

# COSMIC RAYS AND PARTICLE PHYSICS

## SECOND EDITION

Thomas K. Gaisser, Ralph Engel and Elisa Resconi

# **Cosmic Rays And Particle Physics**

**Thomas K. Gaisser** 

#### **Cosmic Rays And Particle Physics:**

Cosmic Rays and Particle Physics Thomas K. Gaisser,1990 Over recent years there has been marked growth in interest in the study of techniques of cosmic ray physics by astrophysicists and particle physicists Cosmic radiation is important for the astrophysicist because in the farther reaches of the universe For particle physicists it provides the opportunity to study neutrinos and very high energy particles of galactic origin More importantly cosmic rays constitue the background and in some cases possibly the signal for the more exotic unconfirmed hypothesized particles such as monopoles and sparticles Concentrating on the highest energy cosmic rays this book describes where they originate acquire energy and interact in accreting neutron stars supernova remnants in large scale shock waves It also describes their interactions in the atmosphere and in the earth how they are studied in surface and very large underground detectors and what they tell us

Cosmic Rays at Earth P.K.F. Grieder, 2001-07-27 In 1912 Victor Franz Hess made the revolutionary discovery that ionizing radiation is incident upon the Earth from outer space He showed with ground based and balloon borne detectors that the intensity of the radiation did not change significantly between day and night Consequently the sun could not be regarded as the sources of this radiation and the question of its origin remained unanswered Today almost one hundred years later the question of the origin of the cosmic radiation still remains a mystery Hess discovery has given an enormous impetus to large areas of science in particular to physics and has played a major role in the formation of our current understanding of universal evolution For example the development of new fields of research such as elementary particle physics modern astrophysics and cosmology are direct consequences of this discovery. Over the years the field of cosmic ray research has evolved in various directions Firstly the field of particle physics that was initiated by the discovery of many so called elementary particles in the cosmic radiation. There is a strong trend from the accelerator physics community to reenter the field of cosmic ray physics now under the name of astroparticle physics Secondly an important branch of cosmic ray physics that has rapidly evolved in conjunction with space exploration concerns the low energy portion of the cosmic ray spectrum Thirdly the branch of research that is concerned with the origin acceleration and propagation of the cosmic radiation represents a great challenge for astrophysics astronomy and cosmology Presently very popular fields of research have rapidly evolved such as high energy gamma ray and neutrino astronomy. In addition high energy neutrino astronomy may soon initiate as a likely spin off neutrino tomography of the Earth and thus open a unique new branch of geophysical research of the interior of the Earth Finally of considerable interest are the biological and medical aspects of the cosmic radiation because of it ionizing character and the inevitable irradiation to which we are exposed This book is a reference manual for researchers and students of cosmic ray physics and associated fields and phenomena It is not intended to be a tutorial However the book contains an adequate amount of background materials that its content should be useful to a broad community of scientists and professionals The present book contains chiefly a data collection in compact form that covers the

cosmic radiation in the vicinity of the Earth in the Earth's atmosphere at sea level and underground Included are predominantly experimental but also theoretical data In addition the book contains related data definitions and important relations The aim of this book is to offer the reader in a single volume a readily available comprehensive set of data that will save him the need of frequent time consuming literature searches **Cosmic Rays and Particle Physics** Thomas K. Gaisser, 1991-01-25 Over recent years there has been marked growth in interest in the study of techniques of cosmic ray physics by astrophysicists and particle physicists Cosmic radiation is important for the astrophysicist because in the farther reaches of the universe For particle physicists it provides the opportunity to study neutrinos and very high energy particles of galactic origin More importantly cosmic rays constitue the background and in some cases possibly the signal for the more exotic unconfirmed hypothesized particles such as monopoles and sparticles Concentrating on the highest energy cosmic rays this book describes where they originate acquire energy and interact in accreting neutron stars supernova remnants in large scale shock waves It also describes their interactions in the atmosphere and in the earth how they are studied in surface and very large underground detectors and what they tell us **Cosmic Rays and Particle Physics** Thomas K. Gaisser, Ralph Engel, Elisa Resconi, 2016-06-02 Fully updated for the second edition this book introduces the growing and dynamic field of particle astrophysics It provides an overview of high energy nuclei photons and neutrinos including their origins their propagation in the cosmos their detection on Earth and their relation to each other Coverage is expanded to include new content on high energy physics the propagation of protons and nuclei in cosmic background radiation neutrino astronomy high energy and ultra high energy cosmic rays sources and acceleration mechanisms and atmospheric muons and neutrinos Readers are able to master the fundamentals of particle astrophysics within the context of the most recent developments in the field This book will benefit graduate students and established researchers alike equipping them with the knowledge and tools needed to design and interpret their own experiments and ultimately to address a number of questions concerning the nature and origins of cosmic particles that have arisen in recent research **Cosmic Rays and Particle Physics** T. K. Gaisser,1979 A Thin Cosmic Rain Michael W. Friedlander, 2002-11-30 Enigmatic for many years cosmic rays are now known to be not rays at all but particles the nuclei of atoms raining down continually on the earth where they can be detected throughout the atmosphere and sometimes even thousands of feet underground This book tells the long running detective story behind the discovery and study of cosmic rays a story that stretches from the early days of subatomic particle physics in the 1890s to the frontiers of high energy astrophysics today Writing for the amateur scientist and the educated general reader Michael Friedlander a cosmic ray researcher relates the history of cosmic ray science from its accidental discovery to its present status He explains how cosmic rays are identified and how their energies are measured then surveys current knowledge and theories of thin cosmic rain The most thorough up to date and readable account of these intriguing phenomena his book makes us party to the search into the nature behavior and origins of cosmic rays and into the

sources of their enormous energy sometimes hundreds of millions times greater than the energy achievable in the most powerful earthbound particle accelerators As this search led unexpectedly to the discovery of new particles such as the muon pion kaon and hyperon and as it reveals scenes of awesome violence in the cosmos and offers clues about black holes supernovas neutron stars quasars and neutrinos we see clearly why cosmic rays remain central to an astonishingly diverse range of research studies on scales infinitesimally small and large Attractively illustrated engagingly written this is a fascinating inside look at a science at the center of our understanding of our universe **Astroparticle Physics** Claus Grupen, 2005-12-06 Describes the branch of astronomy in which processes in the universe are investigated with experimental methods employed in particle physics experiments After a historical introduction the basics of elementary particles Explains particle interactions and the relevant detection techniques while modern aspects of astroparticle physics are described in a chapter on cosmology Provides an orientation in the field of astroparticle physics that many beginners might seek and appreciate because the underlying physics fundamentals are presented with little mathematics and the results are illustrated by many diagrams Readers have a chance to enter this field of astronomy with a book that closes the gap between expert and Introduction to Particle and Astroparticle Physics Alessandro De Angelis, Mário João Martins Pimenta, 2015-09-05 This book written by researchers who had been professionals in accelerator physics before becoming leaders of groups in astroparticle physics introduces both fields in a balanced and elementary way requiring only a basic knowledge of quantum mechanics on the part of the reader The new profile of scientists in fundamental physics ideally involves the merging of knowledge in astroparticle and particle physics but the duration of modern experiments is such that people cannot simultaneously be practitioners in both Introduction to Particle and Astroparticle Physics is designed to bridge the gap between the fields It can be used as a self training book a consultation book or a textbook providing a modern approach to particles and fundamental interactions Cosmic Rays and Astrophysics Carlos Javier Solano Salinas, Jose Bellido, David Wahl, Oscar Saavedra, 2009-05-29 The purpose of the School was to promote cosmic ray physics and astrophysics within the Latin American community These proceedings aim to provide a comprehensive overview of the theoretical and experimental aspects of Cosmit Ray Physics and Astrophysics The list of lecture topics includes experimental techniques primary spectrum and composition of cosmic rays high energy interactions gamma ray astronomy and GRBs neutrino astrophsyics cosmic ray detectors simulation solar modulation and present status of the development and results from several present day observations such as the Pierre Auger IceCube HESS KASCADE etc The proceedings will provide students with a common background and will give them an updated panorama **Cosmic Radiations: From Astronomy** to Particle Physics Giorgio Giacomelli, Maurizio Spurio, Jamal Eddine Derkaoui, 2001-11-30 Non accelerator particle physicists especially those studying neutrino oscillation experiments will read with profit the in depth discussions of new results and their interpretations new guidelines are also set out for new developments in this and related fields Discussions

are presented of neutrino oscillations neutrino astronomy high energy cosmic rays gravitational waves magnetic monopoles and dark matter The future large scale research projects discussed include the experiments on long baseline neutrino beams from CERN to Gran Sasso and Fermilab to the Soudan mine large underwater and under ice experiments the highest energy cosmic rays gravitational waves and the search for new particles and new phenomena

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