Book Reviews

Quality Assessment and Improvement for Dose-Response Models. Some Effects of Study Weaknesses on Study Findings. "C'est Magnifique?" AAPM Report No. 43. Biological Effects Committee Task Group 1, Donald E. Herbert, principal author. 372 pp. Medical Physics Publishing Corp., Madison, Wisconsin. Price: $25.00.

C'est magnifique, mais ce n'est pas la guerre.

So remarked General P. Bosquet in 1857, on observing the innovative deployment of Lord Raglan's light cavalry brigade at Balaclava. And, as indicated in the Report's title, this quotation does indeed characterize the current literature on radiobiological modeling reviewed in AAPM Report No. 43. Loosely translated in this context, the quotation reads: "It looks great, but it ain't science?".

Report 43 is the culmination of many years of investigation of the radiobiological literature by Task Group 1 of AAPM's Biological Effects Committee, consisting of Donald E. Herbert (Chairperson and principal author of the Report), Arnold Feldman, Engikolai Krishnan, Colin Orton, Jacques Ovadia, Bhadan Paliwal, Timothy Schultheiss, Prakash Shrivastava, Alfred Smith, Marilyn Stovall, and Lionel Cohen (Consultant). What Task Group 1 did was to critically evaluate 40 authoritative studies of models of radiation dose response for certain endpoints: radiation toxicity, mutagenesis, tumorigenesis, and lethality. They closely examined the empirical evidence and theoretical arguments—concepts, data, methods, and criteria—which were presented in these studies, and concluded that what is required is a "sea-change" in the statistical practices employed in the construction, testing, and deployment of radiobiological models.

Task Group 1 did not come into this enterprise as unbiased observers—after all, an unbiased mind is an empty mind! They knew that there were fundamental problems with current radiobiological modeling, and they took a general approach toward dealing with these problems, seeking to answer four questions: 1. What do we believe? 2. Why do we believe it? 3. Should we believe it? 4. What shall we do now? The result has been a highly unorthodox presentation which starts with consideration of the philosophy of science. Such an approach does seem to be necessary, in order to effect the required sea-change in our ways of thinking, given the failure of more traditional formats to do so. (For example, that of AAPM Monograph No. 13, *Multiple Regression Analysis: Applications in the Health Sciences*, edited by D. Herbert and R. Myers, 1986.) Quite deliberately, Report 43 tries both to inform and to persuade, rather than being a dispassionate scientific treatise.

The heart of Report 43 is its long (115 pg.) Sec. 7, which presents the statistical methods required for correct modeling of radiobiological data. But it "presents" this vital information as an advocate of the new methods ("new," at least, to much of the radiobiological literature). First, in Sec. 7, there is detailed mathematical explanation of these statistical methods, and then, most importantly, these methods are *applied* in understanding flaws in the 40 studies reviewed. (Full secondary analyses of 34 of these studies are given elsewhere, in what Report 43 refers to as its Annexes.) Many of the Report's 173 figures are in Sec. 7, and in themselves all these figures constitute a highly useful "teaching file," as the Report points out. Add to Sec. 7 the secondary analyses presented in Secs. 16 and 17, as self-contained attachments to the main body of the Report, and you have an immensely valuable introduction to how to do your dose-response modeling right! (The importance of this cannot be overstated.)

Given these fundamental problems with current radiobiological modeling, what should be done now? This is the fourth general question which Task Group 1 sought to answer, and in Sec. 14 they recommended four ways to go forward. First, we should use classical meta-analysis, combining results from a number of related studies of a common hypothesis to arrive at conclusions (e.g., rejection of the hypothesis) that could not be achieved otherwise because of various weaknesses (such as small sample sizes) in the component studies; furthermore, we should continue to perform secondary analyses of the data upon which published results are based, to validate these results. Second, Task Group 1 suggest using certain mixture methods for discriminating between the linear quadratic and target theory models of cell survival. Their third recommendation is to use a recently developed class of Bayesian statistical methods—Bayesian hierarchical meta-analysis—for interspecies extrapolation of radiation dose-response data (the "mouse-to-human" problem). Finally, Task Group 1 suggest using multivariate probit analysis for both clinical and animal studies of the joint occurrence of characteristic radiation responses in normal and tumor tissues. Appendix II continues further, proposing a somewhat different perspective on radiation "tolerance" for use in statistically adequate models.

An unexpected, but most welcome, aspect of Report 43 is its presentation of concise quotations on the philosophy of science. This is actually done in considerable depth, both in separate subsections and in introducing many subsections, as is appropriate to effect a sea-change in our approach to science. We certainly tend to accept the usual way of doing things ("normal science"), until "paradoxes" (outcomes which "should not" have occurred) shake up our complacency. But why wait for the paradoxes to occur? Better to understand clearly how one approaches scientific research, what pitfalls lie lurking. For example, given two sets of data for similar situations, taken at different times, our tendency is to construct a model from the first set of data and use *this model* to explain the second set of data. But what if we had taken the second set of data first? Would we not perhaps have constructed a *qualitatively different model*, and tried to fit the first set of data to this model? If our methods for data acquisition and analysis might well lead to two different models, then we have not really deduced the model from the data. This problem evidently has occurred in current radiobiological modeling, but any domain of science is susceptible to it.

Task Group 1's Report 43 is of incalculable importance for rectifying the fundamental problems in current dose-response modeling, and for investigators in this field, there is no excuse for not reading it carefully and following its lead. There are, however, some minor problems with the presentation of this material. First, the already dense reading may be slowed down by occasional use of obscure words ("ament"??)—be sure to have your dictionary handy when you are in the philosophy-of-science parts! The Report could have been made more readable by using headings for sections and subsections in a larger (and perhaps different) typeface, and starting sections on new pages. (In fact, until page 94 there are not even blank lines between sections!) Finally, there is the sexist language which occasionally crops into Report 43, with the use of the male pronoun to describe people in general. Even when repeating a historical quotation, it is possible to avoid doing this, such as by replacing "men" with "[women and] men." Medical physics, like our society in general, is overwhelmingly dominated by men, but is it not time for a "sea-change" in this regard?

Reviewed by David Jette

Dr. Jette is Executive Director of the Lawrence N. Lamf Institute of Medical Physics in Seattle, and Professor of Medical Physics at Rush University in Chicago.

Stopping Powers And Ranges For Protons And Alpha Particles Icru Report 49

John R. Cooper,Keith Randle,Ranjeet S. Sokhi

Stopping Powers And Ranges For Protons And Alpha Particles Icru Report 49:

Introduction to Radiation Protection Dosimetry Jozef Sabol,Baoshan Weng,1995 One essential characteristic of life is the exchange of matter and energy between organisms and their environment Radiation is a form of energy that has always been around in nature and will forever be the companion of human beings throughout life In order to assess the impact of radiation exposures properly it is essential to introduce appropriate quantities and units which can then be used for quantification of exposures from various sources In principle radiation protection is mainly aimed at controlling radiation exposure while radiation dosimetry deals primarily with the measurement of relevant radiation quantities especially doses This book is divided into two parts The first contains up to date definitions of the most significant radiation quantities including their interpretation In the second part the exposures of both individuals and population at large to various types of natural and man made sources are compared and discussed The concept of quantities and units as well as analysis of exposure due to various sources in our environment is based on the latest highly regarded authentic sources such as ICRU ICRP IAEA and particularly UNSCEAR reports and recommendations The material reflects the latest review of the current terminology in radiation protection dosimetry and the contemporary assessment of radiation exposures of the population radiation workers and patients **Intermediate Physics for Medicine and Biology** Russell K. Hobbie,Bradley J Roth,2007-03-12 This text bridges the gap between introductory physics and its application to the life sciences It is intended for advanced undergraduates and beginning graduate students The Fourth Edition is updated to include new findings discussion of stochastic processes and expanded coverage of anatomy and biology The text includes many problems to test the student s understanding and chapters include useful bibliographies for further reading Its minimal prerequisites and wide coverage make it ideal for self study The fourth edition is updated throughout to reflect new developments

Radiochromic Film Indra J. Das,2017-10-30 This book provides a first authoritative text on radiochromic film covering the basic principles technology advances practical methods and applications It focuses on practical uses of radiochromic film in radiation dosimetry for diagnostic x rays brachytherapy radiosurgery external beam therapies photon electron protons stereotactic body radiotherapy intensity modulated radiotherapy and other emerging radiation technologies The expert authors address basic concepts advantages and the main applications including kilovoltage brachytherapy megavoltage electron beam proton beam skin dose in vivo dosimetry postal and clinical trial dosimetry The final chapters discuss the state of the art in microbeam synchrotron radiation and ultraviolet radiation dosimetry **Radioactive Releases in the Environment** John R. Cooper,Keith Randle,Ranjeet S. Sokhi,2003-05-07 This text brings together in one single comprehensive reference the fundamentals of radioactivity It uniquely fills the gap in the market as no other books deal with environmental radioactivity to this degree Timely and invaluable as the studies of environmental processes and the awareness of the impact of human activity on our environment are increasing Links all three main aspects of environmental

radioactivity Principles Transport and Measurement Useful to a wide readership students lecturers researchers companies and environmental consultants **Medical Radiation Dosimetry** Brian J McParland,2013-11-11 Accurate radiation dosimetry is a requirement of radiation oncology diagnostic radiology and nuclear medicine It is necessary so as to satisfy the needs of patient safety therapeutic and diagnostic optimisation and retrospective epidemiological studies of the biological effects resulting from low absorbed doses of ionising radiation The radiation absorbed dose received by the patient is the ultimate consequence of the transfer of kinetic energy through collisions between energetic charged particles and atoms of the tissue being traversed Thus the ability of the medical physicist to both measure and calculate accurately patient dosimetry demands a deep understanding of the physics of charged particle interactions with matter Interestingly the physics of charged particle energy loss has an almost exclusively theoretical basis thus necessitating an advanced theoretical understanding of the subject in order to apply it appropriately to the clinical regime Each year about one third of the world s population is exposed to ionising radiation as a consequence of diagnostic or therapeutic medical practice The optimisation of the resulting radiation absorbed dose received by the patient and the clinical outcome sought whether diagnostic or therapeutic demands accuracy in the evaluation of the radiation absorbed doses resulting from such exposures This requirement arrises primarily from two broadly encompassing factors The requirement in radiation oncology for a 5% or less uncertainty in the calculation and measurement of absorbed dose so as to optimise the therapeutic ratio of the probabilities of tumour control and normal tissue complications and The establishment and further refinement of dose reference levels used in diagnostic radiology and nuclear medicine to minimise the amount of absorbed dose for a required degree of diagnostic benefit The radiation absorbed dose is the outcome of energetic charged particles decelerating and transferring their kinetic energy to tissue The calculation of this energy deposition characterised by the stopping power is unique in that it is derived entirely from theoretical principles This dominant role of the associated theory makes its understanding of fundamental to the calculation of the radiation absorbed dose to the patient The theoretical development of charged particle energy loss recognised in medical physics textbooks is in general limited to basic derivations based upon classical theory generally a simplified form of the Bohr theory More advanced descriptions of for example the Bethe Bloch quantum result usually do not go beyond the simple presentation of the result without full explanation of the theoretical development of the theory and consideration of its limitations its dependencies upon the Born perturbation theory and the various correction factors needed to correct for the failures of that Born theory at higher orders This is not appropriate for a full understanding of the theory that its importance deserves The medical radiation physicist should be aware of the details of the theoretical derivations of charged particle energy loss in order to appreciate the levels of accuracy in tabular data provided in reports and the calculation methodologies used in modern Monte Carlo calculations of radiation dosimetry **Interaction of Radiation with Matter** Hooshang Nikjoo,Shuzo Uehara,Dimitris Emfietzoglou,2016-04-19 Interaction of Radiation with

Matter focuses on the physics of the interactions of ionizing radiation in living matter and the Monte Carlo simulation of radiation tracks Clearly progressing from an elementary level to the state of the art the text explores the classical physics of track description as well as modern aspects based on condensed mat **Advances in Chemical Physics** Ilya Prigogine,Stuart A. Rice,2009-09-09 The Advances in Chemical Physics series provides the chemical physics and physical chemistry fields with a forum for critical authoritative evaluations of advances in every area of the discipline Filled with cutting edge research reported in a cohesive manner not found elsewhere in the literature each volume of the Advances in Chemical Physics series serves as the perfect supplement to any advanced graduate class devoted to the study of chemical physics **Proton and Carbon Ion Therapy** C-M Charlie Ma,Tony Lomax,2012-10-09 Proton and Carbon Ion Therapy is an up to date guide to using proton and carbon ion therapy in modern cancer treatment The book covers the physics and radiobiology basics of proton and ion beams dosimetry methods and radiation measurements and treatment delivery systems It gives practical guidance on patient setup target localization and treatment planning for clinical proton and carbon ion therapy The text also offers detailed reports on the treatment of pediatric cancers lymphomas and various other cancers After an overview the book focuses on the fundamental aspects of proton and carbon ion therapy equipment including accelerators gantries and delivery systems It then discusses dosimetry biology imaging and treatment planning basics and provides clinical guidelines on the use of proton and carbon ion therapy for the treatment of specific cancers Suitable for anyone involved with medical physics and radiation therapy this book offers a balanced and critical assessment of state of the art technologies major challenges and the future outlook of proton and carbon ion therapy It presents a thorough introduction for those new to the field while providing a helpful up to date reference for readers already using the therapy in clinical settings *Proton Therapy Physics, Second Edition* Harald Paganetti,2018-11-19 Expanding on the highly successful first edition this second edition of Proton Therapy Physics has been completely restructured and updated throughout and includes several new chapters Suitable for both newcomers in medical physics and more seasoned specialists in radiation oncology this book provides an in depth overview of the physics of this radiation therapy modality eliminating the need to dig through information scattered across medical physics literature After tracing the history of proton therapy the book explores the atomic and nuclear physics background necessary for understanding proton interactions with tissue The text then covers dosimetry including beam delivery shielding aspects computer simulations detector systems and measuring techniques for reference dosimetry Important for daily operations acceptance testing commissioning quality assurance and monitor unit calibrations are outlined The book moves on to discussions of treatment planning for single and multiple field uniform doses dose calculation concepts and algorithms and precision and uncertainties for nonmoving and moving targets Imaging for treatment guidance as well as treatment monitoring is outlined Finally the biological implications of using protons from a physics perspective are discussed This book is an ideal practical guide for physicians dosimetrists radiation therapists and

physicists who already have some experience in radiation oncology It is also an invaluable reference for graduate students in medical physics programs physicians in their last year of medical school or residency and those considering a career in medical physics Features Updated with the latest technologies and methods in the field covering all delivery methods of proton therapy including beam scanning and passive scattering Discusses clinical aspects such as treatment planning and quality assurance Offers insight on the past present and future of proton therapy from a physics perspective *Quantities For Generalized Dosimetry Of Ionizing Radiations in Liquid Water* D E Watt,2003-09-02 Intended as a reference handbook of quantities used in dosimetry of ionizing radiations Fields of application are radiological protection environmental radiation health physics nuclear medicine and radiotherapy radiobiology radiopharmacy and radiation chemistry The book is in three parts The first part deals with electrons X rays and gamma Clinical 3D Dosimetry in Modern Radiation Therapy Ben Mijnheer,2017-10-31 This book provides a first comprehensive summary of the basic principles instrumentation methods and clinical applications of three dimensional dosimetry in modern radiation therapy treatment The presentation reflects the major growth in the field as a result of the widespread use of more sophisticated radiotherapy approaches such as intensity modulated radiation therapy and proton therapy which require new 3D dosimetric techniques to determine very accurately the dose distribution It is intended as an essential guide for those involved in the design and implementation of new treatment technology and its application in advanced radiation therapy and will enable these readers to select the most suitable equipment and methods for their application Chapters include numerical data examples and case studies

Stopping of Heavy Ions Peter Sigmund,2004-07-09 This book offers a concise presentation of theoretical concepts characterizing and quantifying the slowing down of swift heavy ions in matter Although the penetration of charged particles through matter has been studied for almost a hundred years the quantitative theory for swift penetrating ions heavier than helium has been developed mainly during the past decade and is still progressing rapidly The book addresses scientists and engineers working at accelerators with an interest in materials analysis and modification medical diagnostics and therapy mass spectrometry and radiation damage as well as atomic and nuclear physicists Although not a textbook this monograph represents a unique source of state of the art information that is useful to a university teacher in any course involving the interaction of charged particles with matter Proton Therapy Physics Harald Paganetti,2016-04-19 Proton Therapy Physics goes beyond current books on proton therapy to provide an in depth overview of the physics aspects of this radiation therapy modality eliminating the need to dig through information scattered in the medical physics literature After tracing the history of proton therapy the book summarizes the atomic and nuclear physics background necessary for understanding proton interactions with tissue It describes the physics of proton accelerators the parameters of clinical proton beams and the mechanisms to generate a conformal dose distribution in a patient The text then covers detector systems and measuring techniques for reference dosimetry outlines basic quality assurance and commissioning guidelines and gives examples of

Monte Carlo simulations in proton therapy The book moves on to discussions of treatment planning for single and multiple field uniform doses dose calculation concepts and algorithms and precision and uncertainties for nonmoving and moving targets It also examines computerized treatment plan optimization methods for in vivo dose or beam range verification the safety of patients and operating personnel and the biological implications of using protons from a physics perspective The final chapter illustrates the use of risk models for common tissue complications in treatment optimization Along with exploring quality assurance issues and biological considerations this practical guide collects the latest clinical studies on the use of protons in treatment planning and radiation monitoring Suitable for both newcomers in medical physics and more seasoned specialists in radiation oncology the book helps readers understand the uncertainties and limitations of precisely shaped dose distribution *Monte Carlo Techniques in Radiation Therapy* Frank Verhaegen,Joao Seco,2021-10-13 About ten years after the first edition comes this second edition of Monte Carlo Techniques in Radiation Therapy Introduction Source Modelling and Patient Dose Calculations thoroughly updated and extended with the latest topics edited by Frank Verhaegen and Joao Seco This book aims to provide a brief introduction to the history and basics of Monte Carlo simulation but again has a strong focus on applications in radiotherapy Since the first edition Monte Carlo simulation has found many new applications which are included in detail The applications sections in this book cover the following Modelling transport of photons electrons protons and ions Modelling radiation sources for external beam radiotherapy Modelling radiation sources for brachytherapy Design of radiation sources Modelling dynamic beam delivery Patient dose calculations in external beam radiotherapy Patient dose calculations in brachytherapy Use of artificial intelligence in Monte Carlo simulations This book is intended for both students and professionals both novice and experienced in medical radiotherapy physics It combines overviews of development methods and references to facilitate Monte Carlo studies **Monte Carlo Techniques in Radiation Therapy** Joao Seco,Frank Verhaegen,2021-10-19 Thoroughly updated throughout this second edition of Monte Carlo Techniques in Radiation Therapy Applications to Dosimetry Imaging and Preclinical Radiotherapy edited by Joao Seco and Frank Verhaegen explores the use of Monte Carlo methods for modelling various features of internal and external radiation sources Monte Carlo methods have been heavily used in the field of radiation therapy in applications such as dosimetry imaging radiation chemistry modelling of small animal irradiation units etc The aim of this book is to provide a compendium of the Monte Carlo methods that are commonly used in radiation therapy applications which will allow students postdoctoral fellows and university professors to learn and teach Monte Carlo techniques This book provides concise but detailed information about many Monte Carlo applications that cannot be found in any other didactic or scientific book This second edition contains many new chapters on topics such as Monte Carlo studies of prompt gamma emission Developments in proton imaging Monte Carlo for cone beam CT imaging Monte Carlo modelling of proton beams for small animal irradiation Monte Carlo studies of microbeam radiation therapy Monte Carlo in micro and nano dosimetry GPU based fast

Monte Carlo simulations for radiotherapy This book is primarily aimed at students and scientists wishing to learn and improve their knowledge of Monte Carlo methods in radiation therapy Therapeutic Applications of Monte Carlo Calculations in Nuclear Medicine H. Zaidi,G Sgouros,2002-09-01 Therapeutic Applications of Monte Carlo Calculations in Nuclear Medicine examines the applications of Monte Carlo MC calculations in therapeutic nuclear medicine from basic principles to computer implementations of software packages and their applications in radiation dosimetry and treatment planning With chapters written by recognized authorit **Macroscopic Electrodynamics: An Introductory Graduate Treatment (Second Edition)** Walter Mark Wilcox,Christopher P Thron,2024-02-08 Macroscopic Electrodynamics ME is a comprehensive two semester introductory graduate level textbook on classical electrodynamics for use in physics and engineering programs The word macroscopic is intended to indicate both the large scale nature of the theory as well as the emphasis placed upon applications of the so called macroscopic Maxwell equations to idealized media ME emphasizes principles and practical methods of analysis which are often presented in fresh and original ways Illustrative examples are carefully chosen to promote the students physical intuition and are worked out in detail to give students a thorough grounding in solution techniques The style is informal yet mathematically sound and presumes only a basic familiarity with electrodynamics such as that obtained in a one semester junior level undergraduate class At the end of each chapter many original problems are provided with illustrations or expanded upon specific sections of the text The problems are at the heart of the text and are meant to encourage students develop confidence and emphasize ideas while avoiding both oversimplification and inordinate calculational difficulties **Charged Particles in Oncology** Marco Durante,Francis A. Cucinotta,Jay S. Loeffler,2018-01-31 High energy charged particles represent a cutting edge technique in radiation oncology Protons and carbon ions are used in several centers all over the world for the treatment of different solid tumors Typical indications are ocular malignancies tumors of the base of the skull hepatocellular carcinomas and various sarcomas The physical characteristics of the charged particles Bragg peak allow sparing of much more normal tissues than it is possible using conventional X rays and for this reason all pediatric tumors are considered eligible for protontherapy Ions heavier than protons also display special radiobiological characteristics which make them effective against radioresistant and hypoxic tumors On the other hand protons and ions with high charge Z and energy HZE particles represent a major risk for human space exploration The main late effect of radiation exposure is cancer induction and at the moment the dose limits for astronauts are based on cancer mortality risk The Mars Science Laboratory MSL measured the dose on the route to Mars and on the planet s surface suggesting that a human exploration missions will exceed the radiation risk limits Notwithstanding many studies on carcinogenesis induced by protons and heavy ions the risk uncertainty remains very high In this research topic we aim at gathering the experiences and opinions of scientists dealing with high energy charged particles either for cancer treatment or for space radiation protection Clinical results with protons and heavy ions as well as research in medical

physics and pre clinical radiobiology are reported In addition ground based and spaceflight studies on the effects of space radiation are included in this book Particularly relevant for space studies are the clinical results on normal tissue complications and second cancers The eBook nicely demonstrates that particle therapy in oncology and protection of astronauts from space radiation share many common topics and can learn from each other **Targeted Radionuclide Therapy** Tod W. Speer,2012-03-28 Radioimmunotherapy also known as systemic targeted radiation therapy uses antibodies antibody fragments or compounds as carriers to guide radiation to the targets It is a topic rapidly increasing in importance and success in treatment of cancer patients This book represents a comprehensive amalgamation of the radiation physics chemistry radiobiology tumor models and clinical data for targeted radionuclide therapy It outlines the current challenges and provides a glimpse at future directions With significant advances in cell biology and molecular engineering many targeting constructs are now available that will safely deliver these highly cytotoxic radionuclides in a targeted fashion A companion website includes the full text and an image bank *Astroparticle, Particle and Space Physics, Detectors and Medical Physics Applications* M. Barone,2003 The exploration of the subnuclear world is carried out through increasingly complex experiments covering a wide range of energies and in a large variety of environments from particle accelerators and underground detectors to satellites and space laboratories For these research programs to succeed novel techniques new materials and new instrumentation need to be used in detectors often on a large scale This book reviews the advances made in all technological aspects of the experiments at various stages The proceedings have been selected for coverage in Index to Scientific Technical Proceedings ISTP ISI Proceedings Index to Scientific Technical Proceedings ISTP CDROM version ISI Proceedings CC Proceedings Engineering Physical Science

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