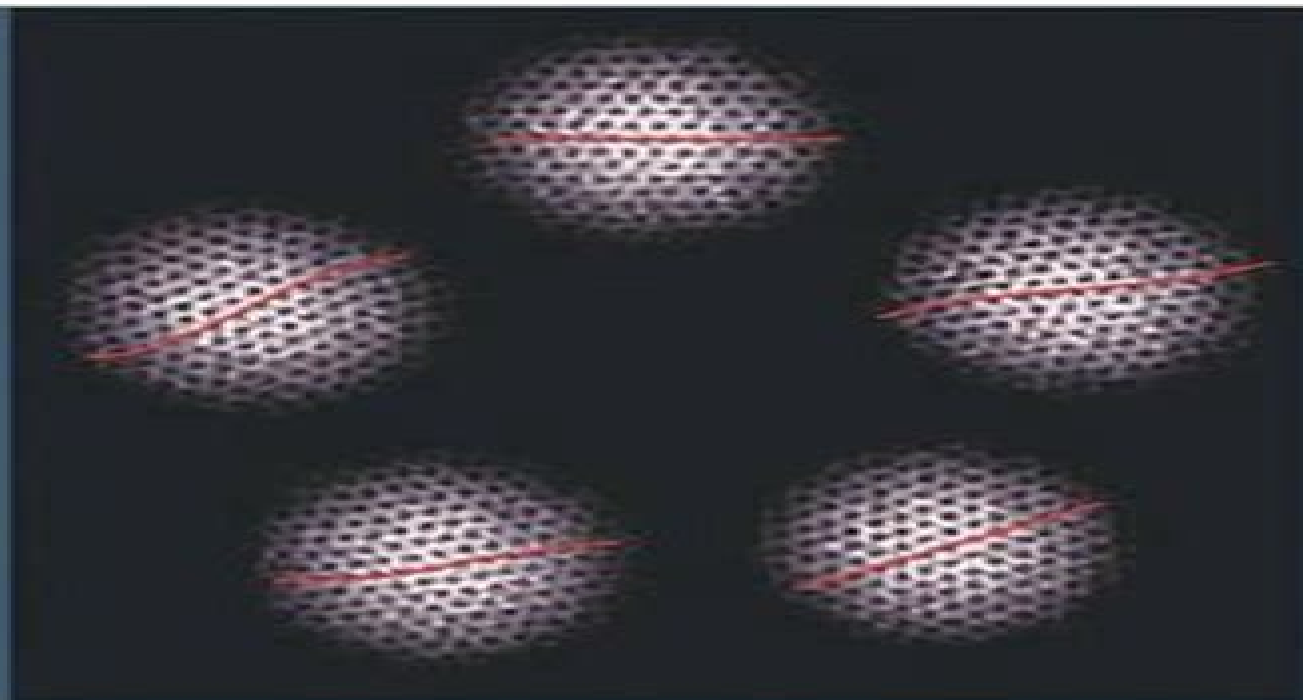


Dynamics of Quantised Vortices in Superfluids

Edouard B. Sonin



Dynamics Of Quantised Vortices In Superfluids

Silvia Zane, Roberto Turolla, Dany Page



Dynamics Of Quantised Vortices In Superfluids:

Dynamics of Quantised Vortices in Superfluids Edouard B. Sonin, 1922 A comprehensive overview of the basic principles of vortex dynamics in superfluids this book addresses the problems of vortex dynamics in all three superfluids available in laboratories ^4He ^3He and BEC of cold atoms alongside discussions of the elasticity of vortices forces on vortices and vortex mass Beginning with a summary of classical hydrodynamics the book guides the reader through examinations of vortex dynamics from large scales to the microscopic scale Topics such as vortex arrays in rotating superfluids bound states in vortex cores and interaction of vortices with quasiparticles are discussed The final chapter of the book considers implications of vortex dynamics to superfluid turbulence using simple scaling and symmetry arguments Written from a unified point of view that avoids complicated mathematical approaches this text is ideal for students and researchers working with vortex dynamics in superfluids superconductors magnetically ordered materials neutron stars and cosmological models

Dynamics of Quantised Vortices in Superfluids Edouard B. Sonin, 2016-02-04 This book draws together all the basic principles of vortex dynamics in neutral superfluids in one comprehensive volume **Quantized Vortices in Helium II** Russell J. Donnelly, 1991-03-07 This book discusses the properties of quantized vortex lines in superfluid helium 4 in the light of research on vortices in modern fluid mechanics and gives the first comprehensive treatment of the problem The author's comprehensive approach will make this book invaluable for students taking advanced undergraduate or graduate courses and for all those involved in research on classical and quantum vortices **Non-equilibrium Thermodynamics of Superfluid Helium and Quantum Turbulence** Maria Stella Mongiovì, David Jou, Michele Sciacca, 2025-07-23 This book puts together non equilibrium thermodynamics heat transport properties of superfluid He II and thermodynamic and dynamic aspects of quantum turbulence A one fluid extended model of superfluid helium with heat flux as an additional independent variable is presented and compared with the two fluid model to explore how both models complement each other Important features arise in rotating situations and in superfluid turbulence characterized by quantized vortices leading to strong nonlinearities between heat flux and temperature gradient The dynamics of vortex lines and their interaction with heat dynamics a central topic in superfluid turbulence is dealt with by introducing the vortex line density as an independent variable and writing its dynamical equations considering the transitions from laminar to turbulent flows and from diffusive to ballistic regimes Classical and quantum turbulence are compared from a mesoscopic view and from their energy spectra The work also explores some parallelisms of quantum vortex thermodynamics with cosmic string thermodynamics and black hole thermodynamics exhibiting duality connections amongst them It emphasizes didactical views over specialistic details and may be used as an introduction to nonequilibrium thermodynamics of superfluid helium and its heat transport properties second sound nonlocal transport nonlinear connections with quantum turbulence The book is useful to researchers in superfluid helium in heat transport and in thermodynamics of cosmic strings and black holes The diversity and complexity of

its several physical equations will be inspiring for researchers in mathematical physics

Quantized Vortex Dynamics and Superfluid Turbulence C.F. Barenghi, R.J. Donnelly, W.F. Vinen, 2001-08-28 This book springs from the programme Quantized Vortex Dynamics and Superfluid Turbulence held at the Isaac Newton Institute for Mathematical Sciences University of Cambridge in August 2000 What motivated the programme was the recognition that two recent developments have moved the study of quantized vorticity traditionally carried out within the low temperature physics and condensed matter physics communities into a new era The first development is the increasing contact with classical fluid dynamics and its ideas and methods For example some current experiments with Helium II now deal with very classical issues such as the measurement of velocity spectra and turbulence decay rates The evidence from these experiments and many others is that superfluid turbulence and classical turbulence share many features The challenge is now to explain these similarities and explore the time scales and length scales over which they hold true The observed classical aspects have also attracted attention to the role played by the flow of the normal fluid which was somewhat neglected in the past because of the lack of direct flow visualization Increased computing power is also making it possible to study the coupled motion of superfluid vortices and normal fluids Another contact with classical physics arises through the interest in the study of superfluid vortex connections Reconnections have been studied for some time in the contexts of classical fluid dynamics and magneto hydrodynamics MHD and it is useful to learn from the experience acquired in other fields

International Journal of Neutrosophic Science (IJNS) Volume 7, 2020 Broumi Said, Florentin Smarandache, International Journal of Neutrosophic Science IJNS is a peer review journal publishing high quality experimental and theoretical research in all areas of Neutrosophic and its Applications IJNS is published quarterly IJNS is devoted to the publication of peer reviewed original research papers lying in the domain of neutrosophic sets and systems Papers submitted for possible publication may concern with foundations neutrosophic logic and mathematical structures in the neutrosophic setting Besides providing emphasis on topics like artificial intelligence pattern recognition image processing robotics decision making data analysis data mining applications of neutrosophic mathematical theories contributing to economics finance management industries electronics and communications are promoted

Collected Papers. Volume XI Florentin Smarandache, 2022-08-01 This eleventh volume of Collected Papers includes 90 papers comprising 988 pages on Physics Artificial Intelligence Health Issues Decision Making Economics Statistics written between 2001-2022 by the author alone or in collaboration with the following 84 co authors alphabetically ordered from 19 countries Abhijit Saha Abu Su'aban Jack Allen Shahbaz Ali Ali Safaa Sadiq Aliya Fahmi Atiqa Fakhar Atiqa Firdous Sukanto Bhattacharya Robert N Boyd Victor Chang Victor Christianto V Christy Dao The Son Debjit Dutta Azeddine Elhassouny Fazal Ghani Fazli Amin Anirudha Ghosha Nasruddin Hassan Hoang Viet Long Jhulaneswar Baidya Jin Kim Jun Ye Darjan Karabac Vasilios N Katsikis Ieva Meidute Kavaliauskienė F Kaymarm Nour Eldeen M Khalifa Madad Khan Qaisar Khan M Khoshnevisan Kifayat Ullah Volodymyr Krasnoholovets Mukesh Kumar Le Hoang Son Luong Thi Hong Lan Tahir

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From Logic to Realism to Brighter Future for Humanity Victor Christianto, Florentin Smarandache, 2022-07-01 This collection of articles explores a wide range of subject from Godel's incompleteness theorem to possible technocalypse and neutrofuturology Articles on historical debates on irrational number to electroculture on vortex particle or on different Neutrosophic applications are included

Progress in Low Temperature Physics, 2008-11-05 Progress in Low Temperature Physics Quantum Turbulence presents seven review articles on the recent developments on quantum turbulence Turbulence has been a great mystery in natural science and technology for more than 500 years since the time of Leonardo da Vinci Recently turbulence in quantum systems at low temperatures has developed into a new research field Quantum turbulence is comprised of quantized vortices realized in superfluid helium and quantum gases of cold atoms Some of the important topics include energy spectra vibrating structures and visualization techniques The understanding of these remarkable systems can have an impact on the general field of turbulence and will be of broad interest to scientists and students in low temperature physics hydrodynamics and engineering Key subjects covered Energy spectra in quantum turbulence Turbulent dynamics in rotating helium superfluids a comparison of ^3He B and ^4He II Quantum turbulence in superfluid ^3He at very low temperatures The use of vibrating structures in the study of quantum turbulence Visualization of quantum turbulence Capillary turbulence on the surface of quantum fluids Quantized vortices in atomic Bose Einstein condensates Crucial information for all experimenters in low temperature physics

Lost and Found in Mathematics. Dissident cosmologists's guide to the Universe Victor Christianto, Florentin Smarandache, 2022-09-01 This book is inspired by a German theoretical physicist Sabine Hossenfelder's publication Lost in Mathematics Her book seems to question highly mathematical and a lot of abstraction in the development of physics and cosmology studies nowadays There is clear tendency that in recent decades the physics science has been predominated by such an advanced mathematics which at times sounding more like acrobatics approach to a reality Through books by senior mathematical physicists like Unzicker and Peter Woit we know that the answer of TOE is not in superstring theories or other variations of such 26 dimensional bosonic string theory of which none of those theories survived experimental test but perhaps in low dimensional physics As Alexander Unzicker suggests perhaps it is more advisable to consider rotation in 3D space known as $\text{SO}(3)$ or a kind of superfluid vortices version of gravitation theory We can also

reconsider proposition by the late Prof F Winterberg formerly professor at Univ Nevada Reno that it is most likely that superfluid phonon roton theory in 3D can replace the entire superstring theories While we don t explore yet implications of his model to particle physics we discuss here some published papers at several journals in the past few years

Astrophysics In The Xxi Century With Compact Stars Cesar Augusto Zen Vasconcellos,Fridolin Weber,2022-10-25

There are reasons to believe the 21st century will be the best ever for astrophysics the James Webb Space Telescope will extend nearly twenty times the present observational limit of visible light neutrino massiveness opens a new window for exploration on dark energy and dark matter physics and is expected to provide insights into the fate of the Universe the Higgs boson may allow for an understanding of the weakness of gravity gravitational waves produced at the birth of the Universe and by compact stellar objects supermassive black holes black hole neutron star mergers gamma ray bursts white dwarf inspirals have unveiled a new area of astronomy Against this background compact stars the theme of this volume present unique astrophysical laboratories for probing the fabric of space time and the building blocks of matter and their interactions at physical regimes not attainable in terrestrial laboratories **Frank Wilczek: 50 Years Of Theoretical**

Physics Antti Niemi,Alfred Shapere,Kok Khoo Phua,2022-03-18 Frank Wilczek is one of the foremost theoretical physicists of the past half century He has made several fundamental contributions that shape our understanding of high energy physics cosmology condensed matter physics and statistical physics In all these fields his many discoveries continue to play a key role in shaping the direction of modern theoretical physics Among Wilczek s major achievements is the discovery of asymptotic freedom which predicts and explains the ultraviolet behavior of non abelian gauge theories The axion which he co discovered and named has emerged as the prevalent candidate for explaining the origin of dark matter in the Universe His invention of color flavor locking explains chiral symmetry breaking in high density quantum chromodynamics His introduction of fractional statistics and anyons are pivotal to our understanding of the fractional quantum Hall effect and form the building blocks of topological quantum computing His invention of the time crystal concept has catalyzed extensive investigations of dynamical phases of physical systems Frank Wilczek received the 2004 Nobel Prize in Physics for the discovery of asymptotic freedom He is also the recipient of several Prizes and honorary awards including the MacArthur Fellowship the Lorentz Medal of the Royal Netherlands Academy of Arts and Sciences the Lilienfeld Prize of the American Physical Society the High Energy and Particle Physics Prize of the European Physical Society and the King Faisal International Prize for Science of the King Faisal Foundation He is a member of the National Academy of Sciences American Academy of Arts and Sciences and the American Philosophical Society He is also a foreign member of the Royal Netherlands Academy of Arts and Sciences and of the Royal Academy of Sciences in Sweden He is currently the Herman Feshbach Professor of Physics at MIT Center for Theoretical Physics He also holds a professorship at Stockholm University is a Distinguished Professor at Arizona State University and is the founding director of the Tsung Dao Lee Institute and Chief Scientist of the Wilczek Quantum Center at

Shanghai Jiao Tong University This volume serves as a tribute to Frank Wilczek's legendary scientific contributions commemorating his 70th birthday and the first 50 years of his career as a theoretical physicist The contributors include several of his PhD students close collaborators and both past and present colleagues

Quantized Vortex Dynamics and Superfluid Turbulence C.F. Barenghi, R.J. Donnelly, W.F. Vinen, 2014-03-12 This book springs from the programme Quantized Vortex Dynamics and Superfluid Turbulence held at the Isaac Newton Institute for Mathematical Sciences University of Cambridge in August 2000 What motivated the programme was the recognition that two recent developments have moved the study of quantized vorticity traditionally carried out within the low temperature physics and condensed matter physics communities into a new era The first development is the increasing contact with classical fluid dynamics and its ideas and methods For example some current experiments with Helium II now deal with very classical issues such as the measurement of velocity spectra and turbulence decay rates The evidence from these experiments and many others is that superfluid turbulence and classical turbulence share many features The challenge is now to explain these similarities and explore the time scales and length scales over which they hold true The observed classical aspects have also attracted attention to the role played by the flow of the normal fluid which was somewhat neglected in the past because of the lack of direct flow visualization Increased computing power is also making it possible to study the coupled motion of superfluid vortices and normal fluids Another contact with classical physics arises through the interest in the study of superfluid vortex connections Reconnections have been studied for some time in the contexts of classical fluid dynamics and magneto hydrodynamics MHD and it is useful to learn from the experience acquired in other fields

Gribov-80 Memorial Volume: Quantum Chromodynamics And Beyond - Proceedings Of The Memorial Workshop Devoted To The 80th Birthday Of V N Gribov Yuri L Dokshitzer, Peter Levai, Julia Nyiri, 2011-04-26 Vladimir Naumovich Gribov was one of the most outstanding theoretical physicists a key figure in the development of modern elementary particle physics His insights into the physics of quantum anomalies and the origin of classical solutions instantons the notion of parton systems and their evolution in soft and hard hadron interactions the first theory of neutrino oscillations and conceptual problems of quantization of non Abelian fields uncovered by him have left a lasting impact on the theoretical physics of the 21st century Gribov 80 the fourth in a series of memorial workshops for V N Gribov was organized on the occasion of his 80th birthday in May 2010 at the Abdus Salam International Centre for Theoretical Physics The workshop paid tribute to Gribov's great achievements and brought close colleagues younger researchers and leading experts together to display the new angles of the Gribov heritage at the new energy frontier opened up by the Large Hadron Collider The book is a collection of the presentations made at the workshop

The Physics and Astrophysics of Neutron Stars Luciano Rezzolla, Pierre Pizzochero, David Ian Jones, Nanda Rea, Isaac Vidaña, 2019-01-09 This book summarizes the recent progress in the physics and astrophysics of neutron stars and most importantly it identifies and develops effective strategies to explore both theoretically and observationally the many

remaining open questions in the field Because of its significance in the solution of many fundamental questions in nuclear physics astrophysics and gravitational physics the study of neutron stars has seen enormous progress over the last years and has been very successful in improving our understanding in these fascinating compact objects The book addresses a wide spectrum of readers from students to senior researchers Thirteen chapters written by internationally renowned experts offer a thorough overview of the various facets of this interdisciplinary science from neutron star formation in supernovae pulsars equations of state super dense matter gravitational wave emission to alternative theories of gravity The book was initiated by the European Cooperation in Science and Technology COST Action MP1304 Exploring fundamental physics with compact stars NewCompStar

Exciton Polaritons in Microcavities Daniele Sanvitto,Vladislav Timofeev,2012-05-01 In the past decade there has been a burst of new and fascinating physics associated to the unique properties of two dimensional exciton polaritons their recent demonstration of condensation under non equilibrium conditions and all the related quantum phenomena which have stimulated extensive research work This monograph summarizes the current state of the art of research on exciton polaritons in microcavities their interactions fast dynamics spin dependent phenomena temporal and spatial coherence condensation under non equilibrium conditions related collective quantum phenomena and most advanced applications The monograph is written by the most active authors who have strongly contributed to the advances in this area It is of great interests to both physicists approaching this subject for the first time as well as a wide audience of experts in other disciplines who want to be updated on this fast moving field

Turbulence Structure and Modulation Alfredo Soldati,Rosesella Monti,2014-05-04 Controlling turbulence is an important issue for a number of technological applications Several methods to modulate turbulence are currently being investigated All of them are based on the introduction of some sort of perturbation into the flow field which affect turbulence coherent structures responsible for turbulence transfer mechanisms The scope of the book is to describe several aspects of turbulence structure and modulation and to explain and discuss the most promising techniques in detail

Quantum Gases Nick Proukakis,2013 This volume provides a broad overview of the principal theoretical techniques applied to non equilibrium and finite temperature quantum gases Covering Bose Einstein condensates degenerate Fermi gases and the more recently realised exciton polariton condensates it fills a gap by linking between different methods with origins in condensed matter physics quantum field theory quantum optics atomic physics and statistical mechanics

Isolated Neutron Stars: From the Surface to the Interior Silvia Zane,Roberto Turolla,Dany Page,2007-05-22 This book is a collation of the contributions presented at a major conference on isolated neutron stars held in London in April 2006 Forty years after the discovery of radio pulsars it presents an up to date description of the new vision of isolated neutron stars that has emerged in recent years The great variety of isolated neutron stars from pulsars to magnetars is well covered by descriptions of recent observational results and presentations of the latest theoretical interpretation of these data

Microcavities Alexey V. Kavokin,Jeremy J. Baumberg,Guillaume

Malpuech, Fabrice P. Laussy, 2017-04-28 Microcavities are semiconductor metal or dielectric structures providing optical confinement in one two or three dimensions At the end of the 20th century microcavities have attracted attention due to the discovery of a strong exciton light coupling regime allowing for the formation of superposition light matter quasiparticles exciton polaritons In the following century several remarkable effects have been discovered in microcavities including the Bose Einstein condensation of exciton polaritons polariton lasing superfluidity optical spin Hall and spin Meissner effects amongst other discoveries Currently polariton devices exploiting the bosonic stimulation effects at room temperature are being developed by laboratories across the world This book addresses the physics of microcavities from classical to quantum optics from a Boltzmann gas to a superfluid It provides the theoretical background needed for understanding the complex phenomena in coupled light matter systems and it presents a broad overview of experimental progress in the physics of microcavities

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