Selected Abstracts from Other Physical Review Journals

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High energy neutrinos from astrophysical sources: An upper bound. Eli Waxman and John Bahcall, *Institute for Advanced Study, Princeton, New Jersey 08540.* (Received 10 June 1998; published 14 December 1998)

We show that cosmic-ray observations set a model-independent upper bound of $E_\nu^2\Phi_\nu < 2\times10^{-8}$ GeV/cm^2 s sr to the intensity of high-energy neutrinos produced by photo-meson (or p-p) interactions in sources of size not much larger than the proton photo-meson (or p-p) mean-free-path. This bound applies, in particular, to neutrino production by either AGN jets or GRBs. The upper limit is two orders of magnitude below the intensity predicted in some popular AGN jet models and therefore contradicts the theory that the cosmic gamma-ray background is due to photo-pion interactions in AGN jets. The upper bound is consistent with our predictions from GRB models. The predicted intensity from GRBs is $E^2dN/dE \sim 0.3\times10^{-8}$ GeV/cm^2 s sr for 10^{14} eV$<E<10^{16}$ eV; we also derive the expected intensity at higher energy.
[S0556-2821(99)03902-8] [Phys. Rev. D **59**, 023002 (1999)]

Neutrino sparking and the neutron→strange stars conversion. J. E. Horvath, *Instituto Astronômico e Geofísico, Universidade de São Paulo, Avenida M. Stéfano 4200, Agua Funda, 04301-904 São Paulo, SP Brazil;* H. Vucetich, *Facultad de Ciencias Astronómicas y Geofísicas, Universidad Nacional de La Plata, Paseo del Bosque S/N, 1900 La Plata, Argentina.* (Received 14 July 1998; published 21 December 1998)

We address the production of strangelets inside neutron stars by means of high-energy neutrino interactions (sparking). Requiring that neutron stars remain as such along their lifetimes, we obtain a bound on the probability of a strangelet in the final state and compare it with existing laboratory limits. It turns out that this mechanism is not likely to drive a neutron→strange stars conversion for realistic values of the minimum center-mass-energy necessary to produce the quark-gluon plasma, a necessary precondition for the formation of the strangelet. [S0556-2821(99)01602-1] [Phys. Rev. D **59**, 023003 (1999)]

High statistics search for $\nu_e(\bar{\nu}_e)\rightarrow\nu_\tau(\bar{\nu}_\tau)$ oscillations. D. Naples,[4] A. Romosan,[2] C. G. Arroyo,[2] L. de Barbaro,[5] P. de Barbaro,[7] A. O. Bazarko,[2] R. H. Bernstein,[3] A. Bodek,[7] T. Bolton,[4] H. Budd,[7] J. Conrad,[2] R. B. Drucker,[6] D. A. Harris,[7] R. A. Johnson,[1] J. H. Kim,[2] B. J. King,[2] T. Kinnel,[8] M. J. Lamm,[3] W. C. Lefmann,[2] W. Marsh,[3] K. S. McFarland,[7] C. McNulty,[2] S. R. Mishra,[2] P. Z. Quintas,[2] W. K. Sakumoto,[7] H. Schellman,[5] F. J. Sciulli,[2] W. G. Seligman,[2] M. H. Shaevitz,[2] W. H. Smith,[8] P. Spentzouris,[2] E. G. Stern,[2] M. Vakili,[1] U. K. Yang,[7] and J. Yu,[3] [1]*University of Cincinnati, Cincinnati, Ohio 45221* [2]*Columbia University, New York, New York 10027* [3]*Fermi National Accelerator Laboratory, Batavia, Illinois 60510* [4]*Kansas State University, Manhattan, Kansas 66506* [5]*Northwestern University, Evanston, Illinois 60208* [6]*University of Oregon, Eugene, Oregon 97403* [7]*University of Rochester, Rochester, New York 14627* [8]*University of Wisconsin, Madison, Wisconsin 53706.* (Received 11 August 1998; published 30 December 1998)

We present new limits on $\nu_e(\bar{\nu}_e)\rightarrow\nu_\tau(\bar{\nu}_\tau)$ and $\nu_e(\bar{\nu}_e)\rightarrow\nu_s$ oscillations by searching for ν_e disappearance in the high-energy wide-band CCFR neutrino beam. Sensitivity to ν_τ appearance comes from τ decay modes in which a large fraction of the energy deposited is electromagnetic. The beam is composed primarily of $\nu_\mu(\bar{\nu}_\mu)$, but this analysis uses the 2.3% $\nu_e(\bar{\nu}_e)$ component of the beam. Electron neutrino energies range from 30 to 600 GeV and flight lengths vary from 0.9 to 1.4 km. This limit improves the sensitivity of existing limits for $\nu_e\rightarrow\nu_\tau$ at high Δm^2 and obtains a lowest 90% confidence upper limit in $\sin^2 2\alpha$ of 9.9×10^{-2} at $\Delta m^2 \sim 125$ eV^2. [S0556-2821(99)50103-3] [Phys. Rev. D **59**, 031101 (1999)]

Naturally light sterile neutrinos. Utpal Sarkar, *Theory Group, DESY, Notkestraße 85, 22603 Hamburg, Germany and Theory Group, Physical Research Laboratory, Ahmedabad, 380 009, India.* (Received 25 September 1998; published 7 January 1999)

A simple model to accommodate light sterile neutrinos naturally with large mixing with the usual neutrinos has been proposed. The standard model gauge group is extended to include an $SU(2)_S$ gauge symmetry. Heavy triplet Higgs scalars give small masses to the left-handed neutrinos, while a heavy doublet Higgs scalar mixes with the sterile neutrinos of the same order of magnitude. We then present a simple form of the neutrino mass matrix, which may originate from this scenario and can explain the solar neutrino deficit, the atmospheric neutrino deficit, the LSND data, and the hot dark matter. The lepton number is violated through decays of the heavy triplet Higgs scalars, which generate the lepton asymmetry of the universe, which in turn generates a baryon asymmetry of the universe. [S0556-2821(99)50203-8] [Phys. Rev. D **59**, 031301 (1999)]

Super-Kamiokande atmospheric neutrino data, zenith distributions, and three-flavor oscillations. G. L. Fogli, E. Lisi, A. Marrone, and G. Scioscia, *Dipartimento di Fisica and Sezione INFN di Bari, Via Amendola 173, I-70126 Bari, Italy.* (Received 3 August 1998; published 22 December 1998)

We present a detailed analysis of the zenith angle distributions of atmospheric neutrino events observed in the Super-Kamiokande (SK) underground experiment, assuming two-flavor and three-

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flavor oscillations (with one dominant mass scale) among active neutrinos. In particular, we calculate the five angular distributions associated with sub-GeV and multi-GeV μ-like and e-like events and to upward through-going muons, for a total of 30 accurately computed observables (zenith bins). First we study how such observables vary with the oscillation parameters, and then we perform a fit to the experimental data as measured in SK for an exposure of 33 kTy (535 days). In the two-flavor mixing case, we confirm the results of the SK Collaboration analysis, namely, that $\nu_\mu \leftrightarrow \nu_\tau$ oscillations are preferred over $\nu_\mu \leftrightarrow \nu_e$, and that the no oscillation case is excluded with high confidence. In the three-flavor mixing case, we perform our analysis with and without the additional constraints imposed by the CHOOZ reactor experiment. In both cases, the analysis favors a dominance of the $\nu_\mu \leftrightarrow \nu_\tau$ channel. Without the CHOOZ constraints, the amplitudes of the subdominant $\nu_\mu \leftrightarrow \nu_e$ and $\nu_e \leftrightarrow \nu_\tau$ transitions can also be relatively large, indicating that, at present, current SK data do not exclude sizable ν_e mixing by themselves. After combining the CHOOZ and SK data, the amplitudes of the subdominant transitions are constrained to be smaller, but they can still play a non-negligible role both in atmospheric and other neutrino oscillation searches. In particular, we find that the ν_e appearance probability expected in long baseline experiments can reach the testable level of $\sim$15%. We also discuss Earth matter effects, theoretical uncertainties, and various aspects of the statistical analysis. [S0556-2821(99)06401-2] [Phys. Rev. D **59**, 033001 (1999)]

Valence quark spin distribution functions. Nathan Isgur, *Jefferson Lab, 12000 Jefferson Avenue, Newport News, Virginia 23606.* (Received 8 June 1998; published 8 January 1999)

The hyperfine interactions of the constituent quark model provide a natural explanation for many nucleon properties, including the Δ-N splitting, the charge radius of the neutron, and the observation that the proton's quark distribution function ratio $d(x)/u(x) \to 0$ as $x \to 1$. The hyperfine-perturbed quark model also makes predictions for the nucleon spin-dependent distribution functions. Precision measurements of the resulting asymmetries $A_1^p(x)$ and $A_1^n(x)$ in the valence region can test this model and thereby the hypothesis that the valence quark spin distributions are ''normal.'' [S0556-2821(99)01503-9] [Phys. Rev. D **59**, 034013 (1999)]

Limits on Pauli principle violation by nucleons. E. Baron, *Department of Physics and Astronomy, University of Oklahoma, Norman, Oklahoma 73019;* Rabindra N. Mohapatra, *Department of Physics, University of Maryland, College Park, Maryland 20742;* Vigdor L. Teplitz, *Department of Physics, Southern Methodist University, Dallas, Texas 75275.* (Received 31 August 1998; published 8 January 1999)

We consider nuclei produced in core collapse supernovas and subjected to a high neutron flux. We show that an accelerator mass spectrometry experiment that searches for traces of anomalous iron isotopes could set limits of the order of 10^{-20}–10^{-25} on (or perhaps discover) Pauli principle violation by neutrons. A similar search for anomalous Co isotopes could set limits in the range 10^{-13}–10^{-18} on Pauli principle violation by protons. We show that existing data on oxygen can be used to set a limit of about 10^{-17} in one proposed model of such violation. [S0556-2821(99)00303-3] [Phys. Rev. D **59**, 036003 (1999)]