total energy density, thus confirming that there is no need for the neutrino to be massive. Altogether, the energy due to neutrino exchange is of the order of $10^{-8} - 10^{-13} \text{ GeV}$ per neutron, i.e., negligible with respect to the neutron mass density. [S0556-2821(98)07317-2] [Phys. Rev. D **58**, 073001 (1998)]

Geomagnetic effects on atmospheric neutrinos. Paolo Lipari, *Departimento di Fisica and INFN Università di Roma I, Piazzale A. Moro 2 00185 Rome, Italy*; Todor Stanev and T. K. Gaisser, *Bartol Research Institute University of Delaware, Newark, Delaware 19716*. (Received 9 March 1998; published 19 August 1998)

Geomagnetic effects distort the zenith angle distribution of sub-GeV and few-GeV atmospheric neutrinos, breaking the up-down

symmetry that would be present in the absence of neutrino oscillations and without a geomagnetic field. The geomagnetic effects also produce a characteristic azimuthal dependence of the ν fluxes, related to the well-known east-west effect, that should be detectable in neutrino experiments of sufficiently large mass. We discuss these

effects quantitatively. Because the azimuthal dependence is in first-order independent of any oscillation effect, it is a useful diagnostic tool for studying possible systematic effects in the search for neutrino oscillations. [S0556-2821(98)00917-5] [Phys. Rev. D **58**, 073003 (1998)]