Selected Abstracts from Physical Review D

Abstracts of papers published in **Physical Review D** *which may be of interest to our readers are printed here.*

No crisis for big bang nucleosynthesis. Peter J. Kernan, *Department of Physics, Case Western Reserve University, 10900 Euclid Avenue, Cleveland, Ohio 44106-7079;* Subir Sarkar, *Theoretical Physics, University of Oxford, 1 Keble Road, Oxford OX1 3NP, United Kingdom.* (Received 12 February 1996; revised manuscript received 28 May 1996)

Contrary to a recent claim, the inferred primordial abundances of the light elements are quite consistent with the expectations from standard big bang nucleosynthesis when attention is restricted to direct observations rather than results from chemical evolution models. The number of light neutrino (or equivalent particle) species (N_ν) can be as high as 4.53 if the nucleon-to-photon ratio (η) is at its lower limit of 1.65×10^{-10}, as constrained by the upper bound on the deuterium abundance in high redshift quasar absorption systems. Alternatively, with $N_\nu=3$, η can be as high as 8.90×10^{-10} if the deuterium abundance is bounded from below by its interstellar value. These conclusions follow from the upward revision of the primordial helium abundance inferred from recent observations of blue compact galaxies, using updated atomic physics inputs. [S0556-2821(96)50118-9] [Phys. Rev. D **54**, 3681 (1996)]

New leptoquark mechanism of neutrinoless double β decay. M. Hirsch, H. V. Klapdor-Kleingrothaus, and S. G. Kovalenko, *Max-Planck-Institut für Kernphysik, P.O. 10 39 80, D-69029, Heidelberg, Germany.* (Received 11 March 1996; revised manuscript received 31 May 1996)

A new mechanism for neutrinoless double β ($0\nu\beta\beta$) decay based on leptoquark exchange is discussed. Because of the specific helicity structure of the effective four-fermion interaction this contribution is strongly enhanced compared to the well-known mass mechanism of $0\nu\beta\beta$ decay. As a result the corresponding leptoquark parameters are severely constrained from nonobservation of $0\nu\beta\beta$ decay. These constraints are more stringent than those derived from other experiments. [S0556-2821(96)50119-0] [Phys. Rev. D **54**, 4207 (1996)]

Effects of the quantity σ_{TS} on the spin structure functions of nucleons in the resonance region. Zhenping Li, *Physics Department, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213-3890 and Physics Department, Peking University, Beijing, 100871, People's Republic of China;* Dong Yu-Bing, *China Center of Advanced Science and Technology (World Laboratory), P.O. Box 8730, Beijing 100080, People's Republic of China and Institute of High Energy Physics, Academia Sinica, Beijing 100039, People's Republic of China.* (Received 5 April 1996)

In this paper, we investigate the effects of the quantity σ_{TS} on the spin structure functions of nucleons in the resonance region. The Schwinger sum rule for the spin structure function $g_2(x,Q^2)$ at the real photon limit is derived for the nucleon treated as a composite system, and it provides a crucial constraint on the longitudinal transition operator which has not been treated consistently in the literature. The longitudinal amplitude $S_{1/2}$ is evaluated in the quark model with the transition operator that generates the Schwinger sum rule. The numerical results of the quantity σ_{TS} are presented for both spin structure functions $g_1(x,Q^2)$ and $g_2(x,Q^2)$ in the resonance region. Our results show that this quantity plays an important role in the low Q^2 region, which can be tested in future experiments at CEBAF. [S0556-2821(96)01819-X] [Phys. Rev. D **54**, 4301 (1996)]

Are we really measuring the phase of the nuclear scattering amplitude? M. M. Block, *Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60208.* (Received 3 April 1996)

The interference at small $|t|$ of the Coulomb scattering amplitude f_c and the nuclear amplitude f_n is used to measure the phase of the nuclear scattering amplitude, and, hence, the ρ value, where $\rho\equiv(\mathrm{Re}f_n/\mathrm{Im}f_n)_{t=0}$. The ''normal'' analysis of $\overline{p}p$ and pp elastic scattering uses a ''spinless'' Coulomb amplitude, i.e., a Rutherford amplitude ($2\sqrt{\pi}\alpha/t$) multiplied by a Coulomb form factor $G^2(t)$, an ansatz that pretends that the nucleon does not have any magnetic scattering. In this article, we investigate the role of the anomalous magnetic moment of the nucleon, $\kappa\approx1.79$. Given the method of analysis currently used by most published experiments, we conclude that the current experimentally inferred values of ρ for $\overline{p}p$ should be *systematically lowered* by ≈0.005–0.0100 and, correspondingly, the ρ values for pp should be *systematically raised* by the same amount. We discuss the theoretical uncertainties and a method of experimentally minimizing them. [S0556-2821(96)03919-7] [Phys. Rev. D **54**, 4337 (1996)]

Resonant conversion of massless neutrinos in supernovae. H. Nunokawa, *Instituto de Física Corpuscular - C.S.I.C., Departament de Física Teòrica, Universitat de València, 46100 Burjassot, València, Spain;* Y.-Z. Qian, *Physics Department, 161-33, California Institute of Technology, Pasadena, California 91125;* A. Rossi and J. W. F. Valle, *Instituto de Física Corpuscular - C.S.I.C., Departament de Física Teòrica, Universitat de València, 46100 Burjassot, València, Spain.* (Received 14 May 1996)

It has been noted for a long time that, in some circumstances, *massless* neutrinos may be *mixed* in the leptonic charged current. Conventional neutrino oscillation searches in vacuum are insensitive to this mixing. We discuss the effects of resonant massless-neutrino conversions in the dense medium of a supernova. In particular, we show how the detected $\overline{\nu}_e$ energy spectra from SN

 © 1996 The American Physical Society

1987A and the supernova r-process nucleosynthesis may be used to provide very stringent constraints on the mixing of *massless* neutrinos. [S0556-2821(96)01119-8] [Phys. Rev. D **54**, 4356 (1996)]

Short-baseline neutrino oscillations and $(\beta\beta)_{0\nu}$ decay in schemes with an inverted mass spectrum. S. M. Bilenky, *Joint Institute for Nuclear Research, Dubna, Russia and Institut für Theoretische Physik, Universität Wien, Boltzmanngasse 5, A-1090 Vienna, Austria;* C. Giunti, *INFN, Sezione di Torino, and Dipartimento di Fisica Teorica, Università di Torino, Via P. Giuria 1, I-10125 Torino, Italy;* C. W. Kim, *Department of Physics and Astronomy, The Johns Hopkins University, Baltimore, Maryland 21218 and Department of Physics, Korea Advanced Institute of Science and Technology, Daeduk, Korea;* S. T. Petcov, *Scuola Internazionale Superiore di Studi Avanzati, I-34013 Trieste, Italy and Institute of Nuclear Research and Nuclear Energy, Bulgarian Academy of Sciences, BG-1784 Sofia, Bulgaria.* (Received 23 April 1996)

We have considered short-baseline neutrino oscillations, ^{3}H β decay, and $(\beta\beta)_{0\nu}$ decay in two schemes with an inverted mass spectrum and mixing of three and four massive neutrino fields. We have analyzed the results of the latest experiments on the search for oscillations of terrestrial neutrinos and we have discussed the compatibility of the LSND indication in favor of neutrino oscillations with the results of the other experiments. In the framework of the models under consideration, it is shown that the observation of $(\beta\beta)_{0\nu}$ decay could allow us to obtain information about the CP violation in the lepton sector. [S0556-2821(96)02819-6] [Phys. Rev. D **54**, 4432 (1996)]

Negative-parity nucleon resonance in the QCD sum rule. D. Jido, N. Kodama, and M. Oka, *Department of Physics, Tokyo Institute of Technology, Meguro, Tokyo 152, Japan.* (Received 9 April 1996)

The negative-parity baryons are studied by a novel approach in the QCD sum rule. It is found that the parity of the ground-state nucleon is determined by the sign of the quark condensate. We predict the mass of the negative-parity nucleon. [S0556-2821(96)01719-5] [Phys. Rev. D **54**, 4532 (1996)]

Unitarity, chiral perturbation theory, and meson form factors. Torben Hannah, *Institute of Physics and Astronomy, Aarhus University, DK-8000 Aarhus C, Denmark.* (Received 16 May 1996)

The inverse-amplitude method is applied to the one-loop chiral expansion of the pion, kaon, and K_{l3} form factors. Since these form factors are determined by the same chiral low-energy constants, it is possible to obtain finite predictions for the inverse-amplitude method. It is shown that this method clearly improves one-loop chiral perturbation theory, and a very good agreement between the inverse-amplitude method and the experimental information is obtained. This suggests that the inverse-amplitude method is a rather systematic way of improving chiral perturbation theory. [S0556-2821(96)02619-7] [Phys. Rev. D **54**, 4648 (1996)]

Possibility of searching for heavy neutrinos at accelerators. D. Fargion,[1,5] Maxim Yu. Khlopov,[2,3] Rostislav V. Konoplich,[2,4,5,6] and R. Mignani[4,5] [1]*Dipartimento di Fisica, I Università di Roma ''La Sapienza,'' P.le A.Moro, 2, I-00185 Rome, Italy* [2]*Center for Cosmoparticle Physics ''Cosmion,'' Miusskaya Pl., 4, 125047 Moscow, Russia* [3]*Institute of Applied Mathematics by M. V. Keldysh, Miusskaya Pl., 4, 125047 Moscow, Russia* [4]*Dipartimento di Fisica ''E. Amaldi,'' III Università di Roma, Via della Vasca Navale, 84, I-00146 Roma, Italy* [5]*INFN, Sezione di Roma I, c/o Dipartimento di Fisica, I Università di Roma ''La Sapienza,'' P.le A.Moro 2, I-00185 Roma, Italy* [6]*Moscow Engineering Physics Institute, Kashirskoe sh., 31-114509 Moscow, Russia.* (Received 5 December 1995)

We discuss the possibility of searching for very heavy neutrinos of new generations in accelerator experiments (by the process $e^+e^-\to\nu\overline{\nu}\gamma$), which allow investigation in the region $m_\nu\sim M_Z/2$, where it is difficult to get cosmological constraints on the neutrino mass. [S0556-2821(96)04017-9] [Phys. Rev. D **54**, 4684 (1996)]