

Bookshelf

COMPILED BY VIRGINIA GRECO, CERN

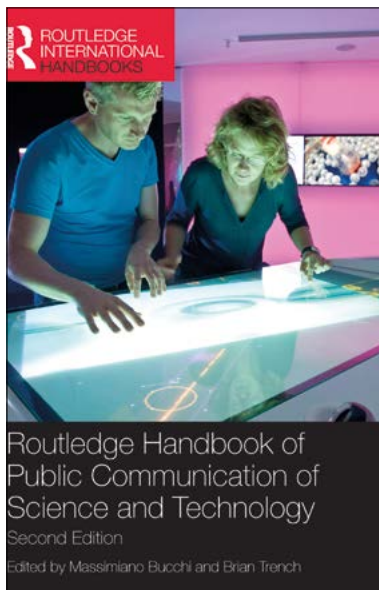
Routledge Handbook of Public Communication of Science and Technology (2nd edition)

By M Bucchi and B Trench (eds)

Routledge

With scientists increasingly asked to engage the public and society-at-large with their research, and include outreach plans as part of grant applications, it helps to have a guide to various involvement possibilities and the research behind them. The second edition of the *Routledge Handbook of Public Communication of Science and Technology* (henceforth referred to as “the *Handbook*”) provides a thorough introduction to public engagement – or outreach, as it is sometimes called – through a varied collection of articles on the subject. In particular, it brings to attention the underlying issues associated with the old “deficit model of science communication”, which presupposes a knowledge deficit about science among the general public that must be filled by scientists providing facts, and facts alone. Although primarily targeting science-communication practitioners and academics researching the field, the *Handbook* can also help scientists to reflect on their outreach efforts and to appreciate the interplay between science and society.

Before plunging into the depths of the book, it is important to remember that the study of science communication is the study of evolving terminology. Historically, an effort was made to determine the “scientific literacy” of society, under the assumption that a society knowledgeable in the facts and methods of science would support research endeavours without much opposition. This approach was made obsolete by the introduction of the “public communication of science and technology” paradigm, which itself was superseded by what is today called “public engagement with science and technology”, or “public engagement” for short. The first chapter, written by the editors, is the best place to familiarise oneself with the various science-communication models, as well as the terms and phrases used throughout the *Handbook*. That said, those with backgrounds in natural sciences might feel somewhat out of their depth, due to a lack of definitions in the rest of the *Handbook* for words and phrases used on a daily basis by their social-science counterparts. However, this is largely mitigated by each chapter containing a wealth of notes and references

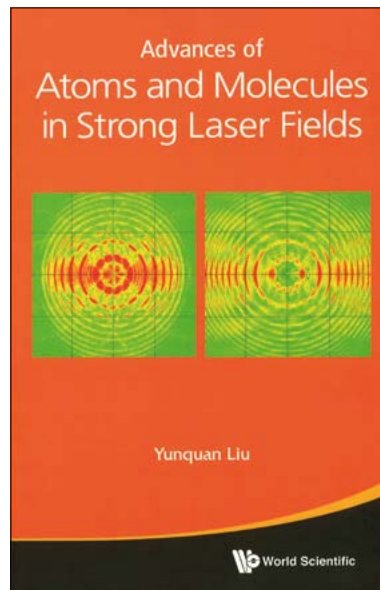


at the end, pointing readers in the direction of further reading.

The chapters themselves are stand-alone articles by experts in their respective topics, many written in engaging, conversational styles. They cover everything from policy and participants, to the handling of “hot-button” issues, to research and assessment methodology. Readers of the *Courier* may find the chapters on science journalism, on public relations in science, on the role of scientists as public experts and on risk management particularly illuminating.

What the same readers might find missing from the book is a specific treatment of fundamental research: the *Handbook* focuses on domains of science – such as climate change – that tend to have a direct or immediate impact on society. Scientists from other areas of research might therefore consider shoe-horning (perhaps non-existing) societal impact into their science-communication efforts, rather than learning how to adapt the lessons learnt from fields such as climate science to their own work. It is therefore this reviewer’s desire that future editions of the *Handbook* address the science-communication challenges of more diverse areas of research, proposing ways in which scientists and practitioners can tackle them.

Overall, the *Handbook* gives readers valuable insight into



science-communication research, and merits a place on the library shelves of every university and research institution.

● Achintya Rao, CERN.

Advances of Atoms and Molecules in Strong Laser Fields

By Y Liu

World Scientific

The challenge of developing more intense, shorter-pulse lasers has already seen outstanding results and opened up completely new perspectives. In fact, the next generation of very-high-power laser facilities will provide the opportunity to explore even ultrarelativistic and vacuum nonlinearity at unprecedented levels, moving towards a QCD regime. At the same time, during the last few years, attosecond physics has provided a new, intriguing way to visualise both atoms and molecules, and the electromagnetic-field structure of the excitation wave packet itself, because this time domain is comparable with the classical periods of electrons orbiting around the nucleus. This growing research field is so recent that the literature on the subject is not yet adequate: in this sense, this book partially fills the gap. It contains contributions from several Chinese groups, both experimental and theoretical, and reports on recent studies of bound electron and molecular nonlinearities. The content is organised

over eight chapters and spans a broad range of topics of this specialist subject.

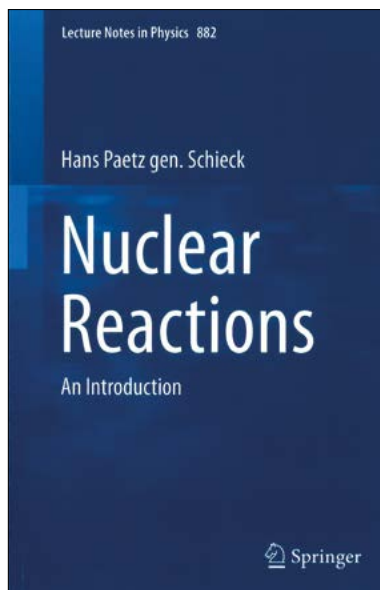
Strong-field tunnelling is a possible key to the ionisation of neutrals. It offers a sophisticated method to image and probe atomic and molecular quantum processes. In fact, the study of direct and rescattered (by the nucleus) electrons in the ionisation process is able to resolve orbitals; in this context, it becomes important to go beyond strong-field approximation, and to evaluate the contribution of the long-range Coulomb field generated by the ion in the electron dynamical evolution (chapter 1).

Direct and rescattered electrons can be recorded together as a reference wave and a signal wave, respectively: the interferential patterns constitute the analogue of optical holography, reconstructing the illuminated objects. It is possible to integrate the influence of the Coulomb field, either in a numerical solution of the time-dependent Schrödinger equation (TDSE) or in a more intuitive quantum-trajectories Monte Carlo method describing the formation mechanisms of the photoelectron angular distribution of above-threshold ionisation (chapter 2).

Dissociation is a basic process of physical chemistry and, before the advent of new ultrafast tools, seemed completely out of scientists' control, because the typical timescale is below the femtosecond range. For an easier comparison of theoretical predictions and experimental results for a molecule interacting with a strong ultrashort laser pulse, it is necessary to start with the simplest systems – the hydrogen molecular ion H_2^+ . In chapter 3, on the basis of a numerical analysis of the related TDSE, the author suggests a pump–probe strategy to understand dissociation.

The theoretical discussion of double ionisation in a strong laser field is treated in chapters 4 and 5 for different kinds of atoms. In the case of high Z , the experiments show a different degree of correlation of the two expelled electrons, with respect to the low- Z case: this is due to the major importance of rescattering, as described by a semiclassical model. For the simpler systems H_2 and He , TDSE is a powerful tool for calculating all of the main features of double ionisation (total and differential cross-sections, recoil-ion momentum spectra, two electron angular distributions, and two electron-interference phenomena).

A promising application of strong-field excitation on atoms and molecules is high-order harmonics generation (HHG), usually providing a XUV comb with different harmonics at the same intensities,



both in a single attosecond pulse and in a train of attosecond pulses, by a conversion of the light frequency from IR to the X-ray regime. This technique provides a tomographic image of molecular orbitals as an alternative to scanning tunnelling microscopy or angle-resolved photoelectron spectroscopy, as well as a way to study ultrafast electronic structures, electron dynamics and multichannel dynamics (chapters 6 and 7).

Finally, chapter 8 presents an interesting review of the properties of free electron laser radiation, showing how nuclear motion in photo-induced reactions can be monitored in real time, the electronic dynamics in molecular co-ordinates can be extracted, and the site-specific information in the structural dynamics of chemical reactions can be provided. The experiments are based on EUV pump–probe and optical pump–X-ray probe excitation techniques, and are located at FLASH (Hamburg) and LCLS (SLAC), respectively.

As a summary, the book is a useful update for people who are interested in the specialised field of the interaction of atoms and molecules with femtosecond or sub-femtosecond high-intensity fields. The comprehensive bibliography allows the reader to gain a more exhaustive view of the subject.

● *Emilio Mariotti, University of Siena, Italy.*

Nuclear Reactions: An Introduction

By Hans Paetz gen. Schieck

Springer

The study of the structure of complex nuclei has experienced a revival in recent years, thanks to the availability of energetic radioactive beams. New facilities such as HIE-ISOLDE at CERN are coming online. Nuclear reactions are exciting objects of study in their own right and are also indispensable tools to study the structure of nuclei. Therefore, one should expect a reactivation of nuclear-reaction courses in graduate nuclear-physics curricula, and the aim of the present book is to provide the material for such courses.

The author is an experimentalist, and as a consequence, the text contains a refreshing mix of experimental facts and methods with basic theoretical knowledge. The book will convince the reader that nuclear physics is a lively and modern field. As examples of recent progress describe, one can cite the discovery of halo nuclei using high-energy reactions induced by radioactive beams (chapter 2), as well as the treatment of superheavy nuclei (chapter 15). It is, however, also satisfying to see some elegant traditional-physics manifestations, such as Ericson fluctuations (chapter 11), which have disappeared from many recent courses.

The first four chapters contain material commonly taught in undergraduate classes, such as cross-section definition, Rutherford scattering and partial wave expansion, which are a prerequisite for following the more intricate parts of the book that start in chapter 5. I was surprised, however, that the author uses the particle-physics definition of isospin ($t_3 = +\frac{1}{2}$ for the proton), which could create some confusion in a nuclear-physics book. An attractive originality of the book is the detailed description of reactions with nuclei with spin and polarised targets or beams – topics that are too often glossed over. Models for direct and compound nucleus reactions are competently covered. The chapter on heavy-ion reactions is minimal. The last part of the book, which starts at chapter 16, describes the techniques for studying nuclear reactions, accelerators and detectors, and gives some applications in the fields of medicine, energy production and fusion. This part makes for lighter reading, and could bring back on board readers who might have found the heart of the material somewhat arduous. These last chapters should be considered as an enticement for the reader to go on to more detailed descriptions of the subjects that arouse their curiosity. At the end of each chapter, some exercises are proposed so that the reader can test their understanding of the concepts presented. ▷

Bookshelf

The book proposes a solid graduate curriculum on nuclear reactions and contains a clear presentation of the basic concepts necessary for undertaking a PhD in nuclear physics, illustrated by examples of modern discoveries and experiments that should motivate the reader. Its aim is not, however, to replace books that are indispensable to the practitioner, such as *Direct Nuclear Reactions* by G R Satchler. Let's hope that this relatively modern and accessible course in nuclear reactions will encourage the teaching of the subject to reappear in many universities where it has been somewhat neglected in recent years. Progress in nuclear structure is, after all, dependent on the understanding of nuclear reactions.

• Yorick Blumenfeld, IPNO, Orsay, France.

Books received

The Thermophysical Properties of Metallic Liquids: Fundamentals (volume 1) and Predictive Models (volume 2)

By T Iida and R I L Guthrie

Oxford University Press



Authored by two leading experts in the field, these books provide a complete review of the static and dynamic thermophysical properties of metallic liquids. Divided into two volumes, the first one (*Fundamentals*) is intended as an introductory text in which the basic topics are covered: the structure of metallic liquids, their thermodynamic properties, density, velocity of sound, surface tension, viscosity, diffusion, and electrical and thermal conductivities. Essential concepts about the methods used to measure these experimental data are also presented.

In the second volume (*Predictive Models*), the authors explain how to develop reliable models of liquid metals, starting from the essential conditions for a model to be truly predictive. They use a statistical approach to rate the validity of different models. On the basis of this assessment, the authors have compiled tables of predicted values for the thermophysical properties of metallic liquids, which are included in the book. A large amount of experimental data are also given.

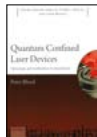
The two books are particularly oriented to students of materials science and engineering, but also to research scientists and engineers engaged in liquid metallic processing. They collect a large amount of information and are written in a clear and readable way, therefore they are bound to become an essential reference for students

and researchers involved in the field.

Quantum Confined Laser Devices: Optical Gain and Recombination in Semiconductors

By P Blood

Oxford University Press



This book provides a comprehensive discussion of quantum confined semiconductor lasers, based on the author's long and extensive experience in the field. In a pedagogical fashion, it takes the reader from the physics principles and processes exploited by lasers (giving a consistent treatment of both quantum-dot and quantum-well structures) to operation of the most advanced devices.

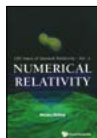
The text begins with a short historical account of the birth and development of lasers in general (called "maser" at the very beginning because restricted to microwaves), and the diode laser in particular. Thereafter, the book is organised into five sections. The first, dedicated to the diode laser, provides the framework for the whole volume. The second section describes the fundamental processes involved in the physics of lasers, a subject that is then treated in depth in the third part. The fourth section discusses the operation of laser devices and their characteristics (light-current curves, threshold current, efficiency, etc). Finally, the author tackles the important topics of recombination and optical gain, describing ways in which they can be measured on device structures and compared with theoretical predictions.

Full of detailed explanations, illustrations from model calculations and experimental observations, as well as a comprehensive set of exercises, the book is recommended to final-year undergraduate and PhD students, as well as researchers who are new to the field and need a complete overview of the subject.

Numerical Relativity: 100 Years of General Relativity – Vol. 1

By M Shibata

World Scientific



Numerical relativity is a field of theoretical physics in which Einstein's equation and associated matter field equations are solved using computer calculations, because they are nonlinear partial-differential equations and therefore they cannot be solved analytically for general problems.

The purpose of this volume is to describe

the techniques of numerical relativity and to report the knowledge obtained from the numerical simulations performed so far. The first chapter offers an overview of the basics of general relativity, gravitational waves and relativistic astrophysics, which are the background of numerical relativity. Then, in the first part of the book (chapters 2 to 7), the author discusses the most used formulations and numerical methods, while in the second part (chapters 8 to 11), he reports on representative numerical-relativity simulations and the knowledge derived from them.

Particular importance is given to the results obtained by applying these simulation techniques to the study of black-hole formation, binary compact objects, and the merger of binary neutron stars and black holes. New frontiers in numerical relativity are also touched on in the last two chapters.

Combinatorial Identities for Stirling Numbers: The Unpublished Notes of H W Gould

By J Quaintance and H W Gould

World Scientific



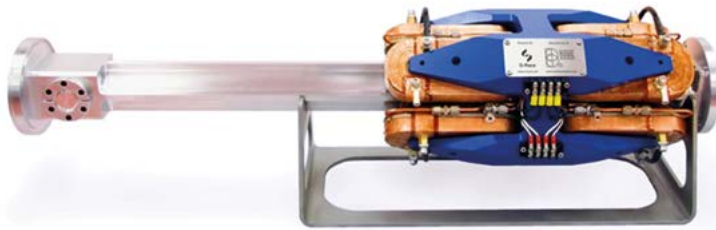
Written by Henry Gould's assistant Jocelyn Quaintance, this book is the result of the deep work and personal relationship between the great mathematician and the author.

They met when Quaintance had recently graduated with a PhD, and was looking for a career in research and an advisor who could guide him. He had the luck to collaborate with Gould, who showed him his manuscripts: several handwritten volumes on combinatorial identities. Quaintance offered to edit a text collecting together all of that material, which led to the publication of this book.

The first eight chapters introduce readers to the special techniques that Gould used in proving his binomial identities. This first part is easily accessible to people who have taken basic courses in calculus and discrete mathematics. The second half of the book applies the techniques from the first part, and is particularly relevant for mathematics researchers. It focuses on the connection between various classes of Stirling numbers, and between them and Bernoulli numbers.

Some of the demonstrations presented in the volume represent the only systematic record of Gould's results. As such, this book is a unique work that could appeal to a wide audience: from graduate students to specialists in enumerative combinatorics, to enthusiasts of Gould's work.

PET project takes flight



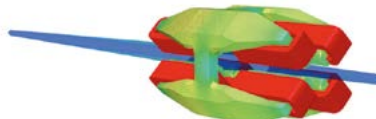
Mini-PET beamline assembled on its vacuum tube (stand for display purposes only)

Mini-PET is a compact beamline for positron emission tomography (PET) radioisotope production collaboratively designed and built by Buckley Systems and Dehnel Particle Accelerator Components and Engineering (D-Pace). The Mini-PET system allows the radioisotope target to be moved away from the proton cyclotron, facilitating the use of local shielding to reduce prompt gammas and neutrons. More importantly this attenuates residual target radiation, minimising ionizing radiation exposure to research and maintenance staff. In addition, dynamic focusing and steering provide increased control of the proton beam, greatly improving radioisotope production rates. A brief description of the Mini-PET design and manufacture process is presented in this article.

Over 30 years Buckley Systems has garnered a wealth of experience crafting particle accelerator systems to the highest standards for the semi conductor, medical and research sectors. D-Pace specialises in beamline design, ion sources and beam diagnostic systems for the medical cyclotron, ion implantation and linear accelerator industries. The two companies have a long and successful history of working together to provide innovative, effective solutions so when D-Pace started the design process for a highly integrated, light weight, high acceptance, low-activation beamline for PET cyclotrons they again teamed up with Buckley Systems.

The short, one meter long Mini-PET beamline consists of an electromagnetic quadrupole doublet with integrated horizontal and vertical steering, mounted on a rigid aluminium vacuum tube that both fully supports and aligns the magnetic elements.

Initial design of the beam optics was carried out by D-Pace using Beamline Simulator and input parameters from both PMB-Alcen ISOTRACE™ and IBA Cyclone 18 cyclotrons. The mechanical design and magnetic optimization of the quadrupole doublet were performed in an iterative fashion. Design changes made at D-Pace could be quickly assessed magnetically and ion-optically by Buckley Systems using OPERA 3D. In this way the mass of the beamline was minimized while avoiding magnetic saturation. Weighing in at just 54kg, the assembly can simply be mounted to upstream and downstream flange elements with no need for extra supports or stands.



Magnetostatic and charged particle beam analysis of the Mini-PET system

Once engineering drawings were finalised Buckley Systems set to work on the manufacture of the beamline. With over 300 staff, quality materials and fully equipped machine, coil and integration shops, manufacturing particle accelerator systems is where Buckley Systems excels.

Magnet yoke halves and poles were individually machined from solid 1006 low carbon steel to tolerances as low as 30µm using one of thirty CNC machines at the machine shop's disposal. Where tighter tolerances are required the entire assembly is EDM wire cut. This effectively keeps parts tolerance stacking to an absolute minimum.

The coil assembly consists of a water cooled aluminium plate sandwiched between the quadrupole and steering coils. Quadrupole coils were of the copper strip/ mylar insulated variety for high current densities while the low power steering coils were wound from enamelled solid wire. All coil components including electrical links, terminals and thermal sensor mounts were epoxy vacuum impregnated in a full mould. The result; a compact, robust, well cooled, integrated coil.

Using 6061 aluminium alloy for its low residual radioactivity, low gas permeability, low magnetic susceptibility and easy machining properties, Buckley Systems shaped the individual vacuum tube components and seamlessly fused them together. The end product was a high acceptance cross shaped vacuum tube that served not only to hold high vacuum but also to align all eight poles, support the system via its flange ends and to facilitate longitudinal movement of the magnetic elements relative to the target for tuning purposes.

All parts were thoroughly dimensionally checked using co-ordinate measuring machines before plating the pole surfaces with a durable layer of nickel for corrosion protection and painting the yoke. Once in

the Integration and Test area the coils, poles and yokes were assembled and aligned before making power, coolant and sensor connections. The electromagnet was then electrically, magnetically and mechanically tested in Buckley Systems' calibrated, temperature controlled test laboratory. Magnetic 3D hall probe scans and rotating coil results were cross referenced with FEA models to ensure that the system met specification.

The finished electromagnet was then coupled to its cleaned and sealed vacuum chamber before being carefully packed to ensure the system was delivered in perfect condition. A document package which draws together travellers, check sheets, test data and instruction manuals accompanies every shipment.

Another plus is that due to the light weight of the packaged system the Mini-PET beamline can be air freighted anywhere in the world within a week, ensuring the system is up and running in the shortest possible time.

Buckley Systems and D-Pace stand by their products and are happy to help with the commissioning process as well as guaranteeing the quality of workmanship and materials that go into each and every system.

Further information on the Mini-PET beamline can be found at http://www.d-pace.com/products_MiniPet.html

Buckley Systems

6 Bowden Rd, Mt Wellington, Auckland 1060, New Zealand
Ph: +64 9 573 2200
Email: info@buckleysystems.com
Web: www.buckleysystems.com

D-Pace

Suite 305, 625 Front Street, Nelson, British Columbia, Canada V1L4B6
Ph: 1 250 352 5162
Email: info@d-pace.com, Web: www.d-pace.com

