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Well Logging for Earth Scientists
Measurement of Downhole Gamma Radiation by Reduction of Compton Scattering
Nuclear Waste Research
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Assessment, Restoration and Reclamation of Mining Influenced Soils
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Gamma-Ray Astrophysics
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Scintillation Spectroscopy of Gamma Radiation
The Multi-Messenger Approach to High-Energy Gamma-Ray Sources
Penetration of Gamma Rays Through Thick Layers
The Principles of Astronomical Telescope Design
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Gamma-ray Detection and Compton Camera Image Reconstruction with Application to Hadron Therapy The text combines an account of scientific and engineering principles with a description of materials and processes of importance in nuclear research and industry. The coverage includes fuel materials, control and shielding materials, and so on - in fact, for most of the important parts of a reactor.

Basic Science of PET Imaging

Langenscheidt Routledge German dictionary of physics

Well Logging for Earth Scientists The `International Heidelberg Workshop on TeV Gamma-Ray Astrophysics' brought together
astrophysicists from the various fields which play a role in the
formation of high energy gamma-ray emission. In particular,
thoretical and observational aspects of the physics and
astrophysics of pulsars and quasars, the acceleration of particles
at Supernova Remnants and other strong astrophysical shock
fronts, and cascade processes in universal background photon
fields were comprehensively discussed in more than thirty
reviews by leading experts. In their entirety these reviews
describe the birth of a new field of astronomy. This field
concerns cosmic gamma-rays of very high energy which are
observed with ground-based optical telescopes due to the
Cherenkov emission of the secondary particles created by the
interaction of these gamma-rays with atoms in the Earth's
atmosphere. Beyond that, the workshop encompassed the latest
developments and trends in theory and observation of cosmic
gamma-ray sources of all energies, from nuclear gamma-ray
lines in the MeV-region, through the Bremsstrahlung, Inverse
Compton, and pion decay continuum emission, to gamma-rays
due the decay of exotic relics from the early Universe.
Audience: Specialists as well as students in physics and
astrophysics and young research workers.

Measurement of Downhole Gamma Radiation by Reduction of
Compton Scattering Assessment, Restoration and Reclamation
of Mining Influenced Soils covers processes operating in the
environment as a result of mining activity, including the whole
spectra of negative effects of anthropopressure and the
environment, from changes in soil chemistry, changes in soil
physical properties, geomechanical disturbances, and mine
water discharges. Mining activity and its waste are an environmental concern. Knowledge of the fate of potentially harmful elements and their effect on plants and the food chain, and ultimately on human health, is still being understood. Therefore, there is a need for better knowledge on the origin, distribution, and management of mine waste on a global level. This book provides information on hazard assessment and remediation of the disturbed environment, including stabilization of contaminated soils and phytoremediation, and will help scientists and public authorities formulate answers to the daily challenges related to the restoration of contaminated land. Provides a thorough overview of the processes operating on mining-devastated areas, as well as origin, distribution, and deactivation of harmful elements Includes outcomes and recommendations of the Global Mining Initiative that are widely regarded as the code of conduct in the minerals industry Contains global case studies that elucidate various aspects of assessment and restoration of mine-contaminated land

Nuclear Waste Research A comprehensive guide to procedures and technologies, Nuclear Medicine and PET/CT: Technology and Techniques provides a single source for state-of-the-art information on all aspects of nuclear medicine. Coverage includes relevant anatomy and physiology and discusses each procedure in relation to the specific use of radiopharmaceuticals and the instruments required. Edited by experts in nuclear imaging and PET/CT, Paul E. Christian and Kristen M. Waterstram-Rich, this edition has a new chapter on MRI as it relates to nuclear medicine and includes practical,
step-by-step instructions for procedures. PET/CT focus with hybrid PET/CT studies in several chapters provides cutting-edge information that is especially beneficial to working technologists. CT Physics and Instrumentation chapter introduces CT as it is applied to PET imaging for combined PET/CT studies. Authoritative, comprehensive resource conveys state-of-the-art information, eliminating the need to search for information in other sources. Foundation chapters cover basic math, statistics, physics, instrumentation, computers, lab science, radiochemistry, and pharmacology, allowing you to understand how and why procedures are performed. Accessible writing style and approach to basic science subjects simplifies topics, progressing from fundamentals to more complex concepts. More than 50 practice problems in the math and statistics chapter let you brush up on basic math skills, with answers provided in the back of the book. Key terms, chapter outlines, learning objectives, and suggested readings help you organize your study. A table of radionuclides used in nuclear medicine and PET is provided in the appendix for quick reference. A glossary provides definitions of key terms and important concepts. High-profile editors and contributors come from a variety of educational and clinical settings, providing a broad philosophic and geographic perspective. New MRI Physics, Instrumentation and Clinical Introduction chapter provides important background on MRI and its relationship with nuclear medicine. Procedures boxes in body systems chapters provide step-by-step descriptions of clinical procedures. Updates and revisions keep you current with the latest advances. Expanded 16-page color insert
includes more diagnostic images demonstrating realistic scans found in practice.

Scientific Papers of Arthur Holly Compton

Assessment, Restoration and Reclamation of Mining Influenced Soils After three decades of intense research in X-ray and gamma-ray astronomy, the time was ripe to summarize basic knowledge on X-ray and gamma-ray spectroscopy for interested students and researchers ready to become involved in new high-energy missions. This volume exposes both the scientific basics and modern methods of high-energy spectroscopic astrophysics. The emphasis is on physical principles and observing methods rather than a discussion of particular classes of high-energy objects, but many examples and new results are included in the three chapters as well.

Nuclear Medicine and PET/CT - E-Book

TeV Gamma-Ray Astrophysics

Gamma Ray Compton Scattering in Transition Metals Soft gamma rays (100 keV-10 MeV) are indispensable probes of the most violent and extreme processes in the cosmos. Gamma rays are produced by non-thermal processes in such disparate objects as neutron stars, X-ray binaries, and Active Galactic Nuclei (AGN), and they also result from the decays of many radioactive nuclei, such as certain isotopes produced in supernova explosions. The penetrating nature of gamma rays
allows the astrophysicist to probe deep within these often obscured systems and make unique and complementary observations of their gravitational fields, magnetic fields, and nuclear reactions. The challenges to soft gamma-ray measurements are numerous. First, the dominant interaction is Compton scattering, which necessitates careful imaging and simulation. Second, there is high background, predominantly from charged particle reactions and the activation of passive material in the instrument. Special care must be taken for background reduction, such as using active shielding and clever event selections. Third, atmospheric absorption of gamma rays necessitates being in space or at balloon altitudes to observe them. Over the last four decades, various types of telescopes have been developed to detect and image soft gamma-rays. One promising technology is the Compton telescope, which exploits the Compton effect to perform direct imaging of gamma-ray photons. The current generation of Compton telescopes are compact Compton telescopes, which rely on both fine position and fine energy resolution of gamma-ray interactions within the detector volume in order to perform Compton imaging. The development of soft gamma-ray telescopes, and Compton telescopes in particular, is reviewed in Chapter 1. The Nuclear Compton Telescope (NCT) is one such compact Compton telescope. NCT is a balloon-borne telescope designed to perform imaging, spectroscopy, and polarization analysis on soft gamma rays from astrophysical sources. NCT detects gamma rays using ten crossed-strip high-purity germanium detectors, each with a 2 mm strip pitch and a 15 mm thickness. This dissertation gives an overview of NCT's detectors, gondola systems, and data
analysis pipeline (Chapter 3), as well as detailed descriptions of the detector calibrations -- the depth calibration, energy calibration, cross-talk correction, and charge loss correction (Chapters 4-6). The NCT instrument has flown twice, both times from the Columbia Scientific Balloon Facility in Fort Sumner, New Mexico. The first flight took place in 2005 with a prototype instrument housing only two germanium detectors. Due to the brief flight (6 hours), the only analysis that could be performed was a characterization of the gamma-ray background at float altitudes (40 km). The second flight, on 17-18 May 2009, is detailed in this thesis (Chapter 7). The full ten-detector instrument was flown for a total of 37 hours. The primary goals of the flight were to observe the Crab Nebula and Cygnus X-1, both bright gamma-ray continuum sources (see Chapter 2 for a review of the Crab Nebula). The Crab Nebula was observed for 9.2 hours of the flight and was detected at a significance of 4 sigma (Chapter 8). This is the first detection of an astrophysical source by a compact Compton telescope. This work is an important step in establishing the viability of the compact Compton telescope design for future space-based wide-survey instruments.

Scintillation Spectroscopy of Gamma Radiation

The Multi-Messenger Approach to High-Energy Gamma-Ray Sources

Penetration of Gamma Rays Through Thick Layers
High-Energy Spectroscopic Astrophysics Using Compton scattered gamma-rays to measure local void fraction was first suggested by Kondic and Hahn in 1970. The Compton scattered gamma-ray densitometers they suggested employ a single, narrow beam source and either a well collimated detector or an uncollimated detector. The collimated detector configuration only gives the local void fraction measurement in the small volume where the source and detector collimators intersect. The uncollimated detector configuration is a more efficient design since the local void fraction along the source beam's path is measured in a single reading. A logical extension of the technique is to use wide beam illumination and uncollimated detectors to sample an even greater portion of the flow cross section. This report investigates and demonstrates several methods of inferring two-phase flow parameters using wide beam illumination coupled with two detectors placed symmetrically about the source and pipe. The spatial distribution of the fluid in a slice of the pipe is encoded with respect to energy in the singly scatter photon flux. Two basic techniques are detailed for decoding the spatial information: the method of spectral moments and the method of computed tomography (CT). Examination of the low-order moments of the singly scattered photon spectra from the two detectors
provides sufficient information for flow regime identification. Flow asymmetries are revealed by comparison of the spectral moments of the two measured spectra. Further classification of the flow pattern is made on the basis of the first and second moments of the spectra. The real focus of this report is the adaptation and successful demonstration of CT techniques with Compton scattering. Three series expansion techniques are considered: the algebraic reconstruction technique (ART), the simultaneous iterative reconstruction technique (SIRT), and the iterative least squares (ILS) technique. Application of the modified ART, SIRT, and ILS algorithms to a hot-spot and a cold-spot reconstruction problem indicates that SIRT and ILS are more accurate than ART. A more extensive testing of the ILS algorithm for a variety of model flow regimes demonstrates the potential of Compton scatter tomography as a quantitative measurement technique.

Proton Compton Scattering with Polarized [gamma] Rays

Dictionary of Physics Radioactive wastes are waste types containing radioactive chemical elements that do not have a practical purpose. They are sometimes the products of a nuclear processes, such as nuclear fission. However, other industries not directly connected to the nuclear industry can produce large quantities of radioactive waste. For instance, over the past 20 years it is estimated that just the oil-producing endeavours of the US have accumulated 8 million tons of radioactive wastes. The majority of radioactive waste is "low-level waste", meaning it has low levels of radioactivity per mass or volume. This type
of waste often consists of used protective clothing, which is only slightly contaminated but still dangerous in case of radioactive contamination of a human body through ingestion, inhalation, absorption, or injection. The issue of disposal methods for nuclear waste was one of the most pressing current problems the international nuclear industry faced when trying to establish a long term energy production plan, yet there was hope it could be safely solved. In the U.S., the DOE acknowledged much progress in addressing the waste problems of the industry, and successful remediation of some contaminated sites, yet also major uncertainties and sometimes complications and setbacks in handling the issue properly, cost effectively, and in the projected time frame. In other countries with lower ability or will to maintain environmental integrity the issue would be more problematic. This new book presents the latest research in the field.

New Insights on Gamma Rays The first edition of this book demystified the process of well log analysis for students, researchers and practitioners. In the two decades since, the industry has changed enormously: technical staffs are smaller, and hydrocarbons are harder to locate, quantify, and produce. New drilling techniques have engendered new measurement devices incorporated into the drilling string. Corporate restructuring and the "graying" of the workforce have caused a scarcity in technical competence involved in the search and exploitation of petroleum. The updated 2nd Edition reviews logging measurement technology developed in the last twenty years, and expands the petrophysical applications of the
measurements.

Tomographic Two-phase Flow Measurement Using Compton Scattering of Gamma-rays This book is based on the compilation of lecture notes on nuclear techniques in agriculture and biology, prepared and updated for students of PG School, IARI, New Delhi during the past 16 years. The book contains three parts, namely, Fundamentals of Nuclear Science (covering the basic features), Applications (comprising essential application with focus on agriculture) and Appendices (consisting of bibliography, nuclear terms, radioactive decay charts, select constants and abbreviations used). Salient Features Language is lucid and informal. Unique in terms of its contents and 88 illustrations and 11 photographs that simplify and encourage the readers in understanding the approach and theory. Recent developments in Nuclear Magnetic Resonance have been discussed. Provides a comprehensive view of the potentialities of nuclear science and its application. Contains clarity and high level of precision in presenting the subject matter. A detailed bibliography for further reading. Detail contents at the beginning facilitate quick revision. Can be used either as a textbook or for supplementary reading in colleges, universities and research institutions dealing with applications of nuclear techniques. Would be of immense help to the academic community at large. In short, the flawless presentation on various aspects of nuclear applications is expected to enrich biologists and agricultural scientists to easily understand not only the basic concepts but also essentials on the application of the nuclear energy in a
variety of ways for research and in agriculture.

Engineering Physics

Nuclear Physics

The Effects of Atomic Weapons This book provides a theoretical and observational overview of the state of the art of gamma-ray astrophysics, and their impact and connection with the physics of cosmic rays and neutrinos. With the aim of shedding new and fresh light on the problem of the nature of the gamma-ray sources, particularly those yet unidentified, this book summarizes contributions to a workshop that continues today.

Materials in Nuclear Energy Applications

Large Angle Scattering of Cobalt 60 Gamma Rays

A Compton Scatter Camera for Spectral Imaging of 0.5 to 3.0 MeV Gamma Rays This book presents a complete summary of the author's twenty five years of experience in telescope design. It provides a general introduction to every aspect of telescope design. It also discusses the theory behind telescope design in depth, which makes it a good reference book for professionals. It covers Radio, Infrared, Optical, X-Ray and Gamma-Ray wavelengths. Originally published in Chinese.

Gamma-ray Compton Scattering Studies A novel technique for
radiotherapy - hadron therapy - irradiates tumors using a beam of protons or carbon ions. Hadron therapy is an effective technique for cancer treatment, since it enables accurate dose deposition due to the existence of a Bragg peak at the end of particles range. Precise knowledge of the fall-off position of the dose with millimeters accuracy is critical since hadron therapy proved its efficiency in case of tumors which are deep-seated, close to vital organs, or radio-resistant. A major challenge for hadron therapy is the quality assurance of dose delivery during irradiation. Current systems applying positron emission tomography (PET) technologies exploit gamma rays from the annihilation of positrons emitted during the beta decay of radioactive isotopes. However, the generated PET images allow only post-therapy information about the deposed dose. In addition, they are not in direct coincidence with the Bragg peak. A solution is to image the complete spectrum of the emitted gamma rays, including nuclear gamma rays emitted by inelastic interactions of hadrons to generated nuclei. This emission is isotropic, and has a spectrum ranging from 100 keV up to 20 MeV. However, the measurement of these energetic gamma rays from nuclear reactions exceeds the capability of all existing medical imaging systems. An advanced Compton scattering detection method with electron tracking capability is proposed, and modeled to reconstruct the high-energy gamma-ray events. This Compton detection technique was initially developed to observe gamma rays for astrophysical purposes. A device illustrating the method was designed and adapted to Hadron Therapy Imaging (HTI). It consists of two main sub-systems: a tracker where Compton recoiled electrons are measured, and a
calorimeter where the scattered gamma rays are absorbed via the photoelectric effect. Considering a hadron therapy scenario, the analysis of generated data was performed, passing through the complete detection chain from Monte Carlo simulations to reconstruction of individual events, and finally to image reconstruction. A list-mode Maximum-Likelihood Expectation-Maximization (MLEM) algorithm was adopted to perform image reconstruction in conjunction with the imaging response, which has to depict the complex behavior of the detector. Modeling the imaging response requires complex calculations, considering the incident angle, all measured energies, the Compton scatter angle in the first interaction, the direction of scattered electron (when measured). In the simplest form, each event response is described by Compton cone profiles. The shapes of the profiles are approximated by 1D Gaussian distributions. A strong correlation was observed between pattern of the reconstructed high-energy gamma events, and location of the Bragg peak. The performance of the imaging technique illustrated by the HTI is a function of the detector performance in terms of detection efficiency, spatial and energy resolution, acquisition time, and the algorithms used to reconstruct the gamma-ray activity. Thus beside optimizations of the imaging system, the applied imaging algorithm has a high influence on the final reconstructed images. The HTI reconstructed images are corrupted by noise due to the low photon counts recorded, the uncertainties induced by finite energy resolution, Doppler broadening, the limited model used to estimate the imaging response, and the artifacts generated when iterating the MLEM algorithm. This noise is spatially
varying and signal-dependent, representing a major obstacle for information extraction. Thus image de-noising techniques were investigated. A Wavelet based multi-resolution strategy of list-mode MLEM Regularization (WREM) was developed to reconstruct Compton images. At each iteration, a threshold-based processing step was integrated. The noise variance was estimated at each scale of the wavelet decomposition as the median value of the coefficients from the high-frequency sub-bands. This approach allowed to obtain a stable behavior of the iterative algorithm, presenting lower mean-squared error, and improved contrast recovery ratio.

Ionizing Radiation, 584: Instructor's course outline and notes
This book serves as both a primer to astronomical polarimetry and an authoritative overview of its application to various types of astronomical objects from AGN, compact stars, binary systems, stars across the HR diagram, transients, the interstellar medium and solar system bodies. It starts with an historical perspective, a discussion of polarimetric theory, instrumentation and techniques in wave bands from the near infrared to gamma rays. The book presents the state of the art in astronomical polarimetry. It is motivated by the new X-ray polarimeters due to be launched in the next four years and improved optical polarimeters on large telescopes requiring a new analysis of polarimetric theory, methodology and results. This book will be suitable as advanced undergraduate companion text, a primer for graduate students and all researchers with an interest in astronomical polarimetry.
The Evaluation of Errors Due to Compton Scattering in Gamma-ray Emission Imaging Covers all areas of theoretical and applied physics including related disciplines. Each volume contains over 120,000 terms and over 160,000 translations.

X-ray and Gamma-ray Compton Scattering

Observation of the Crab Nebula in Soft Gamma Rays with the Nuclear Compton Telescope Applied Gamma-Ray Spectrometry covers real life application of the gamma-ray and the devices used in their experimental studies. This book is organized into 9 chapters, and starts with discussions of the various decay processes, the possible interaction mechanisms of gamma radiation with matter, and the intrinsic and extrinsic variables, which affect the observed gamma-ray and X-ray spectra. The subsequent chapters deal with the properties and fabrication of scintillation detectors, semiconductor detectors, and proportional gas counters. These chapters present some of the most widely utilized applications of these detectors, with a particular emphasis to the activation analysis. These topics are followed by reviews of the description of basic equipment, such as amplifiers, analyzers, special spectrometer arrangements, and detector shielding. Other chapters describe energy and time resolution and quantitative calibration. The quantitative and qualitative interpretation of the spectra is also explained, along with the calibration of the detectors. The last chapter considers the analytical applications of gamma-ray and X-ray spectrometry in tracer studies, activation analysis, fission product studies, and X-ray fluorescence analysis. This book will
be of value to analytical chemists and analytical chemistry researchers.

Investigation of SKYSHINE The "Dictionary of Physics" is a major reference source in the vast and dynamic field of physics that caters for both the undergraduate and graduate student. Spanning the space between the primary literature and educational texts, it encompasses 16,000 entries and 1.8 million words in four volumes.

Investigation of Gamma Ray Attenuation Anomaly

Compton Scattering with Gamma-rays and Synchrotron Radiation Systems, methods and devices for evaluating an earth formation intersected by a borehole. The method includes using a first radiation responsive component to detect gamma rays having an energy below a threshold energy; using a second radiation responsive component configured to detect gamma rays that traverse the first radiation responsive component; generating a reduced-Compton gamma ray spectrum by generating an anticoincidence gamma ray spectrum indicative of the gamma rays detected by the first radiation responsive component and the gamma rays detected by the second radiation responsive component. The anticoincidence gamma ray spectrum represents those gamma rays of the gamma rays detected by the second radiation responsive component that are not detected in coincidence with the gamma rays detected by the first radiation responsive component.
Astronomical Polarisation from the Infrared to Gamma Rays

Arthur Holly Compton was one of the great leaders in physics of the twentieth century. In this volume, Robert S. Shankland, who was once a student of Compton's, has collected and edited the most important of Professor Compton's papers on X-rays—the field of his greatest achievement—and on other related topics. Compton entered the field of X-ray research in 1913 and carried on active work until the 1930s, when he began to specialize in cosmic rays. During the years when Compton was an active leader in X-ray research, he made many notable contributions which are reflected in the papers presented here. He was the first to prove several important optical properties of X-rays, including scattering, complete polarization, and total reflection. He was also the first, with his student R. L. Doan, to use ruled gratings for the production of X-ray spectra.

Professor Compton's greatest discovery, for which he was awarded a Nobel Prize in 1927, was the Compton Effect. This was the outgrowth of experiments he had initiated during a year at Cambridge in 1919-20. He did the major portion of these experiments at Washington University in St. Louis during the period 1920-24. His work demonstrated that in the scattering of X-rays by electrons, the radiation behaves like corpuscles, and that the interaction between the X-ray corpuscles and the electrons in the scatter is completely described by the principles of the conservation of energy and momentum for the collisions of particles. In his introduction, Professor Shankland gives a historical account of the papers, narrates Professor Compton's early scientific career, and shows how he arrived at a quantum explanation of the Compton scattering after eliminating all
classical explanations.

The Attenuation of Gamma Rays and Neutrons in Reactor Shields Gamma radiation has been discovered since more than a century and contributed in many achievements in human life. Continuous developments make it necessary to have more understandings and more discussions about well-established concepts as well as newly implemented hypothesis and applications of gamma rays. This book presents new visions of gamma ray spectrometry and applications. I hope this book can present part of the useful applications of gamma rays.

Analysis of the Recent TSF Secondary Gamma-ray Experiment This book offers a wide-ranging and up-to-date overview of the basic science underlying PET and its preclinical and clinical applications in modern medicine. In addition, it provides the reader with a sound understanding of the scientific principles and use of PET in routine practice and biomedical imaging research. The opening sections address the fundamental physics, radiation safety, CT scanning dosimetry, and dosimetry of PET radiotracers, chemistry and regulation of PET radiopharmaceuticals, with information on labeling strategies, tracer quality control, and regulation of radiopharmaceutical production in Europe and the United States. PET physics and instrumentation are then discussed, covering the basic principles of PET and PET scanning systems, hybrid PET/CT and PET/MR imaging, system calibration, acceptance testing, and quality control. Subsequent sections focus on image reconstruction, processing, and quantitation in PET and hybrid
PET and on imaging artifacts and correction techniques, with particular attention to partial volume correction and motion artifacts. The book closes by examining clinical applications of PET and hybrid PET and their physiological and/or molecular basis in conjunction with technical foundations in the disciplines of oncology, cardiology and neurology, PET in pediatric malignancy and its role in radiotherapy treatment planning. Basic Science of PET Imaging will meet the needs of nuclear medicine practitioners, other radiology specialists, and trainees in these fields.

Diffusion of High Energy Gamma Rays Through Matter

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