

## Quasielastic Axial Vector Mass From Experiments On

*This volume is a collection of the scientific papers of Frederick Reines. Its publication is to commemorate the 70th birthday, in 1988, of this distinguished scientist. The selected papers here cover many aspects of his work in neutrino physics, astrophysics and conservation law tests. They have been divided into logical groupings, each introduced by a leading authority in that field, who helps the reader to see the reprinted articles with a better historical and scientific perspective.*

*A series of new and relevant experimental results are here presented to the community for the first time. In particular, we refer to the measurement of the neutron spin structure functions by the SLAC (E142) and CERN (SMC) collaborations; the first results from MAMI on experiments with tagged photons (A1 collaboration), on electroproduction of multi-hadron final states (A2 collaboration) and the neutron form factor (A3 collaboration); the experiments on strangeness photoproduction at ELSA; the polarization experiments at Bates on the neutron form factor and nuclear response functions and the photon and electron scattering data obtained by the Genova-Frascati Jet Target collaboration.Focused on the study of spin observables and exclusive processes at high momenta, the following sessions were held: The Neutron Form Factors; Spin Structure Functions; Exclusive Processes at High *q* and Q2. Deep Inelastic Scattering; Spin Observables: One- and Two-Nucleon Knockout at Low and Intermediate Energies; Excitation of Baryons Resonances and Strangeness.*

*When Kai Zuber's pioneering text on neutrinos was published in 2003, the author correctly predicted that the field would see tremendous growth in the immediate future. In that book, Professor Zuber provided a comprehensive self-contained examination of neutrinos, covering their research history and theory, as well as their application to particle physics, astrophysics, nuclear physics, and the broad reach of cosmology; but now to be truly comprehensive and accurate, the field's seminal reference needs to be revised and expanded to include the latest research, conclusions, and implications. Revised as needed to be equal to the research of today, Neutrino Physics, Second Edition delves into neutrino cross sections, mass measurements, double beta decay, solar neutrinos, neutrinos from supernovae, and high energy neutrinos, as well as new experimental results in the context of theoretical models. It also provides entirely new discussion on: Resolution of the solar neutrino problem The first real-time measurement of solar neutrinos below 1 MeV Geoneutrinos Long baseline accelerator experiments Written to be accessible to readers from diverse backgrounds, this edition, like the first, provides both an introduction to the field as well as the information needed by those looking to make their own contribution to it. And like the first edition, it whets the researcher's appetite, going beyond certainty to pose those questions that still need answers.*

Energy Research Abstracts

The Physics Associated with Neutrino Masses

NuInt04

Comparison of Quasielastic Scattering Nu

Nuclear Science Abstracts

Measurement of Neutrino Interactions and Three Flavor Neutrino Oscillations in the T2K Experiment

*This book discusses the upgrade of the Super-Kamiokande (SK) detector, which consists in the addition of a salt of gadolinium into the detector's water, the goal being to endow it with a very high-efficiency ability to detect neutrons: the SuperK-Gd project. This will substantially improve the scientific value of the SK detector because, among others, neutron production is related to the matter-antimatter character of the interacting neutrino. In this book the authors develop several procedures for maximizing the impact of neutron tagging in various physics analyses involving a broad range of neutrino energy. They thoroughly study the impact of new backgrounds introduced by Gd in key physics analyses, most remarkably including the search for the Diffuse Supernova Neutrino Background. At GeV energies, the neutron tagging improvements are evaluated by performing a complete neutrino oscillation sensitivity study using atmospheric and long baseline neutrinos, with a focus on the neutrino mass hierarchy and the leptonic CP violation. In order to prove the relevance of neutron tagging with the available data, the authors apply the neutron-tagging tools developed here to the 4th phase of the SK detector, which is already capable of detecting a low fraction of the neutrons produced through hydrogen-neutron captures. A global oscillation analysis of the SK's atmospheric neutrino data is also conducted.*

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*This book contains the proceedings of the third international workshop on From Parity Violation to Hadronic Structure and More. The many applications of parity violation are way beyond the scope of what Lee and Yang could have imagined fifty years after their proposal. For the physics topics discussed during this workshop, the application of parity violation has become a standard work horse allowing for the extraction of many physics topics in different experiments.*

Electromagnetic Interactions and Hadronic Structure

Physics and chemistry

Adventures in Theoretical Physics

Neutrino Physics

Measurement of the Antineutrino Double-Differential Charged-Current Quasi-Elastic Scattering Cross Section at MINERvA

*The distribution of quarks within protons and neutrons, and how they define the properties of protons, neutrons and nuclei, are subjects of major research worldwide. Written by leading experts in the field, both theoretical and experimental, this book provides an authoritative overview on the subject. The emphasis throughout the book is on phenomenology, and the book concentrates on describing the main features of the experimental data and the theoretical ideas used in their interpretation. Sections on chiral perturbation theory, crucial in understanding soft pions and soft photons near threshold, and duality ideas, equally crucial at intermediate energies, are included. This is an essential reference for graduate students and researchers in the field of particle physics and electromagnetic interactions.*

*The conference focused on the current status of baryon spectroscopy, form factors and structure functions, electroweak interactions and symmetries, strange and exotic states, chiral perturbation theory, heavy quark physics, and medium modifications, through plenary session summaries and reviews and parallel session reports of recent experimental and theoretical advances. Plans for future facilities and upgrades were highlighted in special plenary sessions.*

*This book shows the usefulness of the nucleus as a laboratory for learning about basic symmetries and fundamental interactions. It is aimed at advanced graduate students and beginning researchers, but should be useful to advanced researchers as well. Nuclear and particle physicists will find it particularly useful.*

Held at Rheinisch-Westfälische Technische Hochschule Aachen June 8-12, 1976

High Energy Physics Index

Neutrino Physics in Present and Future Kamioka Water-Cerenkov Detectors with Neutron Tagging

Neutrino-Nucleus Interactions in the Few-GeV Region

Selected Works of Frederick Reines

Quasi-elastic Neutrino Scattering and the Axial Vector Form Factor

Quasi-elastic Neutrino Scattering and the Axial Vector Form Factor

*Observations of neutrinos being emitted by the supernova SN1987A, star neutrinos, and atmospheric neutrinos have provided new insights into astronomy, as well as new unresolved phenomena such as the solar neutrino problem, spurring investigative studies among particle physicists and astrophysicists. One of the most important features of this book is its enumeration of a number of basic properties of neutrinos and their relationship to Grand Unified Theories, focusing on the origin of the neutrino's mass and the generation mixing of neutrinos. All the kamiokande results, detector performances, and complete references are included.*

*The Main Injector Neutrino Oscillation Search (MINOS) is a two detector, long baseline neutrino oscillation experiment. The MINOS near detector is an inrinsicallitor tracking/sampling calorimeter and has recorded the world's largest data set of neutrino interactions in the 0-5 GeV region. This high statistics data set is used to make precision measurements of neutrino interaction cross-sections on iron. The Q2 dependence in charged current quasi-elastic (CCQE) scattering probes the axial and vector structure (form factor) of the nucleon/nuclear target, and nuclear effects in neutrino scattering. Presented here is a study of the MINOS Data that will introduce a method that improves the existing MINOS CCQE analysis. This analysis uses an additional CCQE dominated sub-sample from a different kinematic region to reduce correlations between fit parameters in the existing MINOS CCQE analysis. The measured value of the axial-vector mass is MQE A = 1.312+0.037-0.038(fit)+0.123-0.265(syst.) GeV.*

10th Conference on the Intersections of Particle and Nuclear Physics

Third Edition

From Parity Violation to Hadronic Structure and more

Neutrino Oscillation Searches with the Soudan 2 Detector

Nuclear Power Reactor Instrumentation Systems Handbook

Symmetries and Fundamental Interactions in Nuclei

*The neutrino quasi-elastic and delta-1232 production in nu/sub .mu./d -->. .mu.?pp and nu/sub .mu./d -->. .mu.?delta./sup + +/n interactions have been studied using high statistics data obtained from a bubble chamber experiment at Brookhaven. Results on a detailed study of the axial form factor in these reactions are presented. In particular, assuming the dipole axial form factor, the behavior of the axial-vector mass is examined from the Q2 distributions for these reactions. The results of these reactions are shown. (LEW)*

*CIPANP 2009 explores areas of common interest between nuclear physicists, high energy (particle) physicists and astrophysicists. These areas range from studies of the strong interactions that bind nuclei together to physics of the very early Universe and include such topics as neutrinos, hadron physics, spin physics, heavy ion physics, QCD and heavy flavor physics. The Conference papers include descriptions of searches for "new physics", phenomena that cannot be accounted for by the Standard Model. Researchers and graduate students in high energy physics, physics historians. This book contains 13 papers that reflect the development of neutrino interactions with the electrons and protons in a fixed-target experiment that, beginning in 1980, grew out of the formal collaboration in high energy physics between Japanese and American institutions. These experiments were crucial to the merger of quantum electrodynamics and quantum weak dynamics, the foundation of the Standard Model. Perspectives In Nuclear Physics At Intermediate Energy - Proceedings Of The 6th Workshop*

Proceedings of the International Neutrino Conference Aachen 1976

Physics and chemistry. Series A.

Present Status and Future Plans

Neutrino Interactions with Electrons and Protons

Study of Quasielastic Scattering Using Charged-current ??-iron Interactions in the MINOS Near Detector

*A Conference is one thing, its Proceedings is another issue. The 1976 Neutrino Conference at Aachen met with friendly approval, within and beyond the brotherhood of neutrino physicists. The generally well informed "Frankfurter Allgemeine Zeitung" spoke of a "Sternstunde" of Science . . . And even without invoking the stars, we may register with some satisfaction that several important developments came to an end. "Charm is found" - hailed Alvaro de Rujula the most spectacular event of the Conference. The organizers held this opinion even before, as is evidenced by the Conference badge: a little aluminum tetra hedron, symbolizing the four quarks, and fastened by a three-coloured string. In fact, the history of the discovery of charm goes a long way back, perhaps even back to the first CERN neutrino experiment in 1963/64, when indications of charged lepton pairs were recognized - long before charm was taken serious. Muon pairs were established by the Harvard-Pennsylvania-Wisconsin Group in 1974, and correctly inter preted in terms of charm. At the Paris Neutrino Meeting in 1975 the BNL event came, confirming the con nection with strangeness and suggesting charm production to occur at quite low energies.*

*Kinematic distributions from an inclusive sample of 1.41x106 charged-current ?? interactions on iron, obtained using the MINOS near detector exposed to a wide-band neutrino scattering beam with peak flux at 3 GeV, are compared to a conventional treatment of neutrino scattering within a Fermi gas nucleus. Results are also used to guide the selection of a subsample enriched in quasielastic ??Fe interactions, containing an estimated 123,000 quasielastic events of incident energies 1 Esub7/sup @ 6eV, with Esub7/sup = 2.79 GeV. Four additional subsamples representing topological and kinematic sideband regions to quasielastic scattering are also selected for the purpose of evaluating backgrounds. Comparisons using subsample distributions in four-momentum transfer Qsup2/sup show the Monte Carlo model to be inadequate at low Qsup2/sup. Its shortcomings are remedied via inclusion of a Qsup2/sup-dependent suppression function for baryon resonance production, developed from the data. A chi-square fit of the resulting Monte Carlo simulation to the shape of the Qsup2/sup distribution for the quasielastic-enriched sample is carried out with the axial-vector mass MsubA/sub of the dipole axial-vector form factor of the neutron as a free parameter. Furthermore, the effective MsubA/sub which best describes the data is 1.23sup+0.13/supsub-0.09/sub/(fit)sup+0.12/sup*

*NuInt07, the fifth in a series of international workshops, was held at Fermi National Accelerator Laboratory in Batavia, IL. It was the successful continuation of a series of workshops focused solely on the understanding and measurement of low energy neutrino-nucleus interactions. Neutrino cross sections in the few-GeV energy range are an important ingredient for neutrino oscillation experiments as well as being interesting in their own right. Such measurements and their accompanying theoretical calculations had not been updated for decades. The goal of this workshop series has been to remedy this situation by providing an environment where both experimentalists and theorists in nuclear and high energy physics can come together to review and discuss recent progress in neutrino-nucleus measurements and calculations.*

NuInt07: The 5th International Workshop on Neutrino-Nucleus Interactions in the Few-GeV Region

Measurement of the MsubA/(CE)S Parameter Using Multiple Quasi-elastic Dominated Sub-samples in the Minos Near Detector

Proceedings of the 1st International Conference on Neutrino Physics and Astrophysics

Proceedings of the 3rd International Workshop Held at Milos, Greece, May 16-20, 2006

Baryons '95 - Proceedings Of The 7th International Conference On The Structure Of Baryons

Proceedings of the Third International Workshop on Neutrino-Nucleus Interactions in the Few-GeV Region : Assergi, Italy, 17-21 March 2004

*An analysis of 168 quasi-elastic neutrino interactions nu n yields .mu.-p in deuterium yields a value of M/sub A/ = .76 .14.40 GeV for the axial vector mass.*

*Updated results are presented from a study of low energy .nu.-D2 interactions using the ANL 12-Foot Bubble Chamber. These results for the quasi-elastic reaction .nu.n -->. .mu.-p and single pion production final states .mu.-.pi.p, .mu.-.pi.\*p and .mu.-.pi.n are from a total exposure of 2.3 x 1018 protons on target. The axial-vector form factor mass in quasi-elastic scattering, assuming a dipole form, is determined to be M/sub A/ = 0.98 + 0.08 GeV. The single pion production channels are in good agreement with the predictions of the Adler model of weak pion production. In particular, the I = 1/2 pion-nucleon amplitude is substantial and relative to the I = 3/2, is determined to be (A12)/(A32) = 0.57 + 0.06. 4 references.*

*This is the third and fully updated edition of the classic textbook on physics at the subatomic level. An up-to-date and lucid introduction to both particle and nuclear physics, the book is suitable for both experimental and theoretical physics students at the senior undergraduate and beginning graduate levels. Topics are introduced with key experiments and their background, encouraging students to think and empowering them with the capability of doing back-of-the-envelope calculations in a diversity of situations. Earlier important experiments and concepts as well as topics of current interest are covered, with extensive use of photographs and figures to convey principal concepts and show experimental data. The coverage includes new material on: Detectors and acceleratorsNucleon elastic form factor dataNeutrinos, their masses and oscillationsChiral theories and effective field theories, and lattice QCDRelativistic heavy ions (RHIC)Nuclear structure far from the region of stabilityParticle astrophysics and cosmology Errata(s) Errata for Chapter 6 Errata for Chapter 11*

Neutrino 81

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Journal of Science of the Hiroshima University

The Physics of Neutrino Interactions

Foundations of Nuclear and Particle Physics

Proceedings of the 1981 International Conference on Neutrino Physics and Astrophysics, Maui, Hawaii, July 1-8, 1981

*This book is based on the author's work in the T2K long-baseline neutrino oscillation experiment, in which neutrinos are generated by a proton beam and are detected by near and far neutrino detectors. In order to achieve the precise measurement of the neutrino oscillation, an accurate understanding of the neutrino beam and the neutrino interaction is essential. Thus, the author measured the neutrino beam properties and the neutrino interaction cross sections using a near neutrino detector called INGRID and promoted a better understanding of them. Then, the author performed a neutrino oscillation analysis using the neutrino beam and neutrino interaction models verified by the INGRID measurements. As a result, some values of the neutrino CP phase are disfavored at the 90% confidence level. If the measurement precision is further improved, we may be able to discover the finite CP phase which involves the CP violation. Thus, this result is an important step towards the discovery of CP violation in the lepton sector, which may be the key to understanding the origin of the matter-antimatter asymmetry in the universe.*

*? This thesis represents the first double differential measurement of quasi-elastic anti-neutrino scattering in the few GeV range—a region of substantial theoretical and experimental interest as it is the kinematic region where studies of charge-parity (CP) violation in the neutrino sector most require precise understanding of the differences between anti-neutrino and neutrino scatter.*

*This dissertation also presents total antineutrino-scintillator quasi-elastic cross sections as a function of energy, which is then compared to measurements from previous experiments. Next-generation neutrino oscillation experiments, such as DUNE and Hyper-Kamiokande, hope to measure CP violation in the lepton sector. In order to do this, they must dramatically reduce their current levels of uncertainty, particularly those due to neutrino-nucleus interaction models. As CP violation is a measure of the difference between the oscillation properties of neutrinos and antineutrinos, data about how the less-studied antineutrinos interact is especially valuable. The measurement described herewith determines the nuclear and instrumental effects that must be understood to undertake precision neutrino physics. As well as being useful to help reduce oscillation experiments' uncertainty, this data can also be used to study the prevalence of various correlation and final-state interaction effects within the nucleus. In addition to being a substantial scientific advance, this thesis also serves as an outstanding introduction to the field of experimental neutrino physics for future students.*

*The study of neutrinos and their interaction with matter has made many important contributions to our present knowledge of physics. This advanced text introduces neutrino physics and presents a theoretical framework for describing relativistic particles. It gives a pedagogical description of the neutrino, its properties, the standard model of electroweak interactions, and neutrino scattering from leptons and nucleons. Focusing on the role of nuclear effects, the discussion extends to various processes of quasielastic, inelastic, and deep inelastic scattering from nucleons and nuclei. Neutrino sources, detection and oscillation, along with the role of neutrinos in astrophysics and motivation for the need of physics beyond the standard model are discussed in detail. This topical book will stimulate new ideas and avenues for research, and will form a valuable resource for advanced students and researchers working in the field of neutrino physics.*

Physics and Astrophysics of Neutrinos

Neutrino Oscillations

Neutrinos and Other Matters

Journal of Science

Selected Papers with Commentaries

Simple Charged-current Channels In Nu.-D2 Interactions

*This textbook brings together nuclear and particle physics, presenting a balanced overview of both fields as well as the interplay between the two. The theoretical as well as the experimental foundations are covered, providing students with a deep understanding of the subject. In-chapter exercises ranging from basic experimental to sophisticated theoretical questions provide an important tool for students to solidify their knowledge. Suitable for upper undergraduate courses in nuclear and particle physics as well as more advanced courses, the book includes road maps guiding instructors on tailoring the content to their course. Online resources including color figures, tables, and a solutions manual complete the teaching package. This textbook will be essential for students preparing for further study or a career in the field who require a solid grasp of both nuclear and particle physics.*

*This book reviews the status of a very exciting field Oco neutrino oscillations Oco in a very important time. The fact that neutrinos have mass has only been proved in the last few years and the acceptance of that fact has opened up a whole new area of study to understand the fundamental parameters of the mixing matrix. The book summarizes the results from all the experiments which have played a role in the measurement of neutrino oscillations and briefly describes the scope of some new planned experiments. Contributions include a theoretical introduction by Stephen Parke from FNAL, as well as articles from all the major experimental groups who have been pivotal in uncovering the nature of the neutrino mass. Sample Chapter(s). Chapter 1: Neutrino Oscillation Phenomenology (677 KB). Contents: Neutrino Oscillation Phenomenology (S J Parke); The Super-Kamiokande Experiment (C W Walter); Sudbury Neutrino Observatory (S J M Peeters & J R Wilson); Neutrino Oscillation Physics with KamLAND: Reactor Antineutrinos and Beyond (K M Heeger); K2K: KEK to Kamioka Long-Baseline Neutrino Oscillation Experiment (R J Wilkes); MINOS (P Vahle); The LSND and KARMEN Neutrino Oscillation Experiments (W C Louis); MiniBoONE (S J Brice); The OPERA Experiment in the CNGS Beam (D Autiero et al.); The T2K Experiment (D L Wark); The NO7A Experiment (G J Feldman); Double Chooz (G A Horton-Smith & T Lasserre); Daya Bay: A Sensitive Determination of ? 13 with Reactor Antineutrinos (K B Luk & Y Wang). Readership: Physicists, researchers and graduate students in high energy/nuclear and particle physics.\**

Neutrino Physics, Second Edition

Subatomic Physics

Neutrino

ERDA Energy Research Abstracts