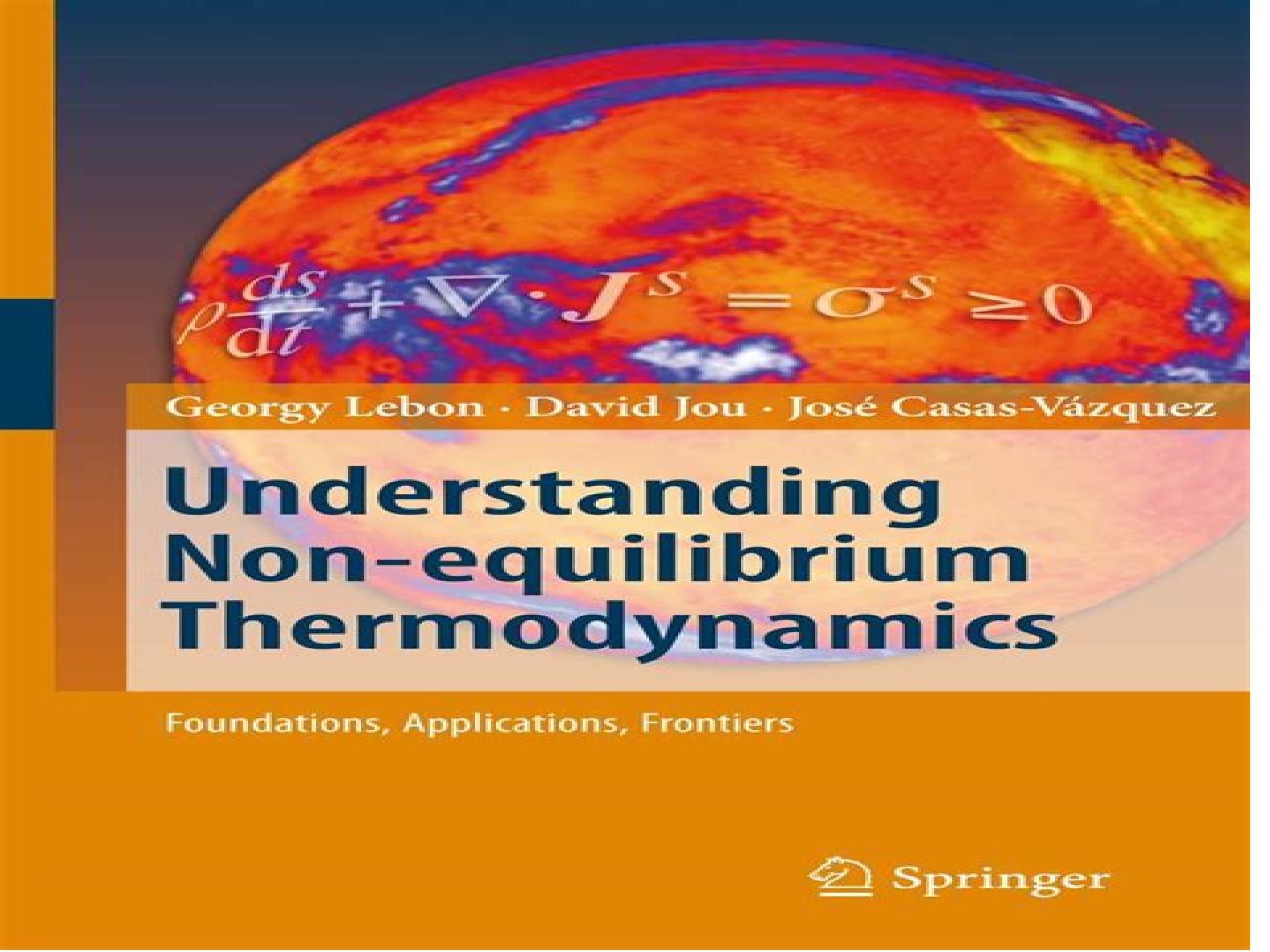


A Cosmic Microwave Background (CMB) radiation map showing temperature fluctuations across the sky. The map is a circular disk with a color scale from blue (cooler) to red and yellow (warmer). The fluctuations are most prominent along the edges and in the center.
$$\rho \frac{ds}{dt} + \nabla \cdot \mathbf{J}^s = \sigma^s \geq 0$$

Georgy Lebon · David Jou · José Casas-Vázquez

Understanding Non-equilibrium Thermodynamics

Foundations, Applications, Frontiers

 Springer

Understanding Non Equilibrium Thermodynamics

Foundations Applications Frontiers

Vladimir V. Uchaikin



Understanding Non Equilibrium Thermodynamics Foundations Applications Frontiers:

Understanding Non-equilibrium Thermodynamics Georgy Lebon, David Jou, 2008-01-12 Our time is characterized by an explosion of information and by an acceleration of knowledge. A book cannot compete with the huge amount of data available on the Web. However, to assimilate all this information, it is necessary to structure our knowledge in a useful conceptual framework. The purpose of the present work is to provide such a structure for students and researchers interested by the current state of the art of non equilibrium thermodynamics. The main features of the book are a concise and critical presentation of the basic ideas illustrated by a series of examples selected not only for their pedagogical value but also for the perspectives offered by recent technological advances. This book is aimed at students and researchers in physics, chemistry, engineering, material sciences and biology. We have been guided by two apparently antagonistic objectives: generality and simplicity. To make the book accessible to a large audience of non specialists, we have decided about a simplified but rigorous presentation. Emphasis is put on the underlying physical background without sacrificing mathematical rigour, the several formalisms being illustrated by a list of examples and problems. Altogether, this work, we have been guided by the formula: Get the more from the less, with the purpose to make a maximum of people aware of a maximum of knowledge from a minimum of basic tools. Besides being an introductory text, our objective is to present an overview as general as possible of the more recent developments in non equilibrium thermodynamics, especially beyond the local equilibrium description.

Introduction to Modern Biophysics Mohammad Ashrafuzzaman, 2023-12-15 This textbook provides an introduction to the fundamental and applied aspects of biophysics for advanced undergraduate and graduate students of physics, chemistry and biology. The application of physics principles and techniques in exploring biological systems has long been a tradition in scientific research. Biological systems hold naturally inbuilt physical principles and processes which are popularly explored. Systematic discoveries help us understand the structures and functions of individual biomolecules, biomolecular systems, cells, organelles, tissues and even the physiological systems of animals and plants. Utilizing a physics based scientific understanding of biological systems to explore disease is at the forefront of applied scientific research. This textbook covers key breakthroughs in biophysics whilst looking ahead to future horizons and directions of research. It contains models based on both classical and quantum mechanical treatments of biological systems. It explores diseases related to physical alterations in biomolecular structures and organizations alongside drug discovery strategies. It also discusses the cutting edge applications of nanotechnologies in manipulating nanoprocesses in biological systems.

Key Features: Presents an accessible introduction to how physics principles and techniques can be used to understand biological and biochemical systems. Addresses natural processes, mutations and their purposeful manipulation. Lays the groundwork for vitally important natural scientific, technological and medical advances.

Thermodynamics of Fluids Under Flow David Jou, José Casas-Vázquez, Manuel Criado-Sancho, 2010-12-02 This is the second edition of the book *Thermodynamics of Fluids under Flow* which was published

in 2000 and has now been corrected expanded and updated This is a companion book to our other title *Extended irreversible thermodynamics* D Jou J Casas Vázquez and G Lebon Springer 4th edition 2010 and of the textbook *Understanding non equilibrium thermodynamics* G Lebon D Jou and J Casas Vázquez Springer 2008 The present book is more specialized than its counterpart as it focuses its attention on the non equilibrium thermodynamics of flowing fluids incorporating non trivial thermodynamic contributions of the flow going beyond local equilibrium theories i e including the effects of internal variables and of external forcing due to the flow Whereas the book's first edition was much more focused on polymer solutions with brief glimpses into ideal and real gases the present edition covers a much wider variety of systems such as diluted and concentrated polymer solutions polymer blends laminar and turbulent superfluids phonon hydrodynamics and heat transport in nanosystems nuclear collisions far from equilibrium ideal gases and molecular solutions It also deals with a variety of situations emphasizing the non equilibrium flow contribution temperature and entropy in flowing ideal gases shear induced effects on phase transitions in real gases and on polymer solutions stress induced migration and its application to flow chromatography Taylor dispersion anomalous diffusion in flowing systems the influence of the flow on chemical reactions and polymer degradation The new edition is not only broader in scope but more educational in character and with more emphasis on applications in keeping with our times It provides many examples of how a deeper theoretical understanding may bring new and more efficient applications forging links between theoretical progress and practical aims This updated version expands on the trusted content of its predecessor making it more interesting and useful for a larger audience

Mystery Of Time, The: Asymmetry Of Time And Irreversibility In The Natural Processes Alexander Leonidovich Kuzemsky, 2022-10-14 The book focuses on the study of the temporal behavior of complex many particle systems The phenomenon of time and its role in the temporal evolution of complex systems is a remaining mystery The book presents the necessity of the interdisciplinary point of view regarding on the phenomenon of time The aim of the present study is to summarize and formulate in a concise but clear form the trends and approaches to the concept of time from a broad interdisciplinary perspective exposing tersely the complementary approaches and theories of time in the context of thermodynamics statistical physics cosmology theory of information biology and biophysics including the problem of time and aging Various approaches to the problem show that time is an extraordinarily interdisciplinary and multifaceted underlying notion which plays an extremely important role in various natural complex processes

Extended Irreversible Thermodynamics David Jou, Georgy Lebon, José Casas-Vázquez, 2010-09-16 The fast progress in many areas of research related to non equilibrium thermodynamics has prompted us to write a fourth edition of this book Like in the previous editions our main concern is to open the subject to the widest audience including students teachers and researchers in physics chemistry engineering biology and materials sciences Our objective is to present a general view on several open problems arising in non equilibrium situations and to afford a wide perspective of applications illustrating their practical outcomes and consequences A better

comprehension of the foundations is generally correlated to an increase of the range of applications implying mutual feedback and cross fertilization Truly thermodynamic methods are widely used in many areas of science but surprisingly the active dynamism of thermodynamics as a field on its own is not sufficiently perceived outside a relatively reduced number of specialized researchers Extended irreversible thermodynamics EIT goes beyond the classical formalisms based on the local equilibrium hypothesis it was also referred to in an earlier publication by the authors Lebon et al 1992 as a thermodynamics of the third type as it provides a bridge between classical irreversible thermodynamics and rational thermodynamics enlarging at the same time their respective range of application The salient feature of the theory is that the fluxes are incorporated into the set of basic variables

Industrial Chemical Separation Timothy C. Frank, Bruce S. Holden, 2023-08-07

A fresh new treatment written by industry insiders this work gives readers a remarkably clear view into the world of chemical separation The authors review distillation extraction adsorption crystallization and the use of membranes providing historical perspective explaining key features and offering insights from personal experience The book is for engineers and chemists with current or future responsibility for chemical separation on a commercial scale in its design operation or improvement or for anyone wanting to learn more about chemical separation from an industrial point of view The result is a compelling survey of popular technologies and the profession one that brings the art and craft of chemical separation to life Ever wonder how popular separation technologies came about how a particular process functions or how mass transfer units differ from theoretical stages Or perhaps you want some pointers on how to begin solving a separation problem You will find clear explanations and valuable insights into these and other aspects of industrial practice in this refreshing new survey

Computational Methods for Complex Liquid-Fluid Interfaces Mohammad Taeibi Rahni, Mohsen Karbaschi, Reinhard Miller, 2015-11-11

Computational Methods for Complex Liquid Fluid Interfaces highlights key computational challenges involved in the two way coupling of complex liquid fluid interfaces The book covers a variety of cutting edge experimental and computational techniques ranging from macro to meso and microscale approaches including pivotal applications As example

Advances in Thermoelectricity: Foundational Issues, Materials and Nanotechnology Dario Narducci, G. Jeffrey Snyder, Carlo Fanciulli, 2021-06-15

The field of thermoelectricity has continued to develop rapidly in recent years and remains one of the most exciting areas of research for a materials physicist The need for sustainable energy has added a technological momentum to the challenge of devising materials with exceptional properties such as low thermal conductivity high electrical conductivity and a large Seebeck coefficient and has triggered a global interdisciplinary effort More recently research on thermoelectric materials has promoted and motivated a major research endeavor to clarify the factors affecting thermal conductivity in nanostructures as part of a more general effort to apply nanotechnology to enhance the performance of thermoelectric materials for use in thermoelectric generators and coolers This book contains the lectures presented as Course 207 of the International School of Physics Enrico Fermi Advances in Thermoelectricity Foundational Issues Materials

and Nanotechnology held in Varenna Italy from 15-20 July 2019. This comprehensive course aimed to provide students with a modern vision of the physics of thermoelectric phenomena starting from the thermodynamics of thermoelectricity and from the physics of transport processes and demonstrating how material structure and nanostructure together with defects have been used to tailor the physical properties of advanced thermoelectrics. Special attention was also given to areas of current research from spin caloritronics to charge transport in polymers and to a selected number of applications for heat recovery. Encompassing the full complexity of modern thermoelectricity and covering the most cogent themes relevant to current research, the book will be of interest to all those working in the field.

Fractional Derivatives for Physicists and Engineers
Vladimir V. Uchaikin, 2013-07-09. The first derivative of a particle coordinate means its velocity, the second means its acceleration, but what does a fractional order derivative mean? Where does it come from, how does it work, where does it lead to? The two-volume book, written on a high didactic level, answers these questions. *Fractional Derivatives for Physicists and Engineers*. The first volume contains a clear introduction into such a modern branch of analysis as the fractional calculus. The second develops a wide panorama of applications of the fractional calculus to various physical problems. This book recovers new perspectives in front of the reader dealing with turbulence and semiconductors, plasma and thermodynamics, mechanics and quantum optics, nanophysics and astrophysics. The book is addressed to students, engineers and physicists, specialists in theory of probability and statistics, in mathematical modeling and numerical simulations, to everybody who doesn't wish to stay apart from the new mathematical methods becoming more and more popular. Prof. Vladimir V. UCHAIKIN is a known Russian scientist and pedagogue, a Honored Worker of Russian High School, a member of the Russian Academy of Natural Sciences. He is the author of about three hundred articles and more than a dozen books, mostly in Russian, in Cosmic ray physics, Mathematical physics, Levy stable statistics, Monte Carlo methods with applications to anomalous processes in complex systems of various levels, from quantum dots to the Milky Way galaxy.

Membrane Characterization José Ignacio Calvo Díez, Antonio Hernández Giménez, 2024-10-21. Membrane technology has become an essential tool in many industrial processes in which the separation or fractionation of various species is necessary to obtain or recover high value added products. In these processes, the synthetic membranes usually play a filter role, being characterized by the size of the pores present in it, which delimit the size of the molecules to be separated. It is therefore necessary to have a precise knowledge of the characteristic size of said pores. In this book, the main techniques that can be used to determine the mean pore size and the pore size distribution of a synthetic membrane are analyzed and discussed from the point of view of their theoretical basis, with special attention to equipment that should be used for each technique, as well as reviewing their advantages and disadvantages. Through this text, the researcher or responsible of the quality control at membrane manufacturing companies will be able to know, decide properly which of the porosimetric techniques is more adequate for the knowledge that needs to be obtained from their filters.

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