

Gravity's Shadow

The Search for Gravitational Waves

Harry Collins

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Timothy Clifton



Gravity's Shadow The Search For Gravitational Waves:

Gravity's Shadow Harry Collins, 2004-09-04 According to the theory of relativity we are constantly bathed in gravitational radiation. When stars explode or collide a portion of their mass becomes energy that disturbs the very fabric of the space time continuum like ripples in a pond. But proving the existence of these waves has been difficult; the cosmic shudders are so weak that only the most sensitive instruments can be expected to observe them directly. Fifteen times during the last thirty years scientists have claimed to have detected gravitational waves but so far none of those claims have survived the scrutiny of the scientific community. *Gravity's Shadow* chronicles the forty year effort to detect gravitational waves while exploring the meaning of scientific knowledge and the nature of expertise. Gravitational wave detection involves recording the collisions, explosions and trembling of stars and black holes by evaluating the smallest changes ever measured. Because gravitational waves are so faint their detection will come not in an exuberant moment of discovery but through a chain of inference. For forty years scientists have debated whether there is anything to detect and whether it has yet been detected. Sociologist Harry Collins has been tracking the progress of this research since 1972, interviewing key scientists and delineating the social process of the science of gravitational waves. Engagingly written and authoritatively comprehensive *Gravity's Shadow* explores the people, institutions and government organizations involved in the detection of gravitational waves. This sociological history will prove essential not only to sociologists and historians of science but to scientists themselves.

Gravity's Kiss Harry Collins, 2018-03-02 A fascinating account written in real time of the unfolding of a scientific discovery: the first detection of gravitational waves. Scientists have been trying to confirm the existence of gravitational waves for fifty years. Then in September 2015 came a very interesting event as the cautious subject line in a physicist's email read that proved to be the first detection of gravitational waves. In *Gravity's Kiss* Harry Collins, who has been watching the science of gravitational wave detection for forty three of those fifty years and has written three previous books about it, offers a final fascinating account written in real time of the unfolding of one of the most remarkable scientific discoveries ever made. Predicted by Einstein in his theory of general relativity, gravitational waves carry energy from the collision or explosion of stars. Dying binary stars, for example, rotate faster and faster around each other until they merge, emitting a burst of gravitational waves. It is only with the development of extraordinarily sensitive, highly sophisticated detectors that physicists can now confirm Einstein's prediction. This is the story that Collins tells. Collins, a sociologist of science who has been embedded in the gravitational wave community since 1972, traces the detection, the analysis, the confirmation and the public presentation and the reception of the discovery from the first email to the final published paper and the response of professionals and the public. Collins shows that science today is collaborative, far flung with the physical location of the participants hardly mattering and sometimes secretive but still one of the few institutions that has integrity built into it.

Gravity's Ghost Harry Collins, 2010-12-15 A gripping look at gravitational wave research and what it says about scientific

discovery and the future of the scientific community This fine book pairs exploratory analysis with the pulse of a detective story Giving a portrait of the way a community chose to test itself on the threshold of new knowledge Collins offers the rich sociological insight that can only be won from uncommon experience from a long standing dialogue with the community he studies and from a moral engagement in the future of science Richard Staley author of Einstein's Generation The Origins of the Relativity Revolution In theory at least gravitational waves do exist We are constantly bathed in gravitational radiation which is generated when stars explode or collide and a portion of their mass becomes energy that ripples out like a disturbance on the surface of a serene pond But unfortunately no gravitational wave has ever been directly detected even though the search has lasted more than forty years As the leading chronicler of the search for gravitational waves Harry Collins has been right there with the scientists since the start The result of his unprecedented access to the front lines of physical science is Gravity's Ghost a thrilling chronicle of high stakes research and cutting edge discovery Here Collins reveals that scientific discovery and nondiscovery can turn on scientific traditions and rivalries that ideal statistical analysis rests on impossible procedures and unattainable knowledge and that fact in one place is baseless assumption in another He also argues that sciences like gravitational wave detection in exemplifying how the intractable is to be handled can offer scientific leadership a moral beacon for the twenty first century In the end Gravity's Ghost shows that discoveries are the denouements of dramatic scientific mysteries A sociologist embedded with full access in the LIGO Scientific Collaboration chronicles the search for gravitational waves Though physicists with very few exceptions are in no doubt that gravitational waves exist evidence for their passage through the new kilometer length interferometers would nevertheless represent the scientific event of the twenty first century Harry Collins has turned the initial joined search exploiting the LIGO and Virgo instruments into a detective novel that exquisitely describes the social processes associated with discovery and statistical analysis in a large collaborative effort Francis Halzen University of Wisconsin Madison and Director of Icecube Neutrino Detector Project *Fundamentals Of Interferometric Gravitational Wave Detectors (Second Edition)* Peter R

Saulson, 2017-02-16 The content of the Saulson's book remains valid and offers a versatile introduction to gravitational wave astronomy The book is appropriate for undergraduate students and can be read by graduate students and researchers who want to be involved in either the theoretical or the experimental traits of the study of gravitational waves Contemporary Physics LIGO's recent discovery of gravitational waves was headline news around the world Many people will want to understand more about what a gravitational wave is how LIGO works and how LIGO functions as a detector of gravitational waves This book aims to communicate the basic logic of interferometric gravitational wave detectors to students who are new to the field It assumes that the reader has a basic knowledge of physics but no special familiarity with gravitational waves with general relativity or with the special techniques of experimental physics All of the necessary ideas are developed in the book The first edition was published in 1994 Since the book is aimed at explaining the physical ideas behind the design

of LIGO it stands the test of time For the second edition an Epilogue has been added it brings the treatment of technical details up to date and provides references that would allow a student to become proficient with today s designs *The Formative Years of Relativity* Hanoch Gutfreund,Jürgen Renn,2017-09-08 First published in 1922 and based on lectures delivered in May 1921 Albert Einstein s *The Meaning of Relativity* offered an overview and explanation of the then new and controversial theory of relativity The work would go on to become a monumental classic printed in numerous editions and translations worldwide Now *The Formative Years of Relativity* introduces Einstein s masterpiece to new audiences This beautiful volume contains Einstein s insightful text accompanied by important historical materials and commentary looking at the origins and development of general relativity Hanoch Gutfreund and Jürgen Renn provide fresh original perspectives placing Einstein s achievements into a broader context for all readers In this book Gutfreund and Renn tell the rich story behind the early reception spread and consequences of Einstein s ideas during the formative years of general relativity in the late 1910s and 1920s They show that relativity s meaning changed radically throughout the nascent years of its development and they describe in detail the transformation of Einstein s work from the esoteric pursuit of one individual communicating with a handful of colleagues into the preoccupation of a growing community of physicists astronomers mathematicians and philosophers This handsome edition quotes extensively from Einstein s correspondence and reproduces historical documents such as newspaper articles and letters Inserts are featured in the main text giving concise explanations of basic concepts and short biographical notes and photographs of some of Einstein s contemporaries are included The first ever English translations of two of Einstein s popular Princeton lectures are featured at the book s end *Truth Machine* Michael Lynch,Simon A. Cole,Ruth McNally,Kathleen Jordan,2010-02-15 DNA profiling commonly known as DNA fingerprinting is often heralded as unassailable criminal evidence a veritable truth machine that can overturn convictions based on eyewitness testimony confessions and other forms of forensic evidence But DNA evidence is far from infallible *Truth Machine* traces the controversial history of DNA fingerprinting by looking at court cases in the United States and United Kingdom beginning in the mid 1980s when the practice was invented and continuing until the present Ultimately *Truth Machine* presents compelling evidence of the obstacles and opportunities at the intersection of science technology sociology and law **The Oxford Handbook of Expertise** Paul Ward,Jan Maarten Schraagen,Julie Gore,Emilie M. Roth,2020 *The Oxford Handbook of Expertise* provides a comprehensive picture of the field of Expertise Studies It offers both traditional and contemporary perspectives and importantly a multidiscipline multimethod view of the science and engineering research on expertise

Quantum Legacies David Kaiser,2022-06-16 Physicists have grappled with quantum theory for over a century They have learned to wring precise answers from the theory s governing equations and no experiment to date has found compelling evidence to contradict it Even so the conceptual apparatus remains stubbornly famously bizarre Physicists have tackled these conceptual uncertainties while navigating still larger ones the rise of fascism cataclysmic world wars and a new nuclear age

an unsteady Cold War stand off and its unexpected end Quantum Legacies introduces readers to physics still unfolding quest by treating iconic moments of discovery and debate among well known figures like Albert Einstein Erwin Schrödinger and Stephen Hawking and many others whose contributions have indelibly shaped our understanding of nature

Ethnographies Revisited Antony J. Puddephatt, William Shaffir, Steven W. Kleinknecht, 2009-12-16 This book presents reflexive first hand accounts from the authors of major book length ethnographies recounting how they generated their key ideas in the practice of field research This volume provides a fresh approach to teaching qualitative research by encouraging students to think creatively and theoretically in the field A Student's Guide to General Relativity Norman

Gray, 2019-01-10 This compact guide presents the key features of general relativity to support and supplement the presentation in mainstream more comprehensive undergraduate textbooks or as a re cap of essentials for graduate students pursuing more advanced studies It helps students plot a careful path to understanding the core ideas and basics of differential geometry as applied to general relativity without overwhelming them While the guide doesn't shy away from necessary technicalities it emphasises the essential simplicity of the main physical arguments Presuming a familiarity with special relativity with a brief account in an appendix it describes how general covariance and the equivalence principle motivate Einstein's theory of gravitation It then introduces differential geometry and the covariant derivative as the mathematical technology which allows us to understand Einstein's equations of general relativity The book is supported by numerous worked examples and problems and important applications of general relativity are described in an appendix

Science, Technology and Society Giampietro Gobo, Valentina Marcheselli, 2023-01-09 Science Technology and Society An Introduction provides students with an accessible overview of the interdisciplinary field of Science and Technology Studies STS The discipline breaks down traditional conceptions of knowledge as universal neutral and ahistorical and takes a more critical approach to science and technology as social embedded phenomena This comprehensive textbook makes use of unique examples and case studies to illustrate theoretical debates and concepts In addition the reader acquires a unique vision of contemporary issues such as the power of algorithms the mystification of fake news the role of experts within the decision making process for example Each chapter incorporates pedagogically rich features including interactive discussion points to be used individually or in class as prompts for debate **Saturation of the f-mode Instability in Neutron Stars**

Pantelis Pnigouras, 2018-09-25 This book presents a study of the saturation of unstable f modes fundamental modes due to low order nonlinear mode coupling Since their theoretical prediction in 1934 neutron stars have remained among the most challenging objects in the Universe Gravitational waves emitted by unstable neutron star oscillations can be used to obtain information about their inner structure that is the equation of state of dense nuclear matter After its initial growth phase the instability is expected to saturate due to nonlinear effects The saturation amplitude of the unstable mode determines the detectability of the generated gravitational wave signal but also affects the evolution of the neutron star The study shows

that the unstable parent mode resonantly couples to pairs of stable daughter modes which drain the parent's energy and make it saturate via a mechanism called parametric resonance instability. Further, it calculates the saturation amplitude of the most unstable f mode multipoles throughout their so-called instability windows. *Intercultural Communication and Science and Technology Studies* Luis Reyes-Galindo, Tiago Ribeiro Duarte, 2017-08-18 This timely and engaging book addresses communicative issues that arise when science and technology travel across socio-cultural boundaries. The authors discuss interactions between different scientific communities: scientists and policy makers, science and the public, scientists and artists, and other situations where science clashes with other socio-cultural domains. The volume includes theoretical proposals of how to deal with intercultural communication related to science and technology as well as rich case studies that illustrate the challenges and strategies deployed in these situations. Individual studies explore Europe, Latin America, and Africa, thus including diverse Global North and South contexts. *Gravity* Timothy Clifton, 2017 Gravity is the most immediately familiar of the four fundamental forces of nature and its effects dominate many of the phenomena commonly observed. Timothy Clifton looks at the development of our understanding of gravity from Newton's apple to gravitational waves and efforts such as string theory to combine gravity with quantum mechanics. *British Sociology* John Scott, 2020-03-06 This Palgrave Pivot will present a comprehensive history of sociology in Britain, tracking the discipline's intellectual developments within the institutional and political context. After tracing the early development of the subject as an intellectual field in empirical and idealist philosophy, evolutionism, socialism, and statistical investigations, Scott lays out the trajectory of sociology as an institutionalised discipline. *British Sociology* maps the spread of the subject from the first Sociology Department at LSE to cover the whole country. It considers the establishment of significant professional organisations and journals and the impact of feminism and political change. Scott also reviews theoretical engagement with Marxism, interactionism, feminism, and post-structuralism and the development of the discipline through research studies of crime, race, and ethnicity, community, stratification, health, sexuality, and work. Set against the backdrop of a changing political context that has seen the growth of neoliberalism and globalisation and looking forward with the ongoing search for new directions, this useful and original contribution will appeal to both academics and students across sociology, criminology, and the political sciences. **Science Between Myth and History** José G. Perillán, 2021 *Science Between Myth and History* explores scientific storytelling and its implications on the teaching practice and public perception of science. In communicating their science, scientists tend to use historical narratives for important rhetorical purposes. This text explores the implications of doing this. **Forms of Life** Harry Collins, 2019-02-12 A concise, accessible, and engaging guide for students and practitioners of sociology. In *Forms of Life*, Harry Collins offers an introduction to social science methodology, drawing on his forty-plus years of conducting high-profile sociological research. In this concise, accessible, and engaging book, Collins explains not only how to do sociology, the method, but also how to think about sociology, the meaning. For example, he

describes the three activities that are the foundations of sociological method immersing oneself in a society estranging oneself from that society and explaining what has been discovered to those who have not been immersed and goes on to consider broader questions of the meaning of science in relation to social science and the scientific authority of subjective methods He explains that sociology is the study of social collectivities often overlapping subdividable and embedded and cites Wittgenstein's notion of forms of life in his definition of collectivity Collins covers such methodological topics as participant comprehension interview based fieldwork expect plans to fail interactional expertise alternation and methodological relativism tangible and inferential experiments tribalism and emotional loyalty and how to communicate your findings Finally he offers recommendations for saving the science of sociology considering among other things sociology's identity as a discipline and the perils of both groupism and being too afraid of it Appendixes offer a code of conduct for interviews a list of his relevant publications and an account in Q A form of a disastrous day in the life of a sociologist doing fieldwork

Communicating Science and Technology in Society Ana Delicado, Fabienne Crettaz Von Roten, Katarina Prpić, 2020-11-22 This volume addresses the engagement between science and society from multiple viewpoints At a time when trust in experts is being questioned misinformation is rife and scientific and technological development show growing social impact the volume examines the challenges in involving the public in scientific debates and decisions It takes into account societal needs and concerns in research and analyses the interface between the roles of institutions and individuals From environmental challenges to science communication participatory technological design to animal experimentation and transdisciplinarity to norms and values in science the volume brings together research on areas in which scientists and citizens interact across diverse often understudied socio cultural contexts in Europe It encompasses the natural sciences engineering and the social sciences and the chapters follow diverse theoretical frameworks and methodologies including both quantitative and qualitative approaches This volume contributes not just to scholarly knowledge on the topic of science and society relations but also provides useful information for students policy makers journalists and STEM science technology engineering and mathematics researchers keen on engaging with their publics and conducting responsible research and innovation

A Companion to the History of American Science Georgina M. Montgomery, Mark A. Largent, 2019-09-23 A Companion to the History of American Science offers a collection of essays that give an authoritative overview of the most recent scholarship on the history of American science Covers topics including astronomy agriculture chemistry eugenics Big Science military technology and more Features contributions by the most accomplished scholars in the field of science history Covers pivotal events in U S history that shaped the development of science and science policy such as WWII the Cold War and the Women's Rights movement

Precision Cosmology Bernard J. T. Jones, 2017-04-20 Cosmology seeks to characterise our Universe in terms of models based on well understood and tested physics Today we know our Universe with a precision that once would have been unthinkable This book develops the entire mathematical

physical and statistical framework within which this has been achieved It tells the story of how we arrive at our profound conclusions starting from the early twentieth century and following developments up to the latest data analysis of big astronomical datasets It provides an enlightening description of the mathematical physical and statistical basis for understanding and interpreting the results of key space and ground based data Subjects covered include general relativity cosmological models the inhomogeneous Universe physics of the cosmic background radiation and methods and results of data analysis Extensive online supplementary notes exercises teaching materials and exercises in Python make this the perfect companion for researchers teachers and students in physics mathematics and astrophysics

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