

Selected Abstracts from Other Physical Review Journals

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Complementarity of eastern and western hemisphere long-baseline neutrino oscillation experiments. Hisakazu Minakata, *Department of Physics, Tokyo Metropolitan University, 1-1 Minami-Osawa, Hachioji, Tokyo 192-0397, Japan*; Hiroshi Nunokawa, *Instituto de Física Teórica, Universidade Estadual Paulista, Rua Pamplona 145, 01405-900 São Paulo, SP, Brazil*; Stephen Parke, *Theoretical Physics Department, Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510, USA*. (Received 29 January 2003; published 30 July 2003)

We present a general formalism for extracting information on the fundamental parameters associated with neutrino masses and mixings from two or more long baseline neutrino oscillation experiments. This formalism is then applied to the current most likely experiments using neutrino beams from the Japan Hadron Facility (JHF) and Fermilab's NuMI beamline. Different combinations of muon neutrino or muon anti-neutrino running are considered. The type of neutrino mass hierarchy is extracted using the effects of matter on neutrino propagation. Contrary to naive expectation, we find that both beams using neutrinos is more suitable for determining the hierarchy provided that the neutrino energy divided by baseline (E/L) for NuMI is smaller than or equal to that of JHF, whereas to determine the small mixing angle, θ_{13} , and the CP or T violating phase δ , one neutrino and the other anti-neutrino are most suitable. We make extensive use of bi-probability diagrams for both understanding and extracting the physics involved in such comparisons. [Phys. Rev. D **68**, 013010 (2003)]

Latent heat in the chiral phase transition. Masaharu Iwasaki and Hiyoshi Kiuchi, *Department of Physics, Kochi University, Kochi 780-8520, Japan*. (Received 6 May 2003; published 22 July 2003)

The chiral phase transition at finite temperature and density is discussed in the framework of the QCD-like gauge field theory. The thermodynamical potential is investigated using a variational approach. Latent heat generated in the first-order phase transition is calculated. It is found that the latent heat is enhanced near the tricritical point and is more than several hundred MeV per quark. [Phys. Rev. D **68**, 014014 (2003)]

Relativistic mean field model for entrainment in general relativistic superfluid neutron stars. G. L. Comer, *Department of Physics, Saint Louis University, St. Louis, Missouri 63156-0907, USA*; R. Joynt, *Department of Physics, University of Wisconsin-Madison, Madison, Wisconsin 53706, USA*. (Received 19 December 2002; revised manuscript received 6 May 2003; published 3 July 2003)

General relativistic superfluid neutron stars have a significantly more intricate dynamics than their ordinary fluid counterparts. Superfluidity allows different superfluid (and superconducting) species

of particles to have independent fluid flows, a consequence of which is that the fluid equations of motion contain as many fluid element velocities as superfluid species. Whenever the particles of one superfluid interact with those of another, the momentum of each superfluid will be a linear combination of both superfluid velocities. This leads to the so-called entrainment effect whereby the motion of one superfluid will induce a momentum in the other superfluid. We have constructed a fully relativistic model for entrainment between superfluid neutrons and superconducting protons using a relativistic $\sigma-\omega$ mean field model for the nucleons and their interactions. In this context there are two notions of "relativistic": relativistic motion of the individual nucleons with respect to a local region of the star (i.e. a fluid element containing, say, an Avogadro's number of particles), and the motion of fluid elements with respect to the rest of the star. While it is the case that the fluid elements will typically maintain average speeds at a fraction of that of light, the supranuclear densities in the core of a neutron star can make the nucleons themselves have quite high average speeds within each fluid element. The formalism is applied to the problem of slowly rotating superfluid neutron star configurations, a distinguishing characteristic being that the neutrons can rotate at a rate different from that of the protons. [Phys. Rev. D **68**, 023002 (2003)]

Resonant spin-flavor conversion of supernova neutrinos: Dependence on presupernova models and future prospects. Shin'ichiro Ando, *Department of Physics, School of Science, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan*; Katsuhiko Sato, *Department of Physics, School of Science, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan*, and *Research Center for the Early Universe, School of Science, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan*. (Received 22 March 2003; published 10 July 2003)

We study the resonant spin-flavor (RSF) conversion of supernova neutrinos, which is induced by the interaction between the nonzero neutrino magnetic moment and the supernova magnetic fields, and its dependence on presupernova models. As the presupernova models, we adopt the latest ones by Woosley, Heger, and Weaver, and, further, models with both solar and zero metallicity are investigated. Since the $(1-2Y_e)$ profile of the new presupernova models, which is responsible for the RSF conversion, suddenly drops at the resonance region, the completely adiabatic RSF conversion is not realized, even if $\mu_\nu B_0 = (10^{-12} \mu_B)(10^{10} \text{ G})$, where B_0 is the strength of the magnetic field at the surface of the iron core. In particular for the model with zero metallicity, the conversion is highly nonadiabatic in the high energy region, reflecting the $(1-2Y_e)$ profile of the model. In calculating the flavor conversion, we find that the shock wave propagation, which changes density profiles drastically, is a much more severe problem than it is for the pure Mikheyev-Smirnov-Wolfenstein (MSW) conversion case. This is because the RSF effect occurs at a far deeper region than the MSW effect. To avoid the uncertainty concerning the shock propagation, we restrict

our discussion to 0.5 s after the core bounce (and for more conservative discussion, 0.25 s), during which the shock wave is not expected to affect the RSF region. We also evaluate the energy spectrum at the Super-Kamiokande detector for various models using the calculated conversion probabilities, and find that it is very difficult to obtain useful information on the supernova metallicities and magnetic fields or on the neutrino magnetic moment from the supernova neutrino observation. Future prospects are also discussed. [Phys. Rev. D **68**, 023003 (2003)]

Nonradial oscillations of quark stars. Hajime Sotani and Tomohiro Harada, *Department of Physics, Waseda University, Okubo 3-4-1, Shinjuku, Tokyo 169-8555, Japan.* (Received 14 March 2003; published 11 July 2003)

Recently, it has been reported that a candidate for a quark star may have been observed. In this article, we consider quark stars with radiation radii in the reported range. We calculate nonradial oscillations of f , w , and w_{Π} modes. We find that the dependence of the f mode quasinormal frequency on the bag constant and stellar radiation radius is very strong and different from that of the lowest w_{Π} mode quasinormal frequency. Furthermore we deduce a new empirical formula between the f mode frequency of gravitational waves and the parameter of the equation of state for quark stars. The observation of gravitational waves both of the f mode and of the lowest w_{Π} mode would provide a powerful probe for the equation of state of quark matter and the properties of quark stars. [Phys. Rev. D **68**, 024019 (2003)]

Hard-thermal-loop quasiparticle models of deconfined QCD at finite chemical potential. A. Rebhan and P. Romatschke, *Institut für Theoretische Physik, Technische Universität Wien, A-1040 Vienna, Austria.* (Received 15 May 2003; published 30 July 2003)

Using quasiparticle models and imposing thermodynamic consistency, lattice data for the equation of state of deconfined QCD can be mapped to finite chemical potential. We consider a refinement of existing simple massive quasiparticle models using the nonlocal hard-thermal-loop propagators, and certain next-to-leading-order corrections thereof, to obtain the thermodynamic potential as a function of temperature and chemical potential. At small chemical potential we find that the results for the slope of constant pressure from our main model for two massless quark flavors is in good agreement with recent lattice data for 2+1 flavors while it deviates somewhat from lattice data for two flavors from another group. For zero temperature, we obtain an estimate for the critical chemical potential which is close to that obtained from simpler quasiparticle models. [Phys. Rev. D **68**, 025022 (2003)]

On the apparent convergence of perturbative QCD at high temperature. J.-P. Blaizot and E. Iancu, *Service de Physique Théorique, CE Saclay, F-91191 Gif-sur-Yvette, France*; A. Rebhan, *Institut für Theoretische Physik, Technische Universität Wien, A-1040 Vienna, Austria.* (Received 31 March 2003; published 10 July 2003)

The successive perturbative estimates of the pressure of QCD at high temperature T show no sign of convergence, unless the coupling constant g is unrealistically small. Exploiting known results of

an effective field theory which separates hard (order $2\pi T$) and soft (order gT) contributions, we explore the accuracy of simple resummations which at a given loop order systematically treat hard contributions strictly perturbatively, but soft contributions without truncations. This turns out to improve significantly the two-loop and the three-loop results in that both remain below the ideal-gas value, and the degree of renormalization scale dependence decreases as one goes from two to three loop order, whereas it increases in the conventional perturbative results. Including the four-loop logarithms recently obtained by Kajantie *et al.*, we find that this trend continues and that with a particular sublogarithmic constant the untruncated four-loop result is close to the three-loop result, which itself agrees well with available lattice results down to temperatures of about $2.5T_c$. We also investigate the possibility of optimization by using a variational (“screened”) perturbation theory in the effective theory. At two loops, this gives a result below the ideal gas value and also closer to lattice results than the recent two-loop hard-thermal-loop-screened result of Andersen *et al.* While at three-loop order the gap equation of dimensionally reduced screened perturbation theory does not have a solution in QCD, this is remedied upon inclusion of the four-loop logarithms. [Phys. Rev. D **68**, 025011 (2003)]

Gauge invariant reduction to the light front. A. N. Kvinikhidze and B. Blankleider, *Department of Physics, The Flinders University of South Australia, Bedford Park, SA 5042, Australia.* (Received 20 March 2003; published 30 July 2003)

The problem of constructing gauge invariant currents in terms of light-front bound-state wave functions is solved by utilizing the gauging of equations method. In particular, we show how to construct perturbative expansions of the electromagnetic current in the light-front formalism such that current conservation is satisfied at each order of the perturbation theory. [Phys. Rev. D **68**, 025021 (2003)]

Impact of CP phases on neutrinoless double beta decay. Asmaa Abada, *Laboratoire de Physique Théorique, Université de Paris XI, Bâtiment 210, 91405 Orsay Cedex, France*; Gautam Bhattacharyya, *Saha Institute of Nuclear Physics, 1/AF Bidhan Nagar, Kolkata 700064, India.* (Received 24 April 2003; published 7 August 2003)

We highlight in a model independent way the dependence of the effective Majorana mass parameter, relevant for neutrinoless double beta decay, on the CP phases of the Pontecorvo-Maki-Nakagawa-Sakata matrix, using the most recent neutrino data including the cosmological Wilkinson Microwave Anisotropy Probe measurement. We perform our analysis with three active neutrino flavors in the context of three kinds of mass spectra: quasidegenerate, normal hierarchical, and inverted hierarchical. If a neutrinoless double beta decay experiment records a positive signal, then assuming that Majorana masses of light neutrinos are responsible for it, we show how it might be possible to discriminate between the three kinds of spectra. [Phys. Rev. D **68**, 033004 (2003)]

Analysis of energy and time dependence of supernova shock effects on neutrino crossing probabilities. G. L. Fogli,¹ E. Lisi,¹ A. Mirizzi,¹ and D. Montanino² ¹*Dipartimento di Fisica and Sezione INFN di Bari, Via Amendola 173, 70126 Bari, Italy,*

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It has recently been realized that supernova neutrino signals may be affected by shock propagation over a time interval of a few seconds after bounce. In the standard three-neutrino oscillation scenario, such effects crucially depend on the neutrino level crossing probability P_H in the 1-3 sector. By using a simplified parametrization of the time-dependent supernova radial density profile, we explicitly show that simple analytical expressions for P_H accurately reproduce the phase-averaged results of numerical calculations in the relevant parameter space. Such expressions are then used to study the structure of P_H as a function of energy and time, with particular attention to cases involving multiple crossing along the shock profile. Illustrative applications are given in terms of positron spectra generated by supernova electron antineutrinos through inverse beta decay. [Phys. Rev. D **68**, 033005 (2003)]

KamLAND, solar antineutrinos, and the solar magnetic field. Bhag C. Chauhan,¹ João Pulido,¹ and E. Torrente-Lujan² ¹*Centro de Física das Interações Fundamentais (CFIF), Departamento de Física, Instituto Superior Técnico, Avenida Rovisco Pais, P-1049-001 Lisboa, Portugal,* ²*Departamento de Física, Grupo de Física Teórica, Universidad de Murcia, Murcia, Spain.* (Received 19 May 2003; published 27 August 2003)

In this work the possibility of detecting solar electron antineutrinos produced by a solar core magnetic field from the KamLAND recent observations is investigated. We find a scaling of the antineutrino probability with respect to the magnetic field profile in the sense that the same probability function can be reproduced by any profile with a suitable peak field value. In this way the solar electron antineutrino spectrum can be unambiguously predicted. We use this scaling and the negative results indicated by the KamLAND experiment to obtain upper bounds on the solar electron antineutrino flux. We get $\phi_{\bar{\nu}} < 3.8 \times 10^{-3} \phi(^8\text{B})$ at 95% C.L. For 90% C.L. this becomes $\phi_{\bar{\nu}} < 3.4 \times 10^{-3} \phi(^8\text{B})$, an improvement by a factor of 3–5 with respect to existing bounds. These limits are independent of the detailed structure of the magnetic field in the solar interior. We also derive upper bounds on the peak field value which are uniquely determined for a fixed solar field profile. In the most efficient antineutrino producing case, we get (95% C.L.) an upper limit on the product of the neutrino magnetic moment by the solar field $\mu_B < 2.8 \times 10^{-19} \text{ MeV}$ or $B_0 \leq 4.9 \times 10^7 \text{ G}$ for $\mu_{\nu} = 10^{-12} \mu_B$. [Phys. Rev. D **68**, 033015 (2003)]

Reactor measurement of θ_{13} and its complementarity to long-baseline experiments. H. Minakata, H. Sugiyama, and O. Yasuda, *Department of Physics, Tokyo Metropolitan University, Hachioji, Tokyo 192-0397, Japan;* K. Inoue and F. Suekane, *Research Center for Neutrino Science, Tohoku University, Sendai, Miyagi, 980-8578, Japan.* (Received 8 November 2002; revised manuscript received 18 April 2003; published 28 August 2003)

The possibility of measuring $\sin^2 2\theta_{13}$ using reactor neutrinos is examined in detail. It is shown that the sensitivity $\sin^2 2\theta_{13} > 0.02$ can be reached with 40 ton yr data by placing identical CHOOZ-like detectors at near and far distances from a giant nuclear power plant whose total thermal energy is $24.3 \text{ GW}_{\text{th}}$. It is emphasized

that this measurement is free from the parameter degeneracies that occur in accelerator appearance experiments, and therefore the reactor measurement is complementary to accelerator experiments. It is also shown that the reactor measurement may be able to resolve the degeneracy in θ_{23} if $\sin^2 2\theta_{13}$ and $\cos^2 2\theta_{23}$ are relatively large. [Phys. Rev. D **68**, 033017 (2003)]

Neutrino masses from beta decays after KamLAND and WMAP. F. R. Joaquim, *Centro de Física das Interações Fundamentais (CFIF), Departamento de Física, Instituto Superior Técnico, Avenida Rovisco Pais, 1049-001 Lisboa, Portugal.* (Received 12 May 2003; published 28 August 2003)

The first data released by the KamLAND Collaboration have confirmed the strong evidence in favor of the large mixing angle solution of the solar neutrino problem. Taking into account the ranges for the oscillation parameters allowed by the global analysis of the solar, CHOOZ and KamLAND data, we update the limits on the neutrinoless double beta decay effective neutrino mass parameter and analyze the impact of all the available data from neutrinoless double beta decay experiments on the neutrino mass bounds, in view of the latest WMAP results. For the normal neutrino mass spectrum the range (0.05–0.23) eV is obtained for the lightest neutrino mass if one takes into account the Heidelberg-Moscow evidence for neutrinoless double beta decay and the cosmological bound. It is also shown that under the same conditions the mass of the lightest neutrino may not be bounded from below if the spectrum is of the inverted type. Finally, we discuss how future experiments can improve the present bounds on the lightest neutrino mass set by the Troitsk, Mainz, and Wilkinson microwave anisotropy probe results. [Phys. Rev. D **68**, 033019 (2003)]

Testing the statistical compatibility of independent data sets. M. Maltoni, *Instituto de Física Corpuscular–C.S.I.C./Universitat de València Edificio Institutos de Paterna, Apt 22085, E-46071 Valencia, Spain;* T. Schwetz, *Institut für Theoretische Physik, Physik Department Technische Universität München, James–Franck–Strasse, D-85748 Garching, Germany.* (Received 5 May 2003; published 29 August 2003)

We discuss a goodness-of-fit method which tests the compatibility between statistically independent data sets. The method gives sensible results even in cases where the χ^2 minima of the individual data sets are very low or when several parameters are fitted to a large number of data points. In particular, it avoids the problem that a possible disagreement between data sets becomes diluted by data points which are insensitive to the crucial parameters. A formal derivation of the probability distribution function for the proposed test statistics is given, based on standard theorems of statistics. The application of the method is illustrated on data from neutrino oscillation experiments, and its complementarity to the standard goodness-of-fit is discussed. [Phys. Rev. D **68**, 033020 (2003)]

Separation of soft and hard physics in deeply virtual compton scattering. A. Gärdestig, A. P. Szczepaniak, and J. T. Londergan, *Indiana University Nuclear Theory Center, Bloomington, Indiana 47405, USA.* (Received 19 May 2003; published 7 August 2003)

A model for deeply virtual Compton scattering, based on analytical light-cone hadron wave functions, is presented and studied at energies currently accessible at Jefferson Laboratory, DESY, and beyond. It is shown that perpendicular vector components play an important role at $Q^2 < 10 \text{ GeV}^2$ and that the meson-exchange diagrams are important at all energies. This could significantly impact the physical interpretation of the underlying hadronic amplitudes. [Phys. Rev. D **68**, 034005 (2003)]

Positivity and dense matter. Deog Ki Hong, *Department of Physics, Pusan National University, Pusan 609-735, Korea*; Stephen D.H. Hsu, *Department of Physics, University of Oregon, Eugene, Oregon 97403-5203, USA*. (Received 16 April 2003; published 18 August 2003)

We elaborate on previous results concerning the positivity of the Euclidean path integral measure for low-energy modes in dense fermionic matter. We show that the sign problem usually associated with fermions is absent if one considers only low-energy degrees of freedom. We describe a method for simulating dense QCD on the lattice and give a proof using rigorous inequalities that the color-flavor locked (CFL) phase is the true vacuum of three flavor, massless QCD. We also discuss applications to electronic systems in condensed matter, such as generalized Hubbard models. [Phys. Rev. D **68**, 034011 (2003)]

Neutrinoless double β decay and effective field theory. G. Prézeau, *Kellogg Radiation Laboratory, California Institute of Technology, Pasadena, California 91125, USA*; M. Ramsey-Musolf, *Kellogg Radiation Laboratory, California Institute of Technology, Pasadena, California 91125, USA*; *Department of Physics, University of Connecticut, Storrs, Connecticut 06269, USA*; and *Institute of Nuclear Theory, University of Washington, Physics/Astronomy Building Box 351550, Seattle, Washington 98195-1550, USA*; Petr Vogel, *Kellogg Radiation Laboratory, California Institute of Technology, Pasadena, California 91125, USA*. (Received 24 March 2003; published 25 August 2003)

We analyze neutrinoless double β decay ($0\nu\beta\beta$ decay) mediated by heavy particles from the standpoint of effective field theory. We show how symmetries of the $0\nu\beta\beta$ -decay quark operators arising in a given particle physics model determine the form of the corresponding effective, hadronic operators. We classify the latter according to their symmetry transformation properties as well as the order at which they appear in a derivative expansion. We apply this framework to several particle physics models, including R-parity violating supersymmetry (RPV SUSY) and the left-right symmetric model (LRSM) with mixing and a right-handed Majorana neutrino. We show that, in general, the pion exchange contributions to $0\nu\beta\beta$ decay dominate over the short-range four-nucleon operators. This confirms previously published RPV SUSY results and allows us to derive new constraints on the masses in the LRSM. In particular, we show how a nonzero mixing angle ζ in the left-right symmetry model produces a new potentially dominant contribution to $0\nu\beta\beta$ decay that substantially modifies previous limits on the masses of the right-handed neutrino and boson stemming from constraints from $0\nu\beta\beta$ decay and vacuum stability requirements. [Phys. Rev. D **68**, 034016 (2003)]

Parton distribution functions in the pion from lattice QCD. W. Detmold, *Department of Physics, University of Washington, Box 351560, Seattle, Washington 98195, USA*; W. Melnitchouk, *Jefferson Lab, 12000 Jefferson Avenue, Newport News, Virginia 23606, USA*; A. W. Thomas, *Department of Physics and Mathematical Physics and Special Research Centre for the Subatomic Structure of Matter, University of Adelaide, Adelaide, SA 5005, Australia*. (Received 18 March 2003; published 29 August 2003)

We analyze the moments of parton distribution functions in the pion calculated in lattice QCD, paying particular attention to their chiral extrapolation. Using the lowest three nontrivial moments calculated on the lattice, we assess the accuracy with which the x dependence of both the valence and sea quark distributions in the pion can be extracted. The resulting valence quark distributions at the physical pion mass are in fair agreement with existing Drell-Yan data, but the statistical errors are such that one cannot yet confirm (or rule out) the large- x behavior expected from hadron helicity conservation in perturbative QCD. However, one can expect that the next generation of calculations in lattice QCD will allow one to extract parton distributions with a level of accuracy comparable with current experiments. [Phys. Rev. D **68**, 034025 (2003)]

Meson model for $f_0(980)$ production in peripheral pion-nucleon reactions. F. P. Sassen, S. Krewald, and J. Speth, *Institut für Kernphysik, Forschungszentrum Jülich GmbH, 52425 Jülich, Germany*; A. W. Thomas, *Special Research Centre for the Subatomic Structure of Matter, University of Adelaide, Adelaide 5005, Australia*. (Received 3 December 2002; published 25 August 2003)

The Jülich model for $\pi\pi$ scattering, based on an effective meson-meson Lagrangian, is applied to the analysis of the S -wave production amplitudes derived from the BNL E852 experiment $\pi^- p \rightarrow \pi^0 \pi^0 n$ for a pion momentum of 18.3 GeV and the GAMS experiments performed at 38 GeV and 100 GeV. The unexpected strong dependence of the S -wave partial wave amplitude on the momentum transfer between the proton and neutron in the vicinity of the $f_0(980)$ resonance is explained in our analysis as an interference effect between the resonance and the nonresonant background. [Phys. Rev. D **68**, 036003 (2003)]

Collective modes of an anisotropic quark-gluon plasma. Paul Romatschke and Michael Strickland, *Institut für Theoretische Physik, Technische Universität Wien, Wiedner Hauptstrasse 8-10, A-1040 Vienna, Austria*. (Received 22 April 2003; published 28 August 2003)

We analyze the collective modes of high-temperature QCD in the case when there is an anisotropy in the momentum-space distribution function for the gluons. We perform a tensor decomposition of the gluon self-energy and solve the dispersion relations for both stable and unstable modes. Results are presented for a class of anisotropic distribution functions which can be obtained by stretching or squeezing an isotropic distribution function along one direction in momentum space. We find that there are three stable modes and either one or two unstable modes, depending on whether the distribution function is stretched or squeezed. The presence of unstable modes which have exponential growth can lead to a more rapid thermalization and isotropization of the soft modes in a quark

gluon plasma and therefore may play an important role in the dynamical evolution of a quark-gluon plasma. [Phys. Rev. D **68**, 036004 (2003)]

Baryon-baryon bound states in a (2+1)-dimensional lattice QCD model. Paulo A. Faria da Veiga and Michael O'Carroll, *Departamento de Matemática, ICMC-USP, C. P. 668, 13560-970 São Carlos, SP, Brazil*; Ricardo Schor, *Departamento de Física-ICEx, UFMG, C. P. 702, 30161-970 Belo Horizonte, MG, Brazil*. (Received 14 May 2003; published 25 August 2003)

We consider bound states of two baryons (antibaryons) in lattice QCD in a Euclidean formulation. For simplicity, we analyze an

$SU(3)$ theory with a single flavor in 2+1 dimensions and two-dimensional Dirac matrices. For a small hopping parameter $0 < \kappa \ll 1$ and large glueball mass, we recently showed the existence of a (anti)baryonlike particle, with an asymptotic mass of the order of $-3 \ln \kappa$ and with an isolated dispersion curve, i.e., an upper gap property persisting up to near the meson-baryon threshold, which is of order $-5 \ln \kappa$. Here, we show that there is no baryon-baryon (or antibaryon-antibaryon) bound state solution to the Bethe-Salpeter equation up to the two-baryon threshold, which is approximately $-6 \ln \kappa$. [Phys. Rev. D **68**, 037501 (2003)]