HK 11 Theorie

Zeit: Montag 16:30–18:45 Raum: B

HK 11.1 Mo 16:30 B

Stability of color-superconducting strangelets — •Osamu Kiriyama — Institut fuer Theoretische Physik, J.W. Goethe-Universitaet, 60438 Frankfurt am Main, Germany

The two-flavor color-superconducting (2SC) phase in small ($A \ll 10^7$) strangelets is studied [1]. In such small strangelets, electrons mainly stay outside of quark core. Therefore, in the study of the quark core of small strangelets, the (local) electric neutrality condition can be neglected, but finite-size effects should be included instead. Consequently, the phase structure of small strangelets could be different from that of strange quark matter in bulk.

In order to describe the 2SC phase we use the three-flavor Nambu–Jona-Lasinio model. We explicitly take into account finite size effects by making use of the approximation for the density of states in spherical cavities called multiple reflection expansion (MRE). (The MRE density of states has been used to calculate thermodynamic quantities of strangelets and reproduced well the results of the MIT bag model [2].)

The thermodynamic potential for the 2SC strangelets is derived in the mean-field approximation with the help of the MRE. We found that 2SC phase survives in small strangelets with a sizable gap. Consequences for the 2SC phase will be also presented.

\Zitat{1}{O. Kiriyama, Phys. Rev. D {\bf 72}, 054009 (2005); hep-ph/0401075 (to be published in Int. J. Mod. Phys. A).} \Zitat{2}{M.S. Berger and R.L. Jaffe, Phys. Rev. C {\bf 35}, 213 (1987); {\bf 44}, 566(E) (1991); J. Madsen, Phys. Rev. D {\bf 50}, 3328 (1994).}

HK 11.2 Mo 16:45 B

How To Classify Three-Body Forces – And Why — •Harald W. Griesshammer — Institut für Theoretische Physik (T39), TU München — Centre for Nuclear Studies, The George Washington University, Washington DC, USA

To add 3-body forces whenever theory and data disagree is untenable when predictions are required. Effective Field Theories can provide a model-independent way to estimate the typical strength of 3-body forces. For the "pion-less" Effective Field Theory, valid for processes with momenta below the pion-mass, I systematise the power-counting of 3-body forces in all partial waves and orders, including external currents [1]. The underlying tenet is that low-energy observables must be insensitive to details of short-distance dynamics. Using renormalisation-group arguments, the typical strength of a 3-body force is thus determined from the superficial degree of divergence of the 3-body diagrams which contain only two-body forces. This naïve dimensional analysis must be amended as the asymptotic solution to the leading-order Faddeev equation depends for large off-shell momenta crucially on the partial wave and spin-combination of the system. 3-body forces turn out to be weaker than expected in most channels with angular momentum smaller than 3. This demotes many 3-nucleon forces to high orders. I outline the underlying principle and some consequences for Nuclear Physics. For example, the $^4S_{\frac{3}{2}}$-scattering length of the neutron-deuteron-system is less sensitive to 3-nucleon forces than guessed.

[1] H.W. Grießhammer: Nucl. Phys. **A760** (2005) 110

HK 11.3 Mo 17:00 B

Triton Radiative Capture at Thermal Energies in Effective Field Theory — •Harald W. Griesshammer — Institut für Theoretische Physik (T39), TU München, Germany — Centre for Nuclear Studies, The George Washington University, Washington DC, USA

The cross section of radiative neutron capture by the deuteron at thermal neutron energies, $nd \to t\gamma$, is calculated in "pion-less" Effective Field Theory, the unique, model-independent and systematic low-energy version of QCD for processes involving momenta below the pion-mass. Nuclear models give a spread of $[0.49 \dots 0.66]$ mb, depending on the 2-nucleon potential, and how the $\Delta(1232)$ as first nucleonic excitation is included. On the other hand, a process at 0.0253 eV incident neutron energy and less than 7 MeV photon energy should be insensitive to details of the deuteron wave-function and of a resonance with an excitation energy of 300 MeV. No new 3-nucleon forces are needed up to next-to-next-to-leading order for cut-off independent results, besides those fixed by the triton binding energy and nd scattering length in the triton channel. Our cross-section is completely determined by these, and by simple 2-body observables, as $\sigma_{\text{tot}} = [0.485(\text{LO}) + 0.011(\text{NLO}) + 0.007(\text{NNLO})]$ mb = $[0.503 \pm 0.003]$ mb [1]. It thus converges order by order in the low-energy expansion and compares well with the measured value, $[0.509 \pm 0.015]$ mb.

[1] H. Sadeghi, S. Bayegan and H.W. Grießhammer, in preparation.

HK 11.4 Mo 17:15 B

Plasminos in superconductors — •Barbara Betz and Dirk-H. Rischke — Institut für Theoretische Physik, Johann Wolfgang Goethe-Universität, D-60438 Frankfurt am Main, Germany

Hot and/or dense, normal-conducting systems of relativistic fermions exhibit a particular collective excitation, the so-called plasmino. We show that such excitations also exist in superconducting fermionic systems. We compute the dispersion relation and the spectral function for the particular case of fermions interacting via (attractive) scalar boson exchange.

HK 11.5 Mo 17:30 B

Systematic analysis of the uncertainty in the $0\nu\beta\beta$-decay nuclear matrix elements — •Vadim Rodin[1], Amand Faessler[1], Fedor Simkovic[1,2], and Petr Vogel[3] — [1]Institut fuer Theoretische Physik, Universitaet Tuebingen, Auf der Morgenstelle 14, D-72076 Tuebingen, Deutschland — [2]Department of Nuclear Physics, Comenius University, Mlynska dolina F1, Bratislava, Slovakia — [3]Department of Physics 106-38, California Institute of Technology, Pasadena, CA 91125, USA

The discovery of neutrino oscillations has unambiguously shown that neutrinos have a non-vanishing rest-mass. The neutrinoless double beta decay ($0\nu\beta\beta$) is an *experimentum crucis* to reveal the Majorana nature of the neutrinos and to determine the absolute neutrino mass scale.

The determination of the Majorana mass from experimental data can be only as good as the knowledge of the nuclear matrix elements $M^{0\nu}$ on which the $0\nu\beta\beta$-decay rates depend. In [1] the values of $M^{0\nu}$ for most nuclei with known $2\nu\beta\beta$-decay rates are systematically evaluated using the QRPA and RQRPA. The experimental $2\nu\beta\beta$-decay rate is used to adjust the most relevant parameter, the strength of the particle-particle interaction. The results show that with such a procedure the $M^{0\nu}$'s become essentially independent on the size of the single-particle basis and on the possible quenching of the axial vector strength g_A. Theoretical arguments in favor of the adopted way of determining the interaction parameters are presented.

[1] V. A. Rodin, A. Faessler, F. Simkovic and P. Vogel, Phys. Rev. C **68** (2003) 044302; arXiv:nucl-th/0503063

HK 11.6 Mo 17:45 B

Sonification of Baryon and Quark Spectra — •Harald Markum[1], Alberto de Campo[2], Natascha Hörmann[1], Willibald Plessas[3], and Katharina Vogt[3] — [1]Atominstitut, Technische Universität Wien — [2]Institut für Elektronische Musik und Akustik, Universität für Musik und Darstellende Kunst, Graz — [3]Theoretische Physik, Institut für Physik, Universität Graz

Sonification is defined as the use of non-speech audio to extract information from data and it represents the sound analogue to graphical visualization. The method is applied in several disciplines from economy to medicine to physics. Sonification might also help in analyzing spectra of quantum particles. It could assist, together with graphical display, to distinguish between different models or to examine the behavior of physical observables as a function of parameters like temperature and couplings. In order to demonstrate the methodology a graphical user interface was developed for listening, e.g., to different level orderings in baryon spectra obtained from one-gluon or Goldstone-boson-exchange dynamics. We further applied the technique to quantum chromodynamics on the lattice and analyzed the eigenvalues of the Dirac operator as a function of temperature over the phase transition from confinement to the quark-gluon plasma. The studies are also part of the development of program packages for audio browsing within the interdisciplinary research project SonEnvir (http://sonenvir.at/).

HK 11.7 Mo 18:00 B

Ab intio Berechnung von Reaktionen im $\^4$He System — •Martin Trini, Stephan Eisen, Johannes Kirscher und Hartmut M. Hofmann — Institut für Theoretische Physik III, Universität Erlangen-Nürnberg, Staudtstr. 7, 91058 Erlangen

Wir berichten von unseren ab initio Berechnungen des Grundzustands und der Streuzustände des $\^4$He Systems. Die Rechnungen wurden im

Rahmen des Resonating Group Models mit realistischen Zwei- und Drei-Nukleonen Potentialen durchgeführt. Die erhaltenen Streuphasen werden mit einer aktuellen R-Matrix-Analyse verglichen. Im Großen und Ganzen ist die Übereinstimmung sehr gut.

Der Vergleich von Wirkungsquerschnitten und Polarisationsobservablen mit leider nur älteren Daten zeigt sowohl gute Übereinstimmung als auch klare Diskrepanzen. Die Effekte des Drei-Nukleonen Potentials sind teilweise groß.

Des Weiteren wurden Strahlungseinfang- und Photodisintegrationsreaktionen, die zu $ˆ4$He führen, im Langwellenlimes berechnet und mit aktuellen Daten verglichen. Speziell diskutieren wir z.B. den astrophysikalisch bedeutsamen Deuteron-Deuteron S-Faktor und welche zusätzlichen experimentellen Daten zur besseren Bestimmung der Drei-Nukleonen Kraft notwendig sind.

HK 11.8 Mo 18:15 B

τ-Zerfall und die Struktur des a_1 — •Markus Wagner und Stephan Leupold — Institut für Theoretische Physik, Universität Giessen, Germany

Wir untersuchen anhand der Daten für den τ-Zerfall die Struktur des a_1. Wir beschreiben den τ-Zerfall in drei Pionen und ein Neutrino mit Hilfe einer gekoppelten-Kanal-Rechnung, basierend auf einem chiralen Lagrangian. Im Falle eines elementaren a_1 wird dieses explizit in den Lagrangian eingebaut und die entsprechenden Wechselwirkungen berücksichtigt. Ist das a_1 dynamisch erzeugt, wird dieses nicht explizit berücksichtigt und durch die Endzustandswechselwirkung selbst erzeugt. Die beiden Szenarien werden dann mit den Daten verglichen.
Gefördert durch DFG.

HK 11.9 Mo 18:30 B

Das relativistische Dreiteilchenproblem auf dem Lichtkegel — •Stefano Mattiello[1], Michael Beyer[1], Stefan Strauss[1], Tobias Frederico[2] und Hans-Juergen Weber[3] — [1]Institut für Physik, Universität Rostock, 18051 Rostock — [2]Dep. de Fisica, Instituto Tecnologico de Aeronautica, Centro Tecnico Aeroespacial — [3]Dept. of Physics, University of Virginia, Charlottesville, VA 22904, U.S.A.

Die Lichtkegelquantisierung einer Feldtheorie bei endlichen Temperaturen und Dichten erlaubt eine systematische Behandlung von Korrelationen in Quarkmaterie. Zur Untersuchung der in-medium Eigenschaften des Nukleons werden relativistische Faddeevartige Gleichungen verwendet, die über eine Dyson-Entwicklung hergeleitet wurden, bisher mit einer Spinmittelung zur Vereinfachung der Gleichungen. Aktuell behandeln wir das Dreiquarkproblem mit einem Wechselwirkungskern, der die Spinstruktur berücksichtigt. Dafür wird ein gekoppeltes System von Faddeevartigen Gleichungen gelöst. In diesem Beitrag werden die neuesten Ergebnisse für die Beschreibung des Protons auf dem Lichtkegel gezeigt sowie ein Überblick der bis jetzt erzielten Resultate für die Dreiteilchenkorrelationen in Quarkmaterie gegeben.