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Timelike Compton Scattering Off the Nucleon Jun 05 2020 Hard exclusive processes such as photoproduction or electroproduction of photon or meson off the nucleon provide access to the Generalized Parton Distributions (GPDs), in the regime where the scattering amplitude is factorized into a hard and a soft part. GPDs contain the correlation between the longitudinal momentum fraction and the transverse spatial densities of quarks and gluons in the nucleon. Timelike Compton Scattering (TCS) correspond to the reaction gammaN --> gamma*N --> e+e?N, where the photon is scattered off a quark. It is measured through its interference with the associated Bethe-Heitler process, which has the same final state. TCS allows to access the GPDs and test their universality by comparison to the results obtained with the DVCS process (eN --> e gamma N). Also, results obtained with TCS provide additional independent constrains to the GPDs parameterization. We will present the physical motivations for TCS, with our theoretical predictions for TCS observables and their dependencies. We calculated for JLab 12 GeV energies all the single and double beam and/or target polarization observables off the proton and off the neutron. We will also present the experimental perspectives for the next years at JLab. Two proposals were already accepted at JLab: in Hall B, with the CLAS12 spectrometer, in order to measure the unpolarized cross section and in Hall A, with the SoLID spectrometer, in order to measure the unpolarized cross section and the beam spin asymmetry at high intensity. A Letter Of Intent was also submitted in order to measure the transverse target spin asymmetries in Hall C. We will discuss the merits of this different experiments and present some of the expected results.

The Nucleon Spin as Cause of the Strong Interaction Feb 06 2023 This work is a translation of the German edition "Der Nukleonenspin als Ursache der starken Wechselwirkung". (Dec. 2020). The strong interaction is supposed to describe the forces which are active in the atomic nucleus between the nuclear building blocks. Until today, however, it has not been possible to design a theory free of contradictions. Instead, in the 1970s, the theory of "quantum chromodynamics" emerged, in which the name itself is based on an analogy. Just like the "color charges" mentioned as cause of the interaction. The question is only: Analogy to what and due to which energy? Because either it refers to the electric energy, then there would have to be some kind of electric parallel energy, but this is nonsensical. Or it doesn't refer to the electric energy, then it must be a form of energy which already exists. But quantum chromodynamics makes no statement about this. This QCD theory standing on shaky feet thus virtually challenges the contradiction. In order to oppose this very artificial theory with a down-to-earth one, it is important to keep in mind the basics of the known interactions. All particle systems can build up only if their particles have besides their energy also an opposite property by which they can interact. The simplest system is a binary system, e.g. a common salt crystal. The opposite properties are the electrically positive and negative charge of the ions. But which opposite property enables an interaction of the nucleons? It cannot be an electric charge. The astonishing answer to this question is given in this paper at the end. It also becomes clear that quantum chromodynamics is a fallacy. For a better understanding, contents of earlier publications of the author are partly included.

Models of the Nucleon Apr 08 2023

Three-Dimensional Partonic Structure of the Nucleon Feb 23 2022 The three-dimensional nucleon structure is central to many theoretical and experimental activities, and research in this field has seen many advances in the last two decades, addressing fundamental questions such as the orbital motion of quarks and gluons inside the nucleons, their spatial distribution, and the correlation between spin and intrinsic motion. A real three-dimensional imaging of the nucleon as a composite object, both in momentum and coordinate space, is slowly emerging.This book presents lectures and seminars from the Enrico Fermi School Three-Dimensional Partonic Structure of the Nucleon, held in Varenna,

Strangeness and Charge Symmetry Violation in Nucleon Structure Apr 15 2021 This thesis discusses two key topics: strangeness and charge symmetry violation (CSV) in the nucleon. It also provides a pedagogical introduction to chiral effective field theory tailored to the high-precision era of lattice quantum chromodynamics (QCD). Because the nucleon has zero net strangeness, strange observables give tremendous insight into the nature of the vacuum; they can only arise through quantum fluctuations in which strange–antistrange quark pairs are generated. As a result, the precise values of these quantities within QCD are important in physics arenas as diverse as precision tests of QCD, searches for physics beyond the Standard Model, and the interpretation of dark matter direct-detection experiments. Similarly, the precise knowledge of CSV observables has, with increasing experimental precision, become essential to the interpretation of many searches for physics beyond the Standard Model. In this thesis, the numerical lattice gauge theory approach to QCD is combined with the chiral perturbation theory formalism to determine strange and CSV quantities in a diverse range of observables including the octet baryon masses, sigma terms, electromagnetic form factors, and parton distribution functions. This thesis builds a comprehensive and coherent picture of the current status of understanding of strangeness and charge symmetry violation in the nucleon.

Explicit Quark Degrees of Freedom in the Nucleon-nucleon Interaction Dec 12 2020

Polarization, Motion and Fragmentation Dec 24 2021

Understanding the Nucleon's Spin Structure Jun 17 2021 A modern understanding of the nucleon's spin structure is presented. Polarisation dependent deep inelastic experiments have shown that the helicity contribution of quarks to the nucleon spin is much smaller than expected from the simple quark model. This observation and the role of the triangle anomaly lead to the conclusion that gluons - if strongly polarised, might solve the spin problem of the nucleon. Therefore a direct gluon polarisation measurement is the one of main goals of the COMPASS experiment spin physics programme. New results for the gluon polarisation are obtained. The results strongly support the hypothesis, that the gluons inside the nucleon are weakly or not polarised. Therefore, the possible importance of quark and gluon angular momenta are discussed. A short review of the nucleon's spin structure results obtained in a Lattice Quantum Chromodynamics approach is presented. The concept that the presence of the angular momentum of quarks inside nucleon is related to the spatial deformation of the quark densities in the transverse plane is also reviewed.

Nucleon-Nucleon and Nucleon-Antinucleon Interactions Nov 10 2020 This volume contains the Proceedings of the "XXIV. Inter nationale Universitatswochen fur Kernphysik" held in Schlad ming, Austria, in February 1985. It consists of the written versions of the lectures (3-4 hours) given at this winter school and includes also most of the seminars (30-50 minutes) presented. In choosing the topic for the 1985 meeting, our aim was to give an account of the present understanding of the nucleon-nucleon as well as nucleon-antinucleon inter actions. This field, which is of definite relevance in nuclear and particle physics, has witnessed a rapid develop ment in recent times both in theory and experiment. New evidence has emerged in the whole range from low to extremely high energies. It was an exciting experience to bring to gether knowledge from the very domains of nuclear and high energy physics as well as to meet the respective researchers. Thanks to the efforts of the lecturers, who did a splendid job in presenting the lectures and in preparing their lecture notes, a comprehensive insight into the hadronic interaction between nucleons and anti-nucleons was achieved. The lecture notes were reconsidered by the authors after the meeting and are now being published in their final form. The seminars mainly dealt with specific topics currently under investiga tion within this rather wide field. We are grateful to all authors for their efforts, as they made it possible to speed up the publication of these proceedings.

Nucleon Resonances in the Nucleon-nucleon Interaction Mar 15 2021

Quarks and Gluons in the Nucleon Sep 20 2021 The purpose of the symposium was to discuss the quark and gluon structure of the nucleon as probed experimentally by hard processes with lepton and hadron beams and studied theoretically by perturbative QCD, lattice QCD and effective models on the one hand and to stimulate research activities in the fields related to RHIC and RHIC-SPIN projects on the other hand. There were 18 talks and 2 discussion sessions. About 50, including 5 from abroad participated in the symposium. An excellent summary in the form of 5 most important transparencies and a one-page explanation is included for each of the invited talks.

The Structure of the Nucleon Mar 07 2023 As the only stable baryon, the nucleon is of crucial importance in particle physics. Since the nucleon is a building block for all atomic nuclei, there is a need to analyse the its structure in order to fully understand the essential properties of all atomic nuclei. After more than forty years of research on the nucleon, both the experimental and theoretical situations have matured to a point where a synthesis of the results becomes indispensable. Here, A.W. Thomas and W. Weise present a unique report on the extensive empirical studies, theoretical foundations and the different models of the nucleon. The appendices provide an extensive summary of formulae needed in practical calculations. From the contents: electromagnetic structure of the nucleon, weak probes of nucleon structure, deep inelastic lepton scattering on the nucleon; elements of QCD, aspects of non-perturbative QCD, Chiral Symmetry and nucleon structure, models of the nucleon

Measurement of R in the Nucleon Resonance Region on Deuterium and the Non-Singlet Moments of the Nucleon Nov 03 2022

Particles and Nuclei Jul 19 2021 This well-known introductory textbook gives a uniform presentation of nuclear and particle physics from an experimental point of view. The first part, Analysis, is devoted to disentangling the substructure of matter. This part shows that experiments designed to uncover the substructures of nuclei and nucleons have a similar conceptual basis, and lead to the present picture of all matter being constructed from a small number of elementary building blocks and a small number of fundamental interactions. The second part, Synthesis, shows how the elementary particles may be combined to build hadrons and nuclei. The fundamental interactions, which are responsible for the forces in all systems, become less and less evident in increasingly complex systems. Such systems are in fact dominated by many-body phenomena. A section on neutrino oscillations and one on nuclear matter at high temperatures bridge the field of "nuclear and particle physics" and "modem astrophysics and cosmology. The seventh revised and extended edition includes new material, in particular the experimental verification of the Higgs particle at the LHC, recent results in neutrino physics, the violation of CP-symmetry in the decay of neutral B-mesons, the experimental investigations of the nucleon's spin structure and outstanding results of the HERA experiments in deep-inelastic electron- and positron-proton scattering. The concise text is based on lectures held at the University of Heidelberg and includes numerous exercises with worked answers. It has been translated into several languages and has become a standard reference for advanced undergraduate and graduate courses.

Polarized Structure Functions of the Nucleon in the Resonance Region, January 1994 Jan 01 2020

The Resonance in the nucleon-nucleon interaction Jan 31 2020

Nucleon Correlations in Nuclei Sep 01 2022 In recent years there has been growing interest in the nucleon-nucleon correl ations inside nuclei. In many respects the motions of the nucleons can be very well described by an overall mean field, so that the motion of each nucleon is governed by the mean field due to all the other nucleons. This concept underlies the Fermi-gas, Hartree-Fock and shell models and has enabled a range of nuclear properties to be calculated, often to surprising accuracy. It gradually became clear, however, that these mean-field models are limited by the effects due to the very strong interactions between the nucleons that occur at short distances; these are the short-range correlations. They are responsible for instance for the high-momentum components in the nucleon momentum dis tribution, and prevent the simultaneous description of the nuclear density and momentum distributions by the same mean field. It thus becomes necessary to develop methods for including the effects of nucleon correlations in nuclei, and these are the main subject of this book. Some related problems of nuclear structure were discussed in an earlier book by the same authors: Nucleon Momentum and Density Distributions in Nuclei (Clarendon Press, Oxford, 1988). The main aim of that book was to study the effects of nucleon-nucleon correlations, both short-range and tensor, on the nucleon momentum distribution, which is particularly sensitive to these correl ations, and on the nucleon density distribution.

Strangeness in the Nucleon Apr 27 2022

The Structure of the Proton May 17 2021 This graduate/research level book describes our present knowledge of protons and neutrons, the particles which make up the nucleus of the atom. Experiments using high energy electrons, muons and neutrinos reveal the proton as being made up of point-like constituents, quarks. The strong forces which bind the quarks together are described in terms of the modern theory of quantum chromodynamics (QCD), the â€˜glue' binding the quarks being mediated by new constituents called gluons. Larger and new particle accelerators probe the interactions between quarks and gluons at shorter distances. The understanding of this detailed substructure and of the fundamental forces responsible is one of the keys to unravelling the physics of the structure of matter. This book will be of interest to all theoretical and experimental particle physicists.

Mémoire à consulter et consultation pour la dame Anne-Rose Cabibel, veuve Calas, et pour ses enfans May 29 2022

The Role of Quark Excitation in the Nucleon Self Energy Jan 13 2021

Electromagnetic Structure of the Nucleon in Local-field Theory Oct 10 2020

Hadron-Nucleus Interactions in the Nucleon Resonance Region Jun 29 2022

The Pion-Nucleon System Aug 08 2020 Synthesizing the theoretical and experimental advances in pion-nucleon interactions over approximately the last twelve years, the authors offer here a timely account of the hadronic interactions of pions and nucleons and of the structure of nucleons. Because of the hadronic SU3 symmetry, the book also treats the structure of baryons in general, and so contains much material external to the specific field of pion-nucleon interactions. Thus the book's subject can be stated as the hadronic structure of baryons as illustrated particularly by pion-nucleon interaction. Following an introductory discussion of isotopic spin, the authors proceed to chapters that treat low energy pion scattering by nucleons and the photoproduction of pions; forward and fixed momentum transfer dispersion relations; analytic properties of scattering amplitudes; formation of nucleon resonances; symmetries and classification of particles and resonances; current algebra, sum rules, and superconvergence relations; scattering at higher energies; pion-nucleon dynamics; pion-nucleon inelastic scattering; and the form factors of the nucleon and the pion. Each chapter is followed by abundant references to the original literature. The level of the writing is suitable for students at the graduate level, and the presentation is even and self-contained. On balance, the authors have prepared a useful consolidation and review of this difficult and changing area of investigation. Originally published in 1973. The Princeton Legacy Library uses the latest print-on-demand technology to again make available previously out-of-print books from the distinguished backlist of Princeton University Press. These editions preserve the original texts of these important books while presenting them in durable paperback and hardcover editions. The goal of the Princeton Legacy Library is to vastly increase access to the rich scholarly heritage found in the thousands of books published by Princeton University Press since its founding in 1905.

Symposium on the Internal Spin Structure of the Nucleon Feb 11 2021

Compton Scattering Oct 22 2021 A comprehensive summary of experiments on Compton scattering from the proton and neutron performed at the electron accelerator MAMI. The experiments cover a photon energy range from 30 MeV to 500 MeV. The reader is introduced to the theoretical concepts of Compton scattering, followed by a description of the experiments on the proton, their analysis and results.

Polarized Structure Functions of the Nucleon in the Resonance Region Jul 07 2020

Spin Structure of the Nucleon Jul 31 2022 Readership: Nuclear physicists. keywords:

Flavor Decomposition of the Polarized Quark Distributions in the Nucleon from Inclusive and Semi-inclusive Deep Inelastic Scattering Apr 03 2020
Parity Violation in Elastic Electron-nucleon Scattering Aug 20 2021
Quark Orbital-angular-momentum Distribution in the Nucleon Nov 22 2021
Strangeness in the Nucleon Jan 05 2023
Parity Violation in Elastic Electron-nucleon Scattering Sep 08 2020
Excited Nucleons and Hadronic Structure Jan 25 2022 The conference NSTAR 2000 was part of a series of conferences and workshops that began in New York in 1988. Since then, the field of excited nucleons and hadron structure has developed enormously, and the scope has broadened. Most significantly, new experimental facilities have come into operation, allowing precise measurements of resonance couplings and transition form factors. The search for ?missing? quark model states and gluonic excitations in complex hadronic channels is now possible.On the theory side, new and promising developments have emerged: quark models with meson degrees of freedom, hybrid baryon models, and studies of baryons in the limit of many colors. For the first time, lattice QCD has been employed to calculate masses of excited nucleons. Nucleon resonances are now recognized as providing significant contributions to the nucleon spin sum rules, as well as the Gerasimov-Drell-Hearn and Bjorken integrals, at finite momentum transfer.
Three-Dimensional Partonic Structure of the Nucleon Oct 02 2022
Strange Quarks in the Nucleon Sea Mar 03 2020 The HAPPEX Collaboration measured parity-violating electron scattering from 4He(e, e) and H(e, e) in 2004 and 2005 for Q2 (less-than or equal to) 0.11 GeV2. Results for the strange-quark contributions to the electromagnetic form factors of the nucleon from the 2004 data will be reviewed. Preliminary results from the 2005 data, which have significantly greater statistical precision, are GsE = 0.004 0.014stat 0.013syst for Q2 = 0.0772 GeV2 from the helium data and GsE + 0.088 GsM = 0.004 0.011stat 0.005syst 0.004FF for Q2 = 0.1089 GeV2 from the hydrogen data.
The (p,n) Reaction and the Nucleon-Nucleon Force May 09 2023 This volume contains the proceedings of the "Conference on the (p,n) Reaction and the Nucleon-Nucleon Force" held in Telluride, Colorado, March 29-31, 1979. The idea to hold this conference grew out of a program at the Indiana University Cyclotron Facility to study the (p,n) reaction in the 50-200 MeV energy range. The first new Indiana data, in contrast to low energy data, showed features suggestive of a dominant one pion exchange interaction. It seemed desir able to review what was known about the fre·e and the effective nucleon-nucleon force and the connection between the low and high energy (p,n) data. Thus the conference was born. The following people served as the organizing committee: S. M. Austin, Michigan State University W. Bertozzi, Massachusetts Institute of Technology S. D. Bloom, Lawrence Livermore Laboratory C. C. Foster, Indiana University C. D. Goodman, Oak Ridge National Laboratory (Conference Chairman) D. A. Lind, University of Colorado J. Rapaport, Ohio University G. R. Satch1er, Oak Ridge National Laboratory G. E. Walker, Indiana University R. L. Walter, Duke University and TUNL The sponsoring organizations were: Indiana University, Bloomington, Indiana University of Colorado, Boulder, Colorado Oak Ridge National Laboratory, Oak Ridge, Tennessee Triangle Universities Nuclear Laboratory, Durham, North Carolina Of course, the major credit for the success of the con ference must go to the speakers who diligently prepared their talks that are reproduced in this volume.
Proceedings of the Int Program Int-18-3: Probing Nucleons and Nuclei in High Energy Collisions Mar 27 2022 This book contains proceedings of the 7-week INT program dedicated to the physics of the Electron-Ion Collider (EIC), the world's first polarized electron-nucleon (ep) and electron-nucleus (eA) collider to be constructed in the United States. The 2015 NSAC Long Range Plan recommended EIC as the "highest priority for new facility construction following the completion of FRIB". The primary goal of the EIC is to establish precise multi-dimensional imaging of quarks and gluons inside nucleons and nuclei. This includes (i) understanding the spatial and momentum space structure of the nucleon through the studies of TMDs (transverse-momentum-dependent parton distributions), GPD (generalized parton distributions) and the Wigner distribution; (ii) determining the partonic origin of the nucleon spin; (iii) exploring the new quantum chromodynamics (QCD) frontier of ultra-strong gluon fields, with the potential to seal the discovery of a new form of dense gluon matter predicted to exist in all nuclei and nucleons at small Bjorken x -- the parton saturation. The program brought together both theorists and experimentalists from Jefferson Lab (JLab), Brookhaven National Laboratory (BNL) along with the national and international nuclear physics communities to assess and advance the EIC physics.
Nuclear Reactions Dec 04 2022 Nuclei and nuclear reactions offer a unique setting for investigating three (and in some cases even all four) of the fundamental forces in nature. Nuclei have been shown – mainly by performing scattering experiments with electrons, muons and neutrinos – to be extended objects with complex internal structures: constituent quarks; gluons, whose exchange binds the quarks together; sea-quarks, the ubiquitous virtual quark-antiquark pairs and last but not least, clouds of virtual mesons, surrounding an inner nuclear region, their exchange being the source of the nucleon-nucleon interaction. The interplay between the (mostly attractive) hadronic nucleon-nucleon interaction and the repulsive Coulomb force is responsible for the existence of nuclei; their degree of stability, expressed in the details and limits of the chart of nuclides; their rich structure and the variety of their interactions. Despite the impressive successes of the classical nuclear models and of ab-initio approaches, there is clearly no end in sight for either theoretical or experimental developments as shown e.g. by the recent need to introduce more sophisticated three-body interactions to account for an improved picture of nuclear structure and reactions. Yet, it turns out that the internal structure of the nucleons has comparatively little influence on the behavior of the nucleons in nuclei and nuclear physics – especially nuclear structure and reactions – is thus a field of science in its own right, without much recourse to subnuclear degrees of freedom. This book collects essential material that was presented in the form of lectures notes in nuclear physics courses for graduate students at the University of Cologne. It follows the course's approach, conveying the subject matter by combining experimental facts and experimental methods and tools with basic theoretical knowledge. Emphasis is placed on the importance of spin and orbital angular momentum (leading e.g. to applications in energy research, such as fusion with polarized nuclei) and on the operational definition of observables in nuclear physics. The end-of-chapter problems serve above all to elucidate and detail physical ideas that could not be presented in full detail in the main text. Readers are assumed to have a working knowledge of quantum mechanics and a basic grasp of both non-relativistic and relativistic kinematics; the latter in particular is a prerequisite for interpreting nuclear reactions and the connections to particle and high-energy physics.
The Nucleon-nucleon Potential in the Chromodielectric Soliton Model May 05 2020 The short- and medium-range parts of the nucleon-nucleon interaction are being studied in the framework of the chromodielectric soliton model. The model consists of current quarks, gluons in the abelian approximation, and a scalar [sigma] field which simulates the nonabelian interactions of the gluons and governs the medium through the dielectric function [kappa]([sigma]). Absolute color confinement is effected by the vanishing of the dielectric in vacuum; this also removes the troublesome van der Waals problem. The authors distinguish between spatial confinement, which arises from the self energy of the quarks in medium (excluding MFA contributions), and color confinement which is effected through OGE in the MFA (including the corresponding self energy contributions). The static (adiabatic) energies are computed as a function of deformation (generalized bag separation) in a constrained MFA. Six quark molecular-type wave functions in all important space-spin-isospin-color configurations are included. The gluon propagator is solved in the deformed dielectric medium. The resultant Hamiltonian matrix is diagonalized. Dynamics are handled in the Generator Coordinate Method, which leads to the Hill-Wheeler integral equation. In the present case, this yields a set of coupled equations corresponding to the various configurations. Although this can be approximated by a set of differential equations, they propose to solve the integral equations with some regularization scheme.

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- Cambridge Global English Cambridge University Press
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