Wanda Alberico: 50 years of teaching and research in a nutshell

Andrea Beraudo

INFN - Sezione di Torino

Celebrating Wanda's birthday:
a career devoted to the richness of nuclear many-body physics

Wanda's career

- Degree in Physics, 110/110 cum laude, in 1974 at Unito;
- Assistant at University of Bonn until May 1975;
- Assistant Professor at Unito from 1976 to 1979;
- Associate Professor and then Full Professor at Unito from 1980 to 2020;
- Fellow at CERN from 1981 to 1983;
- INFN scientific associate since 1979 (member of the theory scientific commission and national PI of several specific initiatives);
- President of CCS in Physics (2009-2015) and director of the Natural Science School of Unito (2014-2020);
- Member of "Accademia delle Scienze di Torino" since 2016.

The importance of having/being a good mentor

The nuclear many-body theory group

Investing on the education of young researchers: Varenna school

Scientific Secretary of the International School of Physics "Enrico Fermi", Course CLIII (2002)

Investing on the education of young researchers: Varenna school

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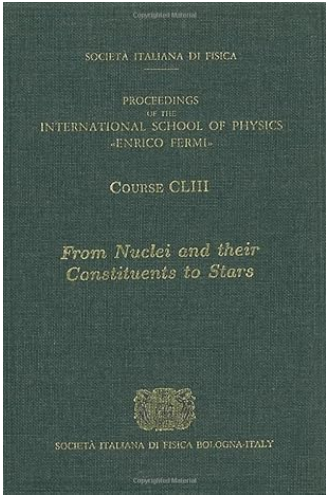
Investing on the education of young researchers: Varenna school



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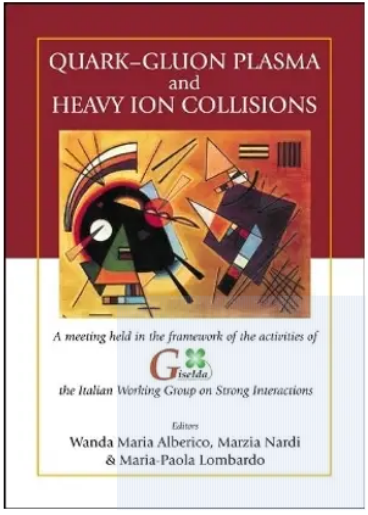
ISBN	978-1-58603-353-8 (print) | 978-1-61499-009-3 (online)
Subject(s)	Physics

Description

This book focuses on the ideas to embed nuclear physics in the larger context of hadronic physics by stressing and deepening its widening overlap with particle, astroparticle and condensed matter physics and to emphasize the unity of the two facets not only of nuclear, but of the whole physics; the theoretical and the experimental ones. Counteracting the ominous trend of enlarging the gap between the two, the danger being of depriving experimental physics of ideas promoting experiments and of transforming theoretical physics into metaphysics. The reader will find modern conceptions on nuclear structure, how atomic nuclei are probed through the scattering of high energy electrons and how they interact when accelerated at ultra-relativistic energies. The item connects to the quest for the quark-gluon plasma, perhaps the central theme of the contemporary hadronic physics, whose unraveling requires a vast and profound knowledge of both nuclear and particle physics, in particular QCD.

Scientific Secretary of the International School of Physics "Enrico Fermi", Course CLIII (2002)

Supporting new lines of research



International School on

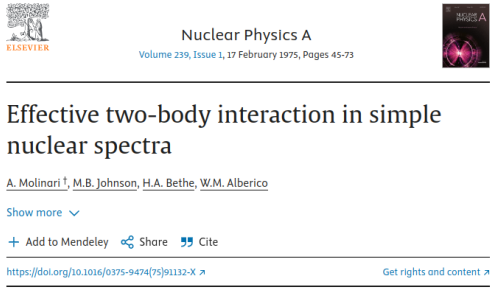
Quark-Gluon Plasma and Heavy Ion Collisions : past, present, future

Torino, "Luci d'artista" (photos by A. Colla)

Villa Gualino, Torino, Italy

7-12 March, 2011

Scientific activity: a good start



Nuclear Physics A
Volume 239, Issue 1, 17 February 1975, Pages 45-73

Effective two-body interaction in simple nuclear spectra

A. Molinari †, M.B. Johnson, H.A. Bethe, W.M. Alberico

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https://doi.org/10.1016/0375-9474(75)91132-X Get rights and content

Abstract

The low-lying spectra of some simple nuclei (two nucleons outside closed shells or the equivalent situations) are analyzed in terms of a force with a short range component, taken to be a delta force, and a long range core-mediated component. Formulas are given for the energy splitting among the members of the resulting multiplets. Both the cases of particles sitting in equivalent as well as in non-equivalent orbits are considered. An estimate of the contribution to the residual effective interaction from the different components of the fosy is obtained by means of a least fit to the data.

First published paper in collaboration with Bethe! Last citations in 2025

Quasi-elastic scattering on nuclei

Physics Letters B
Volume 92, Issues 1–2, 5 May 1980, Pages 153-159

Precursor of pion condensation: The softening of the quasi-elastic peak

W.M. Alberico [a b], M. Ericson [c d], A. Molinari [1]

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https://doi.org/10.1016/0370-2693(80)90326-3 Get rights and content

Abstract

The phase transition of pion condensation is heralded in the disordered phase by an increase in the life time of the fluctuations for the staggered magnetization. This precursor phenomenon entails, in ordinary nuclei, a showing down of the nuclear quasi-elastic response when observed with spin-sensitive probes.

Nuclear Physics A
Volume 379, Issue 3, 10 May 1982, Pages 429-448

Quenching and hardening in the transverse quasi-elastic peak

W.M. Alberico [a1 a2 *], M. Ericson [b1 b2], A. Molinari [a1 a2]

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https://doi.org/10.1016/0375-9474(82)90007-0 Get rights and content

Abstract

We study in the RPA framework the collective response of symmetric, infinite nuclear matter to a spin-isospin sensitive probe with both $\sigma \cdot q$ and $\sigma \times q$ couplings. The two responses, similar in the low-q region, differ markedly for moderate momenta ($\gtrsim 1$ fm^{-1}). Indeed the collective effect manifests itself quite differently in the two responses; whereas the longitudinal one displays a softening and an enhancement (due to the attractive character of the associated particle-hole force), the transverse response is quenched and hardened with respect to the free Fermi gas. The existing experimental data, which we analyze, are compatible with our results. We also explore the total strengths and find that for repulsive forces they are appreciably reduced by the RPA correlations. A large part of this quenching comes from the Δ-excitation (LLEE effect), but some reduction is still present even when the nucleonic degrees of freedom are neglected. This illustrates a violation of strength conservation brought about by the RPA correlations in the spin-isospin channel.

Starting point of fruitful international collaborations (CERN, MIT, CEBAF)

Quasi-elastic scattering on nuclei

PHYSICAL REVIEW C VOLUME 38, NUMBER 4 OCTOBER 1988

Scaling in electron scattering from a relativistic Fermi gas

W. M. Alberico and A. Molinari
Dipartimento di Fisica Teorica dell'Università di Torino and Istituto Nazionale di Fisica Nucleare, Sezione di Torino, Torino, Italy

T. W. Donnelly and E. L. Kronenberg
Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139

J. W. Van Orden
Continuous Electron Beam Accelerator Facility, Newport News, Virginia 23606 and Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742
(Received 16 February 1988)

Within the context of the relativistic Fermi gas model, the concept of "y scaling" for inclusive electron scattering from nuclei is investigated. Specific kinematic shifts of the single-nucleon response in the nuclear medium can be incorporated with this model. Suggested generalizations beyond the strict Fermi gas model, including treatments of separated longitudinal and transverse responses, are also explored.

Starting point of fruitful international collaborations (CERN, MIT, CEBAF)

The 2p2h response and its rediscovery

Annals of Physics
Volume 154, Issue 2, May 1984, Pages 356-395

The role of two particle-two hole excitations in the spin-isospin nuclear response

W.M. Alberico *, M. Ericson [a,b], A. Molinari [c,d]

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https://doi.org/10.1016/0003-4916(84)90155-6 Get rights and content

Abstract

We investigate the role of the 2*p*-2*h* states in the spin-isospin nuclear response function. This is done in the frame of a microscopic approach which includes the meson exchange currents and the nucleon-nucleon correlation. We first test our theory on the transverse response in the inclusive deep inclastic electron scattering, where we achieve a satisfactory agreement with the data for values of the momentum transfer ranging from 1 to 2 fm^{-1}. We next explore the *p*-wave pion-nucleus absorptive optical potential. We find that a strong (~3) Lorentz-Lorenz-Ericson-Ericson quenching factor is needed to reproduce in our framework the phenomenological optical potential deduced from π-mesic atom data. We also examine the real photon absorption cross section accounting rather satisfactorily for its behaviour, in particular for the Pauli blocking at small frequencies. Finally, we elucidate the conditions for the existence of a connection between the magnetic photon absorption and the *p*-wave pion absorption in nuclei.

Nuclear Physics A
Volume 726, Issues 3–4, 20 October 2003, Pages 303-326

The 2p–2h electromagnetic response in the quasielastic peak and beyond

A. De Pace [a], M. Nardi [a], W.M. Alberico [a], T.W. Donnelly [b], A. Molinari [a]

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Abstract

The contribution to the nuclear transverse response function R_T arising from two particle–two hole (2p–2h) states excited through the action of electromagnetic meson exchange currents (MEC) is computed in a fully relativistic framework. The MEC considered are those carried by the pion and by Δ degrees of freedom, the latter being viewed as a virtual nucleonic resonance. The calculation is performed in the relativistic Fermi gas model in which Lorentz covariance can be maintained. All 2p–2h many-body diagrams containing two pionic lines that contribute to R_T are taken into account and the relative impact of the various components of the MEC on R_T is addressed. The non-relativistic limit of the MEC contributions is also discussed and compared with the relativistic results to explore the role played by relativity in obtaining the 2p–2h nuclear response.

The 2p2h response and its rediscovery

PHYSICAL REVIEW D **91,** 073004 (2015)

Meson-exchange currents and quasielastic predictions for charged-current neutrino-^{12}C scattering in the superscaling approach

G. D. Megias,[1,*] T. W. Donnelly,[2] O. Moreno,[2] C. F. Williamson,[2] J. A. Caballero,[1] R. González-Jiménez,[1] A. De Pace,[3] M. B. Barbaro,[4,3] W. M. Alberico,[4,3] M. Nardi,[3] and J. E. Amaro[5]

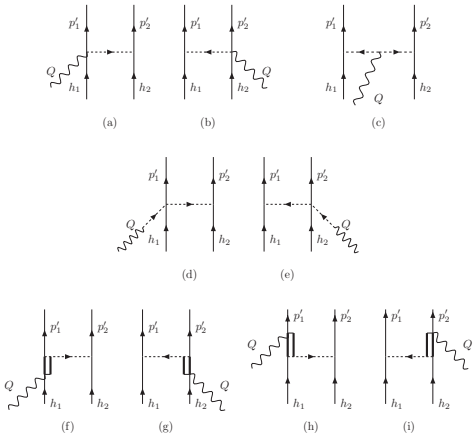
[1]*Departamento de Física Atómica, Molecular y Nuclear, Universidad de Sevilla, 41080 Sevilla, Spain*
[2]*Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA*
[3]*Istituto Nazionale di Fisica Nucleare, Sezione di Torino, Via Pietro Giuria 1, 10125 Torino, Italy*
[4]*Dipartimento di Fisica, Università di Torino, Sezione di Torino, Via Pietro Giuria 1, 10125 Torino, Italy*
[5]*Departamento de Física Atómica, Molecular y Nuclear and Instituto Carlos I de Física Teórica y Computacional, Universidad de Granada, 18071 Granada, Spain*

(Received 2 December 2014; revised manuscript received 9 March 2015; published 7 April 2015)

We evaluate and discuss the impact of meson-exchange currents (MECs) on charged-current quasielastic neutrino cross sections. We consider the nuclear transverse response arising from two-particle two-hole states excited by the action of electromagnetic, purely isovector meson-exchange currents in a fully relativistic framework based on the work by the Torino Collaboration [A. D. Pace, M. Nardi, W. M. Alberico, T. W. Donnelly, and A. Molinari, Nucl. Phys. A726, 303 (2003)]. An accurate parametrization of this MEC response as a function of the momentum and energy transfers involved is presented. Results of neutrino-nucleus cross sections using this MEC parametrization together with a recent scaling approach for the one-particle one-hole contributions (named SuSAv2) are compared with experimental data.

DOI: 10.1103/PhysRevD.91.073004 PACS numbers: 13.15.+g, 25.30.Pt, 24.10.Jv

The 2p2h response and its rediscovery



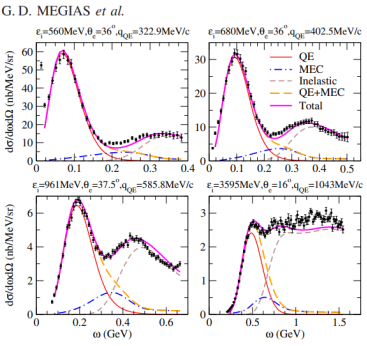


FIG. 6 (color online). Comparison of inclusive $^{12}C(e, e')$ cross sections and predictions of the QE(SuSAv2), MEC, and inelastic (SuSAv2) models at different set values of the position of the QE peak (q_{QE}), incident electron energy (ϵ_i), and the scattering angle (θ_e). Data taken from [40].

The (strange) structure of the proton

Nuclear Physics A
Volume 541, Issue 4, 25 May 1992, Pages 525-577

Parity-violating quasielastic electron scattering ☆

T.W. Donnelly, M.J. Musolf, W.M. Alberico, M.B. Barbaro, A. De Pace, A. Molinari

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https://doi.org/10.1016/0375-9474(92)90220-E ↗

Abstract

Parity-violating quasielastic electron scattering from nuclei is studied within the context of the relativistic Fermi gas model. Three issues are discussed: (i) the merits of such studies for obtaining new information about single-nucleon form factors, especially the roles played by the axial-vector and strangeness form factors, (ii) the degree to which the parity-violating asymmetry is sensitive to specifics of the nuclear model employed, and to a lesser extent (iii) the suitability of using quasielastic scattering from nuclei to test the standard model of the electroweak interaction. It is found that improved limits on the isovector axial form factor could be obtained from a backward angle, moderate momentum transfer measurement, while an experiment performed at forward angles and higher momentum transfer is sensitive to the strangeness electric form factor at a potentially significant level. In addition, it is argued that quasielastic parity-violating scattering is less suitable for high-precision standard model tests than are experiments performed in other sectors, but may provide an interesting new window on nuclear many-body processes.

The (strange) structure of the proton

Nuclear Physics A
Volume 623, Issues 3–4, 22 September 1997, Pages 471-497

Inelastic ν and ν scattering on nuclei and "strangeness" of the nucleon

W.M. Alberico [a], M.B. Barbaro [a], S.M. Bilenky [b,c], J.A. Caballero [d,1], C. Giunti [a], C. Maieron [a], E. Moya de Guerra [d], J.M. Udías [d,2]

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https://doi.org/10.1016/S0375-9474(97)00416-8

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Abstract

Possibilities to extract information on the strange form factors of the nucleon from neutrino (anti-neutrino) inelastic scattering on nuclei, in an energy range from 200 MeV to 1 GeV and more, are investigated in detail. All calculations are performed within two relativistic independent particle models (Fermi gas and shell model); the final state interactions of the ejected nucleon are taken into account through relativistic optical model potentials. We have shown that the values of the cross sections significantly depend on the nuclear model (especially in the lower energy range). However, the NC/CC neutrino-anti-neutrino asymmetry in a medium-high energy range shows a rather small dependence on the model and allows to disentangle different values of the parameters that characterize the strange form factors. We have calculated also the ratio of the cross sections for inelastic NC scattering of neutrinos on nuclei, with the emission of a proton and of a neutron. Our calculations show that at high neutrino energy this ratio depends rather weakly on the nuclear model and confirm previous conclusions on the rather strong dependence of this ratio upon the axial strange form factors; however, at $E_\nu \leqslant 200$ MeV, the FSI are found to significantly affect the ratio.

Physics Letters B
Volume 438, Issues 1–2, 15 October 1998, Pages 9-13

The ratio of p and n yields in NC $\nu(\bar{\nu})$ nucleus scattering and strange form factors of the nucleon

W.M. Alberico a, M.B. Barbaro a, S.M. Bilenky b, J.A. Caballero c [1], C. Giunti a, C. Maieron a, E. Moya de Guerra c, J.M. Udías c [2]

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https://doi.org/10.1016/S0370-2693(98)01043-0

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Full text access

Abstract

We calculate the ratio of proton and neutron yields in NC induced $\nu(\bar{\nu})$–nucleus inelastic scattering at neutrino energies of about 1 GeV. We show that this ratio depends very weakly on the nuclear models employed and that in ν and $\bar{\nu}$ cases the ratios have different sensitivity to the axial and vector strange form factors; moreover the ratio of $\bar{\nu}$–nucleus cross sections turns out to be rather sensitive to the electric strange form factor. We demonstrate that measurements of these ratios will allow to get information on the strange form factors of the nucleon in the region $Q^2 \geq 0.4$ GeV^2.

The (strange) structure of the proton

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Nuclear Physics A 651 (1999) 277–286

NUCLEAR PHYSICS A

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Strange form factors of the proton: a new analysis of the ν ($\overline{\nu}$) data of the BNL–734 experiment

W.M. Alberico [a], M.B. Barbaro [a], S.M. Bilenky [b,c], J.A. Caballero [d,e], C. Giunti [a], C. Maieron [f], E. Moya de Guerra [e], J.M. Udías [e,g]

[a] *INFN, Sezione di Torino and Dipartimento di Fisica Teorica, Università di Torino, Via P. Giuria 1, 10125 Turin, Italy*

[b] *Joint Institute for Nuclear Research, Dubna, Russia*

[c] *Institut für Theoretische Physik, Technische Universität Munchen, D-85748 Garching, Germany*

[d] *Dpto. de Física Atómica, Molecular y Nuclear, Universidad de Sevilla, Apdo. 1065, E-41080 Sevilla, Spain*

[e] *Instituto de Estructura de la Materia, CSIC, Serrano 123, E-28006 Madrid, Spain*

[f] *Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, MA 02139, USA*

[g] *Dpto. de Física Atómica, Molecular y Nuclear, Universidad Complutense de Madrid, E-28040 Madrid, Spain*

Received 17 December 1998; accepted 30 March 1999

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Physics Reports 358 (2002) 227–308

PHYSICS REPORTS

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Strangeness in the nucleon: neutrino–nucleon and polarized electron–nucleon scattering

W.M. Alberico[a,b,*], S.M. Bilenky[a,b,c,1], C. Maieron[a,b]

[a] *Dipartimento di Fisica Teorica, Università di Torino, Via P. Giuria 1, I0125 Torino, Italy*

[b] *INFN, Sezione di Torino, Italy*

[c] *Scuola Internazionale Superiore di Studi Avanzati (SISSA) I-34014 Trieste, Italy*

Received May 2001; editor: W. Weise

Contents

The (strange) structure of the proton

PHYSICAL REVIEW C **79**, 065204 (2009)

Electromagnetic form factors of the nucleon: New fit and analysis of uncertainties

W. M. Alberico,[1] S. M. Bilenky,[2,3] C. Giunti,[1] and K. M. Graczyk[1,4,*]

[1]*Dipartimento di Fisica Teorica, Università di Torino and INFN, Sezione di Torino, I-10125 Torino, Italy*

[2]*BLTP, JINR, RU-141980 Dubna, Russia*

[3]*Physics-Department E15, Technische Universität München, D-85748 Garching, Germany*

[4]*Institute of Theoretical Physics, University of Wrocław, pl. M. Borna 9, PL-50204 Wrocław, Poland*

(Received 18 December 2008; revised manuscript received 2 April 2009; published 23 June 2009)

Electromagnetic form factors of proton and neutron, obtained from a new fit of data, are presented. The proton form factors are obtained from a simultaneous fit to the ratio $\mu_p G_{Ep}/G_{Mp}$ determined from polarization transfer measurements and to ep elastic cross section data. Phenomenological two-photon exchange corrections are taken into account. The present fit for protons was performed in the kinematical region $Q^2 \in (0, 6)$ GeV^2. For both protons and neutrons we use the latest available data. For all form factors, the uncertainties and correlations of form factor parameters are investigated with the χ^2 method.

DOI: 10.1103/PhysRevC.79.065204 PACS number(s): 13.40.Gp, 14.20.Dh, 13.60.Fz

Hypernuclei

ELSEVIER

Physics Letters B

Volume 256, Issue 2, 7 March 1991, Pages 134-140

Two-nucleon induced Λ decay in nuclei

W.M. Alberico [a c], A. De Pace [a c], M. Ericson [b c], A. Molinari [a c]

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https://doi.org/10.1016/0370-2693(91)90663-B ↗ Get rights and content ↗

Abstract

The pionic channel of Λ decay in nuclei is forbidden by the Pauli principle. We discuss the decay in another state, the pion branch, a collective state which is a coherent nuclear stperposition of pionic and Δ-h state and which lies at an energy lower than the physical pion. Its decay mode in the region concerned here is by two-particle emission. The Λ decay process is then a two-nucleon induced one: $\Lambda+p+n \rightarrow p+n+n$. We find a sizeable branching ratio.

PHYSICAL REVIEW C, VOLUME 61, 044314

Weak decays of medium and heavy Λ hypernuclei

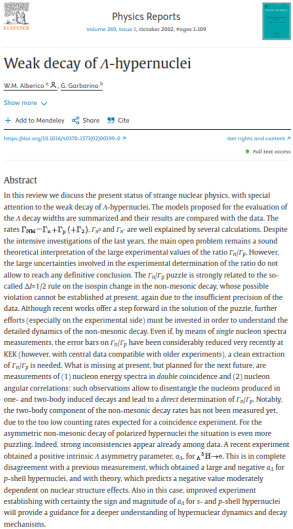
W. M. Alberico, A. De Pace, and G. Garbarino
Dipartimento di Fisica Teorica, Universitá di Torino and INFN, Sezione di Torino, I-10125 Torino, Italy

A. Ramos
Departament d'Estructura i Constituents de la Matèria, Universitat de Barcelona, E-08028 Barcelona, Spain
(Received 4 February 1999; published 10 March 2000)

We have made a new evaluation of the Λ decay width in nuclear matter within the propagator method. Through the local density approximation it is possible to obtain results in finite nuclei. We have also studied the dependence of the widths on the NN and ΛN strong short-range correlations. Using reasonable values for the parameters that control these correlations, as well as realistic nuclear densities and Λ wave functions, we show that it is possible to reproduce the experimental decay rates in a wide range of mass numbers (from medium to heavy hypernuclei); however, the question related to the Γ_n/Γ_p ratio remains open.

PACS number(s): 21.80.+a, 13.75.Ev, 25.40.−h, 24.10.Lx

Hypernuclei



Physics Reports
Volume 369, Issue 1, October 2002, Pages 1-109

Weak decay of Λ-hypernuclei

W.M. Alberico [a], G. Garbarino [b]

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https://doi.org/10.1016/S0370-1573(02)00199-0

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Abstract

In this review we discuss the present status of strange nuclear physics, with special attention to the weak decay of Λ-hypernuclei. The models proposed for the evaluation of the Λ decay widths are summarized and their results are compared with the data. The rates $\Gamma_{\mathrm{NM}}(=\Gamma_n+\Gamma_p(+\Gamma_2))$, $\Gamma_{n'}$ and $\Gamma_{n''}$ are well explained by several calculations. Despite the intensive investigations of the last years, the main open problem remains a sound theoretical interpretation of the large experimental values of the ratio Γ_n/Γ_p. However, the large uncertainties involved in the experimental determination of the ratio do not allow to reach any definitive conclusion. The Γ_n/Γ_p puzzle is strongly related to the so-called $\Delta I=1/2$ rule on the isospin change in the non-mesonic decay, whose possible violation cannot be established at present, again due to the insufficient precision of the data. Although recent works offer a step forward in the solution of the puzzle, further efforts (especially on the experimental side) must be invested in order to understand the detailed dynamics of the non-mesonic decay. Even if, by means of *single* nucleon spectra measurements, the error bars on Γ_n/Γ_p have been considerably reduced very recently at KEK (however, with central data compatible with older experiments), a clean extraction of Γ_n/Γ_p is needed. What is missing at present, but planned for the next future, are measurements of (1) nucleon energy spectra in *double* coincidence and (2) nucleon angular correlations: such observations allow to disentangle the nucleons produced in one- and two-body induced decays and lead to a *direct* determination of Γ_n/Γ_p. Notably, the two-body component of the non-mesonic decay rates has not been measured yet, due to the too low counting rates expected for a coincidence experiment. For the asymmetric non-mesonic decay of polarized hypernuclei the situation is even more puzzling. Indeed, strong inconsistencies appear already among data. A recent experiment obtained a positive intrinsic Λ asymmetry parameter, a_Λ for ${}^5_\Lambda\mathrm{He}$-n. This is in complete disagreement with a previous measurement, which obtained a large and negative a_Λ for p-shell hypernuclei, and with theory, which predicts a negative value moderately dependent on nuclear structure effects. Also in this case, improved experiment establishing with certainty the sign and magnitude of a_Λ for s- and p-shell hypernuclei will provide a guidance for a deeper understanding of hypernuclear dynamics and decay mechanisms.

and, finally, hot deconfined matter!

PHYSICAL REVIEW D **84,** 094004 (2011)

Recent thermodynamic results from lattice QCD analyzed within a quasiparticle model

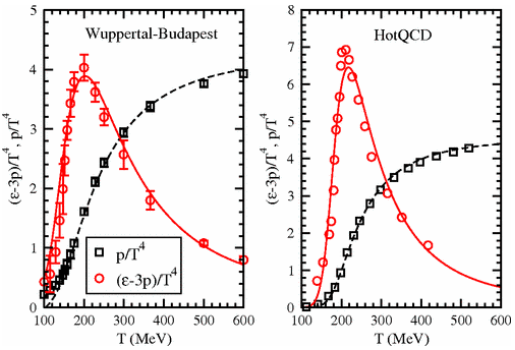
Salvatore Plumari,[1,2] Wanda M. Alberico,[3,4] Vincenzo Greco,[1,2] and Claudia Ratti[3,4]

[1]*Department of Physics and Astronomy, University of Catania, Via S. Sofia 64, I-95125 Catania, Italy*
[2]*Laboratorio Nazionale del Sud, INFN-LNS, Via S. Sofia 63, I-95125 Catania, Italy*
[3]*Dipartimento di Fisica Teorica, Universitá degli Studi di Torino via P. Giuria 1, I-10125 Torino, Italy*
[4]*INFN, Sezione di Torino, Italy*

(Received 29 March 2011; published 4 November 2011)

The thermodynamic behavior of QCD matter at high temperature is currently studied by lattice QCD theory. The main features are the fast rise of the energy density ϵ around the critical temperature T_c and the large trace anomaly of the energy momentum tensor $\langle\Theta^\mu_\mu\rangle = \epsilon - 3P$, which hints at a strongly interacting system. Such features can be accounted for by employing a massive quasiparticle model with a temperature-dependent bag constant. Recent lattice QCD calculations with physical quark masses by the Wuppertal-Budapest group show a slower increase of ϵ and a smaller $\langle\Theta^\mu_\mu\rangle$ peak with respect to previous results from the HotQCD Collaboration. We investigate the implications of such differences from the point of view of a quasiparticle model, also discussing light and strange quark number susceptibilities. Furthermore, we predict the impact of these discrepancies on the temperature dependence of the transport properties of matter, like the shear and bulk viscosities.

DOI: 10.1103/PhysRevD.84.094004 PACS numbers: 12.38.Mh, 25.75.−q



and, finally, hot deconfined matter!

PHYSICAL REVIEW D **95,** 094511 (2017)

Excluded-volume effects for a hadron gas in Yang-Mills theory

Paolo Alba,[1,*] Wanda Maria Alberico,[2,†] Alessandro Nada,[2,‡] Marco Panero,[2,§] and Horst Stöcker[1,3,4,‖]

[1]*Frankfurt Institute for Advanced Studies, Goethe Universität Frankfurt, Ruth-Moufang-Straße 1, D-60438 Frankfurt am Main, Germany*

[2]*Department of Physics, University of Turin & INFN, Turin, Via Pietro Giuria 1, I-10125 Turin, Italy*

[3]*Institut für Theoretische Physik, Goethe Universität Frankfurt, Max-von-Laue-Straße 1, D-60438 Frankfurt am Main, Germany*

[4]*GSI Helmholtzzentrum für Schwerionenforschung GmbH, Planckstraße 1, D-64291 Darmstadt, Germany*

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When the multiplicities of particles produced in heavy-ion collisions are fitted to the hadron-resonance-gas model, excluded-volume effects play a significant role. In this work, we study the impact of such effects on the equation of state of pure Yang-Mills theory at low temperatures, comparing the predictions of the statistical model with lattice results. In particular, we present a detailed analysis of the SU(2) and SU(3) Yang-Mills theories: we find that, for both of them, the best fits to the equilibrium thermodynamic quantities are obtained when one assumes that the volume of different glueball states is inversely proportional to their mass. The implications of these findings for QCD are discussed.

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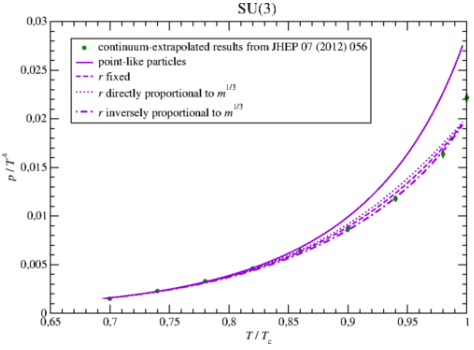

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Physica A 387 (2008) 467–475

PHYSICA A

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Signals of non-extensive statistical mechanics in high energy nuclear collisions

W.M. Alberico[a,b], P. Czerski[c], A. Lavagno[d,b,*], M. Nardi[a,b], V. Somá[a]

[a] *Dipartimento di Fisica Teorica, Università di Torino, Via P. Giuria 1, I-10126 Torino, Italy*
[b] *Istituto Nazionale di Fisica Nucleare, Sezione di Torino, Italy*
[c] *The Henryk Niewodniczanski Institute of Nuclear Physics, Polish Academy of Sciences, Krakow, Poland*
[d] *Dipartimento di Fisica, Politecnico di Torino, C.so Duca degli Abruzzi 24, I-10129 Torino, Italy*

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Abstract

We investigate, from a phenomenological point of view, the relevance of non-conventional statistical mechanics effects on the rapidity spectra of net proton yield at AGS, SPS and RHIC. We show that the broad rapidity shape measured at RHIC can be very well reproduced in the framework of a non-linear relativistic Fokker–Planck equation which incorporates non-extensive statistics and anomalous diffusion.

Keywords: Non-extensive statistical mechanics; Rapidity spectra; Relativistic heavy ion collisions

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PHYSICAL REVIEW D **75,** 065004 (2007)

Mesonic correlation functions at finite temperature and density in the Nambu–Jona-Lasinio model with a Polyakov loop

H. Hansen,[1,*] W. M. Alberico,[1] A. Beraudo,[2] A. Molinari,[1] M. Nardi,[1] and C. Ratti[3]

[1]*INFN, Sezione di Torino and Dipartimento di Fisica Teorica, University of Torino, via Giuria N.1, 10125 Torino, Italy*
[2]*Service de Physique Théorique, CEA Saclay, CEA/DSM/SPhT, F-91191, Gif-sur-Yvette, France*
[3]*ECT*, 38050 Villazzano (Trento), Italy and INFN, Gruppo Collegato di Trento, via Sommarive, 38050 Povo (Trento), Italy*

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We investigate the properties of scalar and pseudoscalar mesons at finite temperature and quark chemical potential in the framework of the Nambu–Jona-Lasinio (NJL) model coupled to the Polyakov loop (PNJL model) with the aim of taking into account features of both chiral symmetry breaking and deconfinement. The mesonic correlators are obtained by solving the Schwinger-Dyson equation in the RPA approximation with the Hartree (mean field) quark propagator at finite temperature and density. In the phase of broken chiral symmetry, a narrower width for the σ meson is obtained with respect to the NJL case; on the other hand, the pion still behaves as a Goldstone boson. When chiral symmetry is restored, the pion and σ spectral functions tend to merge. The Mott temperature for the pion is also computed.

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Transport properties and Langevin dynamics of heavy quarks and quarkonia in the Quark Gluon Plasma

A. Beraudo [a,b,*], A. De Pace [b], W.M. Alberico [a,b], A. Molinari [a,b]

[a] *Dipartimento di Fisica Teorica dell'Università di Torino, via P. Giuria 1, I-10125 Torino, Italy*
[b] *Istituto Nazionale di Fisica Nucleare, Sezione di Torino, via P. Giuria 1, I-10125 Torino, Italy*

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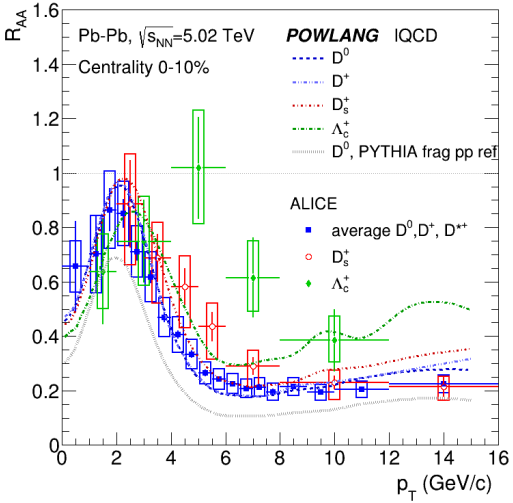
Abstract

Quark Gluon Plasma transport coefficients for heavy quarks and $Q\overline{Q}$ pairs are computed through an extension of the results obtained for a hot QED plasma by describing the heavy-quark propagation in the eikonal approximation and by weighting the gauge-field configurations with the Hard Thermal Loop effective action. It is shown that such a model allows to correctly reproduce, at leading logarithmic accuracy, the results obtained by other independent approaches. The results are then inserted into a relativistic Langevin equation allowing to follow the evolution of the heavy-quark momentum spectra. Our numerical findings are also compared with the ones obtained in a strongly-coupled scenario, namely with the transport coefficients predicted (though with some limitations and ambiguities) by the AdS/CFT correspondence.

PACS: 11.10.Wx; 12.38.Mh; 14.65.Dw; 14.65.Fy; 21.65.Qr; 25.75.Cj; 25.75.Nq

Keywords: Quark Gluon Plasma; Heavy quarks; Transport; Hard Thermal Loop; Langevin equation



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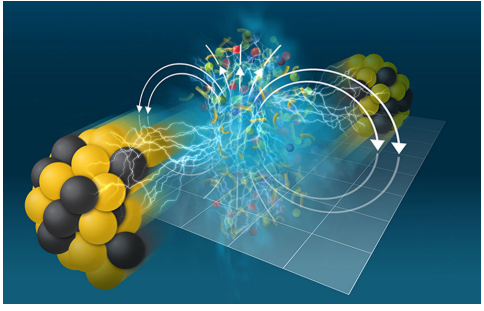

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THE EUROPEAN PHYSICAL JOURNAL C

CrossMark

Regular Article - Theoretical Physics

Non-relativistic approximate numerical ideal-magneto-hydrodynamics of (1+1D) transverse flow in Bjorken scenario

M. Haddadi Moghaddam[1,3], B. Azadegan[1], A. F. Kord[1,2,a], W. M. Alberico[3]

[1] Department of Physics, Hakim Sabzevari University (HSU), P.O. Box 397, Sabzevar, Iran
[2] Institute for Research in Fundamental Sciences(IPM), P.O. Box 19395-5531, Tehran, Iran
[3] Department of Physics, University of Turin and INFN, Turin, Via P. Giuria 1, 10125 Turin, Italy

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Abstract In this study, we investigate the impact of the magnetic field on the evolution of the transverse flow of QGP matter in the magneto-hydrodynamic (MHD) framework. We assume that the magnetic field is perpendicular to the reaction plane and then we solve the coupled Maxwell and conservation equations in (1+1D) transverse flow, within the Bjorken scenario. We consider a QGP with infinite electrical conductivity. First, the magnetic effects on the QGP medium at mid-rapidity are investigated at leading order; then the time and space dependence of the energy density, velocity and magnetic field in the transverse plane of the ideal magnetized hot plasma are obtained.

fields may be important for a variety of new phenomena like the Chiral Magnetic Effect (CME), Chiral Magnetic Wave (CMW), Chiral Electric Separation Effect (CESE), Chiral Hall Separation Effect (CHSE), pressure anisotropy in QGP, influence on the direct and elliptic flow, shift of the critical temperature. A series of reviews and more references can be found in Refs. [7–26]. Hence, it will be worth to further investigate the properties of the QGP in the presence of EM fields.

There have been several works which have explored the behavior of the space-time evolution of electromagnetic fields created by the colliding charged beams moving at rel-

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THE EUROPEAN PHYSICAL JOURNAL C

Regular Article - Theoretical Physics

Isentropic evolution of the matter in heavy-ion collisions and the search for the critical endpoint

Mario Motta[1,2,a], **Rainer Stiele**[2,3,4], **Wanda Maria Alberico**[1,2], **Andrea Beraudo**[2]

[1] Dipartimento di Fisica, Università degli Studi di Torino, Via Pietro Giuria 1, 10125 Turin, Italy
[2] INFN, Sezione di Torino, Via Pietro Giuria 1, 10125 Turin, Italy
[3] Département de Physique, ENS de Lyon, Univ Lyon, F-69342 Lyon, France
[4] Univ Lyon, Univ Claude Bernard Lyon 1, CNRS/IN2P3, IP2I Lyon, 69622 Villeurbanne, France

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Abstract We study the isentropic evolution of the matter produced in relativistic heavy-ion collisions for various values of the entropy-per-baryon ratio of interest for the ongoing and future experimental searches for the critical endpoint (CEP) in the QCD phase diagram: these includes the current beam-energy-scan (BES) program at RHIC and the fixed-target collisions foreseen for the near future at various facilities. We describe the hot-dense matter through two different effective Lagrangians: the PNJL (Polyakov–Nambu–Jona–Lasinio) and the PQM (Polyakov-quark-meson) models. We focus on quantities expected to have a direct experimental relevance: the speed of sound, responsible for the collective acceleration of the fireball, and the generalized susceptibilities, connected to the cumulants of the distributions of conserved charges. In principle they should affect the momentum spectra and the event-by-event fluctuations of the yields of identified particles. Taking realistic values for the initial temperature and the entropy-per-baryon ratio we study the temporal evolution of the above quantities looking for differences along isentropic trajectories covering different regions of the QCD phase diagram, passing far or close to the CEP or even intersecting the first-order critical line.

teris negligible, quarks and gluons are "newly" produced particles arising from the strong colour fields in the overlapping region. Quarks and gluons form a thermalized plasma undergoing an almost adiabatic expansion during which the latter cools down until reaching a temperature at which colour-singlet hadrons become again the active degrees of freedom.

First-principle lattice-QCD simulations show that, at vanishing baryon density (i.e. at baryo-chemical potential $\mu_B = 0$), the transition connecting the partonic and hadronic phases is actually a smooth crossover [1]. This is the regime of relevance for the nuclear collisions at the LHC ($\sqrt{s_{NN}} = 2.76$ and 5.02 TeV) and at the highest center-of-mass energy at RHIC ($\sqrt{s_{NN}} = 200$ GeV) and this corresponds also to the regime at which the QCD transition occurred during the thermal history of the universe, around 1 μs after the Big Bang, when the temperature reached a value around 150–160 MeV [2].

Unfortunately, due to the sign problem which prevents a Monte-Carlo sampling of the gauge-field configurations, lattice-QCD simulations cannot provide definite answers on the QCD thermodynamics and phase structure at finite baryon density, except for sufficiently small values of μ_B/T where, for instance, one can perform a Taylor expansion around