

By Katherine Freese The Cosmic Cocktail Three Parts Dark Matter Science Essentials Hardcover

IF YOU ALLY DEPENDENCE SUCH A REFERRED **BY KATHERINE FREESE THE COSMIC COCKTAIL THREE PARTS DARK MATTER SCIENCE ESSENTIALS HARDCOVER** BOOK THAT WILL OFFER YOU WORTH, GET THE AGREED BEST SELLER FROM US CURRENTLY FROM SEVERAL PREFERRED AUTHORS. IF YOU WANT TO COMICAL BOOKS, LOTS OF NOVELS, TALE, JOKES, AND MORE FICIONS COLLECTIONS ARE AS A CONSEQUENCE LAUNCHED, FROM BEST SELLER TO ONE OF THE MOST CURRENT RELEASED.

YOU MAY NOT BE PERPLEXED TO ENJOY EVERY BOOKS COLLECTIONS BY KATHERINE FREESE THE COSMIC COCKTAIL THREE PARTS DARK MATTER SCIENCE ESSENTIALS HARDCOVER THAT WE WILL TOTALLY OFFER. IT IS NOT ALL BUT THE COSTS. ITS VERY NEARLY WHAT YOU DEPENDENCE CURRENTLY. THIS BY KATHERINE FREESE THE COSMIC COCKTAIL THREE PARTS DARK MATTER SCIENCE ESSENTIALS HARDCOVER, AS ONE OF THE MOST DYNAMIC SELLERS HERE WILL UTTERLY BE ALONG WITH THE BEST OPTIONS TO REVIEW.

BUILT TO MEET NEEDS: CULTURAL ISSUES IN VERNACULAR ARCHITECTURE PAUL OLIVER 2007-06-07 THE STUDY OF VERNACULAR ARCHITECTURE EXPLORES THE CHARACTERISTICS OF DOMESTIC BUILDINGS IN PARTICULAR REGIONS OR LOCALITIES, AND THE MANY SOCIAL AND CULTURAL FACTORS THAT HAVE CONTRIBUTED TO THEIR EVOLUTION. IN THIS BOOK, VERNACULAR ARCHITECTURE SPECIALIST PAUL OLIVER BRINGS TOGETHER A WEALTH OF INFORMATION THAT SPANS OVER TWO DECADES, AND THE WHOLE GLOBE. SOME PREVIOUSLY UNPUBLISHED PAPERS, AS WELL AS THOSE ONLY AVAILABLE IN HARD TO FIND CONFERENCE PROCEEDINGS, ARE BROUGHT TOGETHER IN ONE VOLUME TO FORM A FASCINATING REFERENCE FOR STUDENTS AND PROFESSIONAL ARCHITECTS, AS WELL AS ALL THOSE INVOLVED WITH PLANNING HOUSING SCHEMES IN THEIR HOME COUNTRIES AND OVERSEAS.

THE TELESCOPE IN THE ICE MARK BOWEN 2017-11-14 THE ICECUBE OBSERVATORY HAS BEEN CALLED THE “WEIRDEST” OF THE SEVEN WONDERS OF MODERN ASTRONOMY BY SCIENTIFIC AMERICAN. IN THE TELESCOPE IN THE ICE, MARK BOWEN TELLS THE AMAZING STORY OF THE PEOPLE WHO BUILT THE INSTRUMENT AND THE SCIENCE INVOLVED. LOCATED NEAR THE U. S. AMUNDSEN-SCOTT RESEARCH STATION AT THE GEOGRAPHIC SOUTH POLE, ICECUBE IS UNLIKE MOST TELESCOPES IN THAT IT IS NOT DESIGNED TO DETECT LIGHT. IT EMPLOYS A CUBIC KILOMETER OF DIAMOND-CLEAR ICE, MORE THAN A MILE BENEATH THE SURFACE, TO DETECT AN ELEMENTARY PARTICLE KNOWN AS THE NEUTRINO. IN 2010, IT DETECTED THE FIRST EXTRATERRESTRIAL HIGH-ENERGY NEUTRINOS AND THUS GAVE BIRTH TO A NEW FIELD OF ASTRONOMY. ICECUBE IS ALSO THE LARGEST PARTICLE PHYSICS DETECTOR EVER BUILT. ITS SCIENTIFIC GOALS SPAN NOT ONLY ASTROPHYSICS AND COSMOLOGY BUT ALSO PURE PARTICLE PHYSICS. AND SINCE THE NEUTRINO IS ONE OF THE STRANGEST AND LEAST UNDERSTOOD OF THE KNOWN ELEMENTARY PARTICLES, THIS IS FERTILE GROUND.

NEUTRINO PHYSICS IS PERHAPS THE MOST ACTIVE FIELD IN PARTICLE PHYSICS TODAY, AND ICECUBE IS AT THE FOREFRONT. THE TELESCOPE IN THE ICE IS, ULTIMATELY, A BOOK ABOUT PEOPLE AND THE THRILL OF THE CHASE: THE STRUGGLE TO UNDERSTAND THE NEUTRINO AND THE PIONEERS AND INVENTORS OF NEUTRINO ASTRONOMY. IT IS A SUCCESS STORY.

HEART OF DARKNESS JEREMIAH P. OSTRICKER 2015-05-26 HUMANITY’S ONGOING QUEST TO UNLOCK THE SECRETS OF DARK MATTER AND DARK ENERGY HEART OF DARKNESS DESCRIBES THE INCREDIBLE SAGA OF HUMANKIND’S QUEST TO UNRAVEL THE DEEPEST SECRETS OF THE UNIVERSE. OVER THE PAST THIRTY YEARS, SCIENTISTS HAVE LEARNED THAT TWO LITTLE-UNDERSTOOD COMPONENTS—DARK MATTER AND DARK ENERGY—COMPRISE MOST OF THE KNOWN COSMOS, EXPLAIN THE GROWTH OF ALL COSMIC STRUCTURE AND HOLD THE KEY TO THE UNIVERSE’S FATE. THE STORY OF HOW EVIDENCE FOR THE SO-CALLED “LAMBDA-COLD DARK MATTER” MODEL OF COSMOLOGY HAS BEEN GATHERED BY GENERATIONS OF SCIENTISTS THROUGHOUT THE WORLD IS TOLD HERE BY ONE OF THE PIONEERS OF THE FIELD, JEREMIAH OSTRICKER, AND HIS COAUTHOR SIMON MITTON. FROM HUMANKIND’S EARLY ATTEMPTS TO COMPREHEND EARTH’S PLACE IN THE SOLAR SYSTEM, TO ASTRONOMERS’ EXPLORATION OF THE MILKY WAY GALAXY AND THE REALM OF THE NEBULAE BEYOND, TO THE DETECTION OF THE PRIMORDIAL FLUCTUATIONS OF ENERGY FROM WHICH ALL SUBSEQUENT STRUCTURE DEVELOPED, THIS BOOK EXPLAINS THE PHYSICS AND THE HISTORY OF HOW THE CURRENT MODEL OF OUR UNIVERSE AROSE AND HAS PASSED EVERY TEST HURLED AT IT BY THE SKEPTICS. THROUGHOUT THIS RICH STORY, AN ESSENTIAL THEME IS EMPHASIZED: HOW THREE ASPECTS OF RATIONAL INQUIRY—THE APPLICATION OF DIRECT MEASUREMENT AND OBSERVATION, THE INTRODUCTION OF MATHEMATICAL MODELING, AND THE REQUIREMENT THAT HYPOTHESES SHOULD BE TESTABLE AND VERIFIABLE—GUIDE SCIENTIFIC PROGRESS AND UNDERPIN OUR MODERN COSMOLOGICAL PARADIGM. THIS MONUMENTAL PUZZLE IS FAR FROM

COMPLETE, HOWEVER, AS SCIENTISTS CONFRONT THE MYSTERIES OF THE ULTIMATE CAUSES OF COSMIC STRUCTURE FORMATION AND THE REAL NATURE AND ORIGIN OF DARK MATTER AND DARK ENERGY.

JESUS AND OTHER MEN SUSANNA ASIKAINEN 2018-02-05 In *JESUS AND OTHER MEN*, SUSANNA ASIKAINEN EXPLORES THE MASCULINITIES OF JESUS AND OTHER MALE CHARACTERS AND THE IDEAL FEMININITIES IN THE SYNOPTIC GOSPELS.

COCKTAIL CHEMISTRY NICK FISHER 2022-05-17 ENJOY CLEVER, POP CULTURE-INSPIRED DRINKS WITH THIS COLLECTION OF RECIPES FROM THE BELOVED COCKTAIL CHEMISTRY YOUTUBE CHANNEL. HAVE YOU EVER SEEN A DELICIOUS-LOOKING DRINK ON YOUR FAVORITE MOVIE OR TV SHOW AND WONDERED HOW TO MAKE IT? WELL, NOW YOU CAN, WITH THIS COLLECTION OF RECIPES FROM THE CREATOR OF THE POPULAR COCKTAIL CHEMISTRY YOUTUBE CHANNEL NICK FISHER. FEATURING RECIPES TO RECREATE THE CLASSIC WHITE RUSSIAN FROM *THE BIG LEBOWSKI*, THE ICONIC MARTINI FROM THE *JAMES BOND* MOVIES, TO DRINKS FEATURED IN *MAD MEN*, *THE SIMPSONS*, *IT'S ALWAYS SUNNY IN PHILADELPHIA*, *GAME OF THRONES*, *THE OFFICE*, *HARRY POTTER*, AND MORE, COCKTAIL CHEMISTRY WILL HAVE YOU IMPRESSING YOUR FRIENDS WITH YOUR BARTENDING SKILLS IN NO TIME. IN ADDITION TO RECIPES, COCKTAIL CHEMISTRY INCLUDES EVERYTHING YOU NEED TO KNOW TO BECOME A MIXOLOGY EXPERT, FROM HOW TO MAKE PERFECTLY CLEAR ICE, DELICIOUS FOAMS, AND INFUSIONS, OR HOW TO FLAME A CITRUS PEEL. A MUST-HAVE FOR ALL ASPIRING HOME MIXOLOGISTS AND POP-CULTURE BUFFS, COCKTAIL CHEMISTRY WILL ENSURE YOU NEVER HAVE A BORING DRINK AGAIN.

CLASSICAL AND CHRISTIAN IDEAS IN ENGLISH RENAISSANCE POETRY ISABEL RIVERS 2003-09-02 SINCE PUBLICATION IN 1979 ISABEL RIVERS' SOURCEBOOK HAS ESTABLISHED ITSELF AS THE ESSENTIAL GUIDE TO ENGLISH RENAISSANCE POETRY. IT PROVIDES AN ACCOUNT OF THE MAIN CLASSICAL AND CHRISTIAN IDEAS, OUTLINING THEIR MEANING, THEIR ORIGINS AND THEIR TRANSMISSION TO THE RENAISSANCE; ILLUSTRATES THE WAYS IN WHICH RENAISSANCE POETRY DREW ON CLASSICAL AND CHRISTIAN IDEAS; CONTAINS EXTRACTS FROM KEY CLASSICAL AND CHRISTIAN TEXTS AND RELATES THESE TO THE EXTRACTS OF THE ENGLISH POEMS WHICH DRAW ON THEM; INCLUDES SUGGESTIONS FOR FURTHER READING, AND AN INVALUABLE BIBLIOGRAPHICAL APPENDIX.

THE LITTLE BOOK OF BLACK HOLES STEVEN S. GUBSER 2017-09-25 DIVE INTO A MIND-BENDING EXPLORATION OF THE PHYSICS OF BLACK HOLES. BLACK HOLES, PREDICTED BY ALBERT EINSTEIN'S GENERAL THEORY OF RELATIVITY MORE THAN A CENTURY AGO, HAVE LONG INTRIGUED SCIENTISTS AND THE PUBLIC WITH THEIR BIZARRE AND FANTASTICAL PROPERTIES. ALTHOUGH EINSTEIN UNDERSTOOD THAT BLACK HOLES WERE MATHEMATICAL SOLUTIONS TO HIS EQUATIONS, HE NEVER ACCEPTED THEIR PHYSICAL REALITY—A VIEWPOINT MANY SHARED. THIS ALL CHANGED IN THE 1960S AND 1970S, WHEN A DEEPER CONCEPTUAL UNDERSTANDING OF BLACK HOLES DEVELOPED JUST AS NEW OBSERVATIONS REVEALED THE EXISTENCE OF QUASARS AND X-RAY BINARY STAR SYSTEMS, WHOSE MYSTERIOUS PROPERTIES COULD BE EXPLAINED BY THE PRESENCE OF BLACK HOLES. BLACK

HOLES HAVE SINCE BEEN THE SUBJECT OF INTENSE RESEARCH—AND THE PHYSICS GOVERNING HOW THEY BEHAVE AND AFFECT THEIR SURROUNDINGS IS STRANGER AND MORE MIND-BENDING THAN ANY FICTION. AFTER INTRODUCING THE BASICS OF THE SPECIAL AND GENERAL THEORIES OF RELATIVITY, THIS BOOK DESCRIBES BLACK HOLES BOTH AS ASTROPHYSICAL OBJECTS AND THEORETICAL “LABORATORIES” IN WHICH PHYSICISTS CAN TEST THEIR UNDERSTANDING OF GRAVITATIONAL, QUANTUM, AND THERMAL PHYSICS. FROM SCHWARZSCHILD BLACK HOLES TO ROTATING AND COLLIDING BLACK HOLES, AND FROM GRAVITATIONAL RADIATION TO HAWKING RADIATION AND INFORMATION LOSS, STEVEN GUBSER AND FRANS PRETORIUS USE CREATIVE THOUGHT EXPERIMENTS AND ANALOGIES TO EXPLAIN THEIR SUBJECT ACCESSIBLY. THEY ALSO DESCRIBE THE DECADES-LONG QUEST TO OBSERVE THE UNIVERSE IN GRAVITATIONAL WAVES, WHICH RECENTLY RESULTED IN THE LIGO OBSERVATORIES' DETECTION OF THE DISTINCTIVE GRAVITATIONAL WAVE “CHIRP” OF TWO COLLIDING BLACK HOLES—THE FIRST DIRECT OBSERVATION OF BLACK HOLES' EXISTENCE. *THE LITTLE BOOK OF BLACK HOLES* TAKES READERS DEEP INTO THE MYSTERIOUS HEART OF THE SUBJECT, OFFERING RARE CLARITY OF INSIGHT INTO THE PHYSICS THAT MAKES BLACK HOLES SIMPLE YET DESTRUCTIVE MANIFESTATIONS OF GEOMETRIC DESTINY.

SOMETHING INCREDIBLY WONDERFUL HAPPENS K. C. COLE 2012-08-15 COLE--A FRIEND AND COLLEAGUE OF FRANK OPPENHEIMER'S FOR MANY YEARS--HAS DRAWN FROM LETTERS, DOCUMENTS, AND EXTENSIVE INTERVIEWS TO WRITE A VERY PERSONAL STORY OF THE MAN WHOSE IRREPRESSIBLE SPIRIT WOULD INSPIRE SO MANY.

GALLUCCI'S COMMENTARY ON DÜRER'S 'FOUR BOOKS ON HUMAN PROPORTION' JAMES HUTSON 2020-10-09 In 1591, GIOVANNI PAOLO GALLUCCI PUBLISHED HIS *DELLA SIMMETRIA DEI CORPI HUMANI*, AN ITALIAN TRANSLATION OF ALBRECHT DÜRER'S *FOUR BOOKS ON HUMAN PROPORTION*. WHILE DÜRER'S TREATISE HAD BEEN TRANSLATED EARLIER IN THE SIXTEENTH-CENTURY INTO FRENCH AND LATIN, IT WAS GALLUCCI'S ITALIAN TRANSLATION THAT ENDURED IN POPULARITY AS THE MOST CITED VERSION OF THE TEXT IN LATER BAROQUE TREATISES, COVERING TOPICS THAT WERE SEEN AS CENTRAL TO ARTS EDUCATION, CONNOISSEURSHIP, PATRONAGE, AND THE WIDER APPRECIATION OF THE *STUDIA HUMANITATIS* IN GENERAL. THE TEXT CENTRES ON THE RELATIONSHIPS BETWEEN BEAUTY AND PROPORTION, MACROCOSM AND MICROCOSM: RELATIONSHIPS THAT WERE NOT ONLY ESSENTIAL TO THE VISUAL ARTS IN THE EARLY MODERN ERA, BUT THAT CUT ACROSS A RANGE OF DISCIPLINES - MUSIC, PHYSIOGNOMICS AND HUMORAL READINGS, ASTRONOMY, ASTROLOGY AND COSMOLOGY, THEOLOGY AND PHILOSOPHY, EVEN MNEMONICS AND POETRY. IN HIS VERSION OF THE TEXT, GALLUCCI EXPANDED THE EDUCATIONAL POTENTIAL OF THE TREATISE BY ADDING A PREFACE, A LIFE OF DÜRER, AND A FIFTH BOOK PROVIDING A PHILOSOPHICAL FRAMEWORK WITHIN WHICH TO INTERPRET DÜRER'S PREVIOUS SECTIONS. THIS TRANSLATION IS THE FIRST TO MAKE THESE ORIGINAL CONTRIBUTIONS BY GALLUCCI ACCESSIBLE TO AN ENGLISH-SPEAKING AUDIENCE. GALLUCCI'S CONTRIBUTIONS ILLUMINATE THE SIGNIFICANCE OF SYMMETRY AND PROPORTION IN THE CONTEMPORARY EDUCATION OF THE EARLY MODERN ERA, INFORMING OUR UNDERSTANDING OF THE INTELLECTUAL HISTORY OF THIS PERIOD, AND THE

DEVELOPMENT OF ART THEORY AND CRITICISM. THIS IS A VALUABLE RESOURCE TO EARLY MODERN SCHOLARS AND STUDENTS ALIKE, ESPECIALLY THOSE SPECIALISING IN HISTORY OF ART, PHILOSOPHY, HISTORY OF SCIENCE, AND POETRY. THIS WORK WAS PUBLISHED BY SAINT PHILIP STREET PRESS PURSUANT TO A CREATIVE COMMONS LICENSE PERMITTING COMMERCIAL USE. ALL RIGHTS NOT GRANTED BY THE WORK'S LICENSE ARE RETAINED BY THE AUTHOR OR AUTHORS.

NATURE'S BLUEPRINT DAN HOOPER 2009-10-06 THE FIRST ACCESSIBLE BOOK ON A THEORY OF PHYSICS THAT EXPLAINS THE RELATIONSHIP BETWEEN THE PARTICLES AND FORCES THAT MAKE UP OUR UNIVERSE. FOR DECADES, PHYSICISTS HAVE BEEN FASCINATED WITH THE POSSIBILITY THAT TWO SEEMINGLY INDEPENDENT ASPECTS OF OUR WORLD—MATTER AND FORCE—MAY IN FACT BE INTIMATELY CONNECTED AND INSEPARABLE FACETS OF NATURE. THIS IDEA, KNOWN AS SUPERSYMMETRY, IS CONSIDERED BY MANY PHYSICISTS TO BE ONE OF THE MOST BEAUTIFUL AND ELEGANT THEORIES EVER CONCEIVED. ACCORDING TO THIS THEORY, HOWEVER, THERE IS MUCH MORE TO OUR UNIVERSE THAN WE HAVE WITNESSED THUS FAR. IN PARTICULAR, SUPERSYMMETRY PREDICTS THAT FOR EACH TYPE OF PARTICLE THERE MUST ALSO EXIST OTHERS, CALLED SUPERPARTNERS. TO THE FRUSTRATION OF MANY PARTICLE PHYSICISTS, NO SUCH SUPERPARTNER PARTICLES HAVE EVER BEEN OBSERVED. AS THE WORLD'S MOST POWERFUL PARTICLE ACCELERATOR—THE LARGE HADRON COLLIDER—BEGINS OPERATING IN 2008, THIS MAY BE ABOUT TO CHANGE. BY DISCOVERING THE FORMS OF MATTER PREDICTED BY SUPERSYMMETRY, THIS INCREDIBLE MACHINE IS SET TO TRANSFORM OUR CURRENT UNDERSTANDING OF THE UNIVERSE'S LAWS AND STRUCTURE, AND OVERTURN THE WAY THAT WE THINK ABOUT MATTER, FORCE, SPACE, AND TIME. NATURE'S BLUEPRINT EXPLORES THE REASONS WHY SUPERSYMMETRY IS SO INTEGRAL TO HOW WE UNDERSTAND OUR WORLD AND DESCRIBES THE INCREDIBLE MACHINES USED IN THE SEARCH FOR IT. IN AN ENGAGING AND ACCESSIBLE STYLE, IT GIVES READERS A GLIMPSE INTO THE SYMMETRIES, PATTERNS, AND VERY STRUCTURE BEHIND THE UNIVERSE AND ITS LAWS.

DARK COSMOS DAN HOOPER 2009-10-06 THE TWENTIETH CENTURY WAS ASTONISHING IN ALL REGARDS, SHAKING THE FOUNDATIONS OF PRACTICALLY EVERY ASPECT OF HUMAN LIFE AND THOUGHT, PHYSICS NOT LEAST OF ALL. BEGINNING WITH THE PUBLICATION OF ALBERT EINSTEIN'S THEORY OF RELATIVITY, THROUGH THE WILD REVOLUTION OF QUANTUM MECHANICS, AND UP UNTIL THE PHYSICS OF THE MODERN DAY (INCLUDING THE ASTONISHING REVELATION, IN 1998, THAT THE UNIVERSE IS NOT ONLY EXPANDING, BUT DOING SO AT AN EVER-QUICKENING PACE), MUCH OF WHAT PHYSICISTS HAVE SEEN IN OUR UNIVERSE SUGGESTS THAT MUCH OF OUR UNIVERSE IS UNSEEN—THAT WE LIVE IN A DARK COSMOS. EVERYONE KNOWS THAT THERE ARE THINGS NO ONE CAN SEE—THE AIR YOU'RE BREATHING, FOR EXAMPLE, OR, TO BE MORE EXOTIC, A BLACK HOLE. BUT WHAT EVERYONE DOES NOT KNOW IS THAT WHAT WE CAN SEE—A BOOK, A CAT, OR OUR PLANET—MAKES UP ONLY 5 PERCENT OF THE UNIVERSE. THE REST—FULLY 95 PERCENT—IS TOTALLY INVISIBLE TO US; ITS PRESENCE DISCERNIBLE ONLY BY THE WEAK EFFECTS IT HAS ON VISIBLE MATTER AROUND IT. THIS INVISIBLE STUFF COMES IN TWO VARIETIES—DARK MATTER AND DARK ENERGY. ONE

HOLDS THE UNIVERSE TOGETHER, WHILE THE OTHER TEARS IT APART. WHAT THESE FORCES REALLY ARE HAS BEEN A MYSTERY FOR AS LONG AS ANYONE HAS SUSPECTED THEY WERE THERE, BUT THE LATEST DISCOVERIES OF EXPERIMENTAL PHYSICS HAVE BROUGHT US CLOSER TO THAT KNOWLEDGE. PARTICLE PHYSICIST DAN HOOPER TAKES HIS READERS, WITH WIT, GRACE, AND A KEEN KNACK FOR EXPLAINING THE TOUGHEST IDEAS SCIENCE HAS TO OFFER, ON A QUEST FEW WOULD HAVE EVER EXPECTED: TO DISCOVER WHAT MAKES UP OUR DARK COSMOS.

A MOST INCOMPREHENSIBLE THING PETER COLLIER 2017-04-01 A STRAIGHTFORWARD, ENJOYABLE GUIDE TO THE MATHEMATICS OF EINSTEIN'S RELATIVITY TO REALLY UNDERSTAND EINSTEIN'S THEORY OF RELATIVITY – ONE OF THE CORNERSTONES OF MODERN PHYSICS – YOU HAVE TO GET TO GRIPS WITH THE UNDERLYING MATHEMATICS. THIS SELF-STUDY GUIDE IS AIMED AT THE GENERAL READER WHO IS MOTIVATED TO TACKLE THAT NOT INSIGNIFICANT CHALLENGE. WITH A USER-FRIENDLY STYLE, CLEAR STEP-BY-STEP MATHEMATICAL DERIVATIONS, MANY FULLY SOLVED PROBLEMS AND NUMEROUS DIAGRAMS, THIS BOOK PROVIDES A COMPREHENSIVE INTRODUCTION TO A FASCINATING BUT COMPLEX SUBJECT. FOR THOSE WITH MINIMAL MATHEMATICAL BACKGROUND, THE FIRST CHAPTER GIVES A CRASH COURSE IN FOUNDATION MATHEMATICS. THE READER IS THEN TAKEN GENTLY BY THE HAND AND GUIDED THROUGH A WIDE RANGE OF FUNDAMENTAL TOPICS, INCLUDING NEWTONIAN MECHANICS; THE LORENTZ TRANSFORMATIONS; TENSOR CALCULUS; THE EINSTEIN FIELD EQUATIONS; THE SCHWARZSCHILD SOLUTION (WHICH GIVES A GOOD APPROXIMATION OF THE SPACETIME OF OUR SOLAR SYSTEM); SIMPLE BLACK HOLES, RELATIVISTIC COSMOLOGY AND GRAVITATIONAL WAVES. SPECIAL RELATIVITY HELPS EXPLAIN A HUGE RANGE OF NON-GRAVITATIONAL PHYSICAL PHENOMENA AND HAS SOME STRANGELY COUNTER-INTUITIVE CONSEQUENCES. THESE INCLUDE TIME DILATION, LENGTH CONTRACTION, THE RELATIVITY OF SIMULTANEITY, MASS-ENERGY EQUIVALENCE AND AN ABSOLUTE SPEED LIMIT. GENERAL RELATIVITY, THE LEADING THEORY OF GRAVITY, IS AT THE HEART OF OUR UNDERSTANDING OF COSMOLOGY AND BLACK HOLES. "I MUST OBSERVE THAT THE THEORY OF RELATIVITY RESEMBLES A BUILDING CONSISTING OF TWO SEPARATE STORIES, THE SPECIAL THEORY AND THE GENERAL THEORY. THE SPECIAL THEORY, ON WHICH THE GENERAL THEORY RESTS, APPLIES TO ALL PHYSICAL PHENOMENA WITH THE EXCEPTION OF GRAVITATION; THE GENERAL THEORY PROVIDES THE LAW OF GRAVITATION AND ITS RELATIONS TO THE OTHER FORCES OF NATURE." – ALBERT EINSTEIN, 1919 UNDERSTAND EVEN THE BASICS OF EINSTEIN'S AMAZING THEORY AND THE WORLD WILL NEVER SEEM THE SAME AGAIN. CONTENTS: PREFACE INTRODUCTION 1 FOUNDATION MATHEMATICS 2 NEWTONIAN MECHANICS 3 SPECIAL RELATIVITY 4 INTRODUCING THE MANIFOLD 5 SCALARS, VECTORS, ONE-FORMS AND TENSORS 6 MORE ON CURVATURE 7 GENERAL RELATIVITY 8 THE NEWTONIAN LIMIT 9 THE SCHWARZSCHILD METRIC 10 SCHWARZSCHILD BLACK HOLES 11 COSMOLOGY 12 GRAVITATIONAL WAVES APPENDIX: THE RIEMANN CURVATURE TENSOR BIBLIOGRAPHY ACKNOWLEDGEMENTS JANUARY 2019. THIS THIRD EDITION HAS BEEN REVISED TO MAKE THE MATERIAL EVEN MORE ACCESSIBLE TO THE ENTHUSIASTIC GENERAL READER WHO SEEKS TO UNDERSTAND THE

MATHEMATICS OF RELATIVITY.

THE LAZY UNIVERSE JENNIFER COOPERSMITH 2017-04-28 THIS IS A RARE BOOK ON A RARE TOPIC: IT IS ABOUT 'ACTION' AND THE PRINCIPLE OF LEAST ACTION. A SURPRISINGLY WELL-KEPT SECRET, THESE IDEAS ARE AT THE HEART OF PHYSICAL SCIENCE AND ENGINEERING.

PHYSICS IS WELL KNOWN AS BEING CONCERNED WITH GRAND CONSERVATORY PRINCIPLES (E.G. THE CONSERVATION OF ENERGY) BUT EQUALLY IMPORTANT IS THE OPTIMIZATION PRINCIPLE (SUCH AS GETTING SOMEWHERE IN THE SHORTEST TIME OR WITH THE LEAST RESISTANCE).

THE BOOK EXPLAINS: WHY AN OPTIMIZATION PRINCIPLE UNDERLIES PHYSICS, WHAT ACTION IS, WHAT 'THE HAMILTONIAN' IS, AND HOW NEW INSIGHTS INTO ENERGY, SPACE, AND TIME ARISE.

IT ASSUMES SOME BACKGROUND IN THE PHYSICAL SCIENCES, AT THE LEVEL OF UNDERGRADUATE SCIENCE, BUT IT IS NOT A TEXTBOOK. THE REQUISITE DERIVATIONS AND WORKED EXAMPLES ARE GIVEN BUT MAY BE SKIM-READ IF DESIRED. THE AUTHOR DRAWS FROM CORNELIUS LANCZOS'S BOOK "THE VARIATIONAL PRINCIPLES OF MECHANICS" (1949 AND 1970). LANCZOS WAS A BRILLIANT MATHEMATICIAN AND EDUCATOR, BUT HIS BOOK WAS FOR A POSTGRADUATE AUDIENCE. THE PRESENT BOOK IS NO MERE COPY WITH THE DIFFICULT BITS LEFT OUT - IT IS ORIGINAL, AND A POPULARIZATION. IT AIMS TO EXPLAIN IDEAS RATHER THAN ACHIEVE TECHNICAL COMPETENCE, AND TO SHOW HOW LEAST ACTION LEADS INTO THE WHOLE OF PHYSICS.

LIFE'S ENGINES PAUL G. FALKOWSKI 2015-04-27 THE MARVELOUS MICROBES THAT MADE LIFE ON EARTH POSSIBLE AND SUPPORT OUR VERY EXISTENCE FOR ALMOST FOUR BILLION YEARS, MICROBES HAD THE PRIMORDIAL OCEANS ALL TO THEMSELVES. THE STEWARDS OF EARTH, THESE ORGANISMS TRANSFORMED THE CHEMISTRY OF OUR PLANET TO MAKE IT HABITABLE FOR PLANTS, ANIMALS, AND US. LIFE'S ENGINES TAKES READERS DEEP INTO THE MICROSCOPIC WORLD TO EXPLORE HOW THESE MARVELOUS CREATURES MADE LIFE ON EARTH POSSIBLE—AND HOW HUMAN LIFE TODAY WOULD CEASE TO EXIST WITHOUT THEM. PAUL FALKOWSKI LOOKS "UNDER THE HOOD" OF MICROBES TO FIND THE ENGINES OF LIFE, THE ACTUAL WORKING PARTS THAT DO THE BIOCHEMICAL HEAVY LIFTING FOR EVERY LIVING ORGANISM ON EARTH. WITH INSIGHT AND HUMOR, HE EXPLAINS HOW THESE MINIATURE ENGINES ARE BUILT—AND HOW THEY HAVE BEEN APPROPRIATED BY AND ASSEMBLED LIKE LEGO SETS WITHIN EVERY CREATURE THAT WALKS, SWIMS, OR FLIES. FALKOWSKI SHOWS HOW EVOLUTION WORKS TO MAINTAIN THIS CORE MACHINERY OF LIFE, AND HOW WE AND OTHER ANIMALS ARE VERITABLE CONGLOMERATIONS OF MICROBES. A VIBRANTLY ENTERTAINING BOOK ABOUT THE MICROBES THAT SUPPORT OUR VERY EXISTENCE, LIFE'S ENGINES WILL INSPIRE WONDER ABOUT THESE ELEGANTLY COMPLEX NANOMACHINES THAT HAVE DRIVEN LIFE SINCE ITS ORIGIN. IT ALSO ISSUES A TIMELY WARNING ABOUT THE DANGERS OF TINKERING WITH THAT MACHINERY TO MAKE IT MORE "EFFICIENT" AT MEETING THE EVER-GROWING DEMANDS OF HUMANS IN THE COMING CENTURY.

THE 4 PERCENT UNIVERSE RICHARD PANEK 2011-01-10 THE EPIC, BEHIND-THE-SCENES STORY OF AN ASTOUNDING GAP IN OUR SCIENTIFIC KNOWLEDGE OF THE COSMOS. IN THE PAST FEW YEARS, A HANDFUL OF SCIENTISTS HAVE BEEN IN A RACE TO EXPLAIN A DISTURBING

ASPECT OF OUR UNIVERSE: ONLY 4 PERCENT OF IT CONSISTS OF THE MATTER THAT MAKES UP YOU, ME, OUR BOOKS, AND EVERY PLANET, STAR, AND GALAXY. THE REST—96 PERCENT OF THE UNIVERSE—IS COMPLETELY UNKNOWN. RICHARD PANEK TELLS THE DRAMATIC STORY OF HOW SCIENTISTS REACHED THIS CONCLUSION, AND WHAT THEY'RE DOING TO FIND THIS "DARK" MATTER AND AN EVEN MORE BIZARRE SUBSTANCE CALLED DARK ENERGY. BASED ON IN-DEPTH, ON-SITE REPORTING AND HUNDREDS OF INTERVIEWS—WITH EVERYONE FROM BERKELEY'S FEISTY SAUL PERLMUTTER AND JOHNS HOPKINS'S METICULOUS ADAM RIESS TO THE QUIETLY REVOLUTIONARY VERA RUBIN—THE BOOK OFFERS AN INTIMATE PORTRAIT OF THE BITTER RIVALRIES AND FRUITFUL COLLABORATIONS, THE EUREKA MOMENTS AND BLIND ALLEYS, THAT HAVE FUELED THEIR SEARCH, REDEFINED SCIENCE, AND REINVENTED THE UNIVERSE.

PHYSICS AND LITERATURE AURA HEYDENREICH 2021-12-20 DIE REIHE: LITERATUR- UND NATURWISSENSCHAFTEN ENTSTEHT UNTER FEDERFÜHRUNG DES ERLANGER FORSCHUNGSZENTRUMS FÜR LITERATUR- UND NATURWISSENSCHAFTEN (ELINAS). EXPERTEN UNTERSCHIEDLICHER FACHKULTUREN FÜHREN DARIN IHRE METHODEN ZUSAMMEN UND FRAGEN SOWOHL NACH DEN FUNKTIONEN DER SPRACHE IN DER NATURWISSENSCHAFTLICHEN FORSCHUNG ALS AUCH NACH DEN VERFAHREN DER MODELLIERUNG NATURWISSENSCHAFTLICHER ERKENNTNISSE IN DER LITERATUR. DIE REIHE VERSTEHT SICH ALS EIN INTERDISZIPLINÄRES FORUM ZUR REFLEXION DER KULTURELLEN BEDEUTUNG NATUR- UND LITERATURWISSENSCHAFTLICHER FORSCHUNG SOWIE ZUR ETHIK UND RHETORIK WISSENSCHAFTLICHER ARGUMENTATION.

LOSING THE NOBEL PRIZE: A STORY OF COSMOLOGY, AMBITION, AND THE PERILS OF SCIENCE'S HIGHEST HONOR BRIAN KEATING 2018-04-24 A FORBES, PHYSICS TODAY, SCIENCE NEWS, AND SCIENCE FRIDAY BEST SCIENCE BOOK OF 2018 THE INSIDE STORY OF A QUEST TO UNLOCK ONE OF COSMOLOGY'S BIGGEST MYSTERIES, DERAILED BY THE LURE OF THE NOBEL PRIZE. WHAT WOULD IT HAVE BEEN LIKE TO BE AN EYEWITNESS TO THE BIG BANG? IN 2014, ASTRONOMERS WIELDING BICEP2, THE MOST POWERFUL COSMOLOGY TELESCOPE EVER MADE, REVEALED THAT THEY'D GLIMPSED THE SPARK THAT IGNITED THE BIG BANG. MILLIONS AROUND THE WORLD TUNED IN TO THE ANNOUNCEMENT BROADCAST LIVE FROM HARVARD UNIVERSITY, IMMEDIATELY IGNITING RUMORS OF AN IMMINENT NOBEL PRIZE. BUT HAD THESE COSMOLOGISTS TRULY READ THE COSMIC PROLOGUE OR, SWEEPED UP IN NOBEL DREAMS, HAD THEY BEEN DECEIVED BY A GALACTIC MIRAGE? IN LOSING THE NOBEL PRIZE, COSMOLOGIST AND INVENTOR OF THE BICEP (BACKGROUND IMAGING OF COSMIC EXTRAGALACTIC POLARIZATION) EXPERIMENT BRIAN KEATING TELLS THE INSIDE STORY OF BICEP2'S MESMERIZING DISCOVERY AND THE SCIENTIFIC DRAMA THAT ENSUED. IN AN ADVENTURE STORY THAT SPANS THE GLOBE FROM RHODE ISLAND TO THE SOUTH POLE, FROM CALIFORNIA TO CHILE, KEATING TAKES US ON A PERSONAL JOURNEY OF REVELATION AND DISCOVERY, BRINGING TO VIVID LIFE THE HIGHLY COMPETITIVE, TAKE-NO-PRISONERS, PUBLISH-OR-PERISH WORLD OF MODERN SCIENCE. ALONG THE WAY, HE PROVOCATIVELY ARGUES THAT THE NOBEL PRIZE, INSTEAD OF ADVANCING SCIENTIFIC PROGRESS, MAY ACTUALLY HAMPER IT,

ENCOURAGING SPEED AND GREED WHILE PUNISHING COLLABORATION AND BOLD INNOVATION. IN A THOUGHTFUL REAPPRAISAL OF THE WISHES OF ALFRED NOBEL, KEATING OFFERS PRACTICAL SOLUTIONS FOR REFORMING THE PRIZE, PROVIDING A VISION OF A SCIENTIFIC FUTURE IN WHICH COSMOLOGISTS MAY, FINALLY, BE ABLE TO SEE ALL THE WAY BACK TO THE VERY BEGINNING.

PARTICLE DARK MATTER GIANFRANCO BERTONE 2010 DESCRIBES THE DARK MATTER PROBLEM IN PARTICLE PHYSICS, ASTROPHYSICS AND COSMOLOGY FOR GRADUATE STUDENTS AND RESEARCHERS.

ALIEN OCEANS KEVIN HAND 2021-09-21 INSIDE THE EPIC QUEST TO FIND LIFE ON THE WATER-RICH MOONS AT THE OUTER REACHES OF THE SOLAR SYSTEM WHERE IS THE BEST PLACE TO FIND LIFE BEYOND EARTH? WE OFTEN LOOK TO MARS AS THE MOST PROMISING SITE IN OUR SOLAR SYSTEM, BUT RECENT SCIENTIFIC MISSIONS HAVE REVEALED THAT SOME OF THE MOST HABITABLE REAL ESTATE MAY ACTUALLY LIE FARTHER AWAY. BENEATH THE FROZEN CRUSTS OF SEVERAL OF THE SMALL, ICE-COVERED MOONS OF JUPITER AND SATURN LURK VAST OCEANS THAT MAY HAVE EXISTED FOR AS LONG AS EARTH, AND TOGETHER MAY CONTAIN MORE THAN FIFTY TIMES ITS TOTAL VOLUME OF LIQUID WATER. COULD THERE BE ORGANISMS LIVING IN THEIR DEPTHS? ALIEN OCEANS REVEALS THE SCIENCE BEHIND THE THRILLING QUEST TO FIND OUT. KEVIN PETER HAND IS ONE OF TODAY'S LEADING NASA SCIENTISTS, AND HIS PIONEERING RESEARCH HAS TAKEN HIM ON EXPEDITIONS AROUND THE WORLD. IN THIS CAPTIVATING ACCOUNT OF SCIENTIFIC DISCOVERY, HE BRINGS TOGETHER INSIGHTS FROM PLANETARY SCIENCE, BIOLOGY, AND THE ADVENTURES OF SCIENTISTS LIKE HIMSELF TO EXPLAIN HOW WE KNOW THAT OCEANS EXIST WITHIN MOONS OF THE OUTER SOLAR SYSTEM, LIKE EUROPA, TITAN, AND ENCELADUS. HE SHOWS HOW THE EXPLORATION OF EARTH'S OCEANS IS INFORMING OUR UNDERSTANDING OF THE POTENTIAL HABITABILITY OF THESE ICY MOONS, AND DRAWS LESSONS FROM WHAT WE HAVE LEARNED ABOUT THE ORIGINS OF LIFE ON OUR OWN PLANET TO CONSIDER HOW LIFE COULD ARISE ON THESE DISTANT WORLDS. ALIEN OCEANS DESCRIBES WHAT LIES AHEAD IN OUR SEARCH FOR LIFE IN OUR SOLAR SYSTEM AND BEYOND, SETTING THE STAGE FOR THE TRANSFORMATIVE DISCOVERIES THAT MAY AWAIT US.

SCIENCE WITH THE CHERENKOV TELESCOPE ARRAY THE CTA CONSORTIUM 2018-12-31 THIS BOOK SUMMARIZES THE SCIENCE TO BE CARRIED OUT BY THE UPCOMING CHERENKOV TELESCOPE ARRAY, A MAJOR GROUND-BASED GAMMA-RAY OBSERVATORY THAT WILL BE CONSTRUCTED OVER THE NEXT SIX TO EIGHT YEARS. THE MAJOR SCIENTIFIC THEMES, AS WELL AS CORE PROGRAM OF KEY SCIENCE PROJECTS, HAVE BEEN DEVELOPED BY THE CTA CONSORTIUM, A COLLABORATION OF SCIENTISTS FROM MANY INSTITUTIONS WORLDWIDE. CTA WILL BE THE MAJOR FACILITY IN HIGH-ENERGY AND VERY HIGH-ENERGY PHOTON ASTRONOMY OVER THE NEXT DECADE AND BEYOND. CTA WILL HAVE CAPABILITIES WELL BEYOND PAST AND PRESENT OBSERVATORIES. THUS, CTA'S SCIENCE PROGRAM IS EXPECTED TO BE RICH AND BROAD AND WILL COMPLEMENT OTHER MAJOR MULTIWAVELENGTH AND MULTIMESSENGER FACILITIES. THIS BOOK IS INTENDED TO BE THE PRIMARY RESOURCE FOR THE SCIENCE CASE FOR CTA AND IT THUS WILL BE OF GREAT INTEREST TO THE BROADER

PHYSICS AND ASTRONOMY COMMUNITIES. THE ELECTRONIC VERSION (E-BOOK) IS AVAILABLE IN OPEN ACCESS.

AN INTRODUCTION TO CULTURAL ECOLOGY MARK Q. SUTTON 2020-08-26 THIS CONTEMPORARY INTRODUCTION TO THE PRINCIPLES AND RESEARCH BASE OF CULTURAL ECOLOGY IS THE IDEAL TEXTBOOK FOR ADVANCED UNDERGRADUATE AND BEGINNING GRADUATE COURSES THAT DEAL WITH THE INTERSECTION OF HUMANS AND THE ENVIRONMENT IN TRADITIONAL SOCIETIES. AFTER INTRODUCING THE BASIC PRINCIPLES OF CULTURAL ANTHROPOLOGY, ENVIRONMENTAL STUDIES, AND HUMAN BIOLOGICAL ADAPTATIONS TO THE ENVIRONMENT, THE BOOK PROVIDES A THOROUGH DISCUSSION OF THE HISTORY OF, AND THEORETICAL BASIS BEHIND, CULTURAL ECOLOGY. THE BULK OF THE BOOK OUTLINES THE BROAD ECONOMIC STRATEGIES USED BY TRADITIONAL CULTURES: HUNTING/GATHERING, HORTICULTURE, PASTORALISM, AND AGRICULTURE. FULLY EXPLICATED WITH CASES, ILLUSTRATIONS, AND CHARTS ON TOPICS AS DIVERSE AS SALMON CEREMONIES AMONG NORTHWEST INDIANS, CONTEMPORARY MAYA AGRICULTURE, AND THE SACRED GROVES IN SOUTHERN CHINA, THIS BOOK GIVES A GLOBAL VIEW OF THESE STRATEGIES. AN IMPORTANT EMPHASIS IN THIS TEXT IS ON THE NATURE OF CONTEMPORARY ECOLOGICAL ISSUES, HOW PEOPLES WORLDWIDE ADAPT TO THEM, AND WHAT THE WESTERN WORLD CAN LEARN FROM THEIR EXPERIENCES. A PERFECT TEXT FOR COURSES IN ANTHROPOLOGY, ENVIRONMENTAL STUDIES, AND SOCIOLOGY.

THE MIDDLE INCLUDED [?] MER AYG [?] N 2016-12-15 THE MIDDLE INCLUDED IS THE FIRST COMPREHENSIVE ACCOUNT OF THE ANCIENT GREEK WORD LOGOS IN ARISTOTELIAN PHILOSOPHY. LOGOS MEANS MANY THINGS IN THE ARISTOTELIAN CORPUS: ESSENTIAL FORMULA, PROPORTION, REASON, AND LANGUAGE. SURVEYING THESE MEANINGS IN ARISTOTLE'S LOGIC, PHYSICS, AND ETHICS, [?] MER AYG [?] N PERSUASIVELY DEMONSTRATES THAT THESE DIVERS MEANINGS OF LOGOS ALL REFER TO A BASIC SENSE OF "GATHERING" OR "INCLUSIVENESS." IN THIS SENSE, LOGOS FUNCTIONS AS A COUNTERPART TO A FORMAL VERSION OF THE PRINCIPLES OF NON-CONTRADICTION AND OF THE EXCLUDED MIDDLE IN HIS CORPUS. AYG [?] N THUS SHIFTS ARISTOTLE'S TRADITIONAL IMAGE FROM THAT OF THE FATHER OF FORMAL LOGIC, CLASSIFICATORY THINKING, AND EXCLUSION TO A MORE NUANCED IMAGE OF HIM AS A THINKER OF INCLUSION. THE MIDDLE INCLUDED ALSO EXPLORES HUMAN LANGUAGE IN ARISTOTELIAN PHILOSOPHY. AFTER AN ACCOUNT OF ACOUSTIC PHENOMENA AND ANIMAL COMMUNICATION, AYG [?] N ARGUES THAT HUMAN LANGUAGE FOR ARISTOTLE IS THE ABILITY TO UNDERSTAND AND RELAY BOTH FIRST-HAND EXPERIENCES AND NON-FIRST-HAND EXPERIENCES. THIS DEFINITION IS KEY TO UNDERSTANDING MANY CORE HUMAN EXPERIENCES SUCH AS SCIENCE, HISTORY, NEWS MEDIA, EDUCATION, SOPHISTRY, AND INDEED PHILOSOPHY ITSELF. LOGOS IS THUS NEVER ASSOCIATED WITH ANY OTHER ANIMAL NOR WITH ANYTHING DIVINE—IT REMAINS STRICTLY AND RIGOROUSLY SECULAR, HUMANE, AND YET FULL OF THE WONDER.

EINSTEIN GRAVITY IN A NUTSHELL A. ZEE 2013-05-05 AN IDEAL INTRODUCTION TO EINSTEIN'S GENERAL THEORY OF RELATIVITY THIS UNIQUE TEXTBOOK PROVIDES AN

ACCESSIBLE INTRODUCTION TO EINSTEIN'S GENERAL THEORY OF RELATIVITY, A SUBJECT OF BREATHTAKING BEAUTY AND SUPREME IMPORTANCE IN PHYSICS. WITH HIS TRADEMARK BLEND OF WIT AND INCISIVENESS, A. ZEE GUIDES READERS FROM THE FUNDAMENTALS OF NEWTONIAN MECHANICS TO THE MOST EXCITING FRONTIERS OF RESEARCH TODAY, INCLUDING DE SITTER AND ANTI-DE SITTER SPACETIMES, KALUZA-KLEIN THEORY, AND BRANE WORLDS. UNLIKE OTHER BOOKS ON EINSTEIN GRAVITY, THIS BOOK EMPHASIZES THE ACTION PRINCIPLE AND GROUP THEORY AS GUIDES IN CONSTRUCTING PHYSICAL THEORIES. ZEE TREATS VARIOUS TOPICS IN A SPIRAL STYLE THAT IS EASY ON BEGINNERS, AND INCLUDES ANECDOTES FROM THE HISTORY OF PHYSICS THAT WILL APPEAL TO STUDENTS AND EXPERTS ALIKE. HE TAKES A FRIENDLY APPROACH TO THE REQUIRED MATHEMATICS, YET DOES NOT SHY AWAY FROM MORE ADVANCED MATHEMATICAL TOPICS SUCH AS DIFFERENTIAL FORMS. THE EXTENSIVE DISCUSSION OF BLACK HOLES INCLUDES ROTATING AND EXTREMAL BLACK HOLES AND HAWKING RADIATION. THE IDEAL TEXTBOOK FOR UNDERGRADUATE AND GRADUATE STUDENTS, EINSTEIN GRAVITY IN A NUTSHELL ALSO PROVIDES AN ESSENTIAL RESOURCE FOR PROFESSIONAL PHYSICISTS AND IS ACCESSIBLE TO ANYONE FAMILIAR WITH CLASSICAL MECHANICS AND ELECTROMAGNETISM. IT FEATURES NUMEROUS EXERCISES AS WELL AS DETAILED APPENDICES COVERING A MULTITUDE OF TOPICS NOT READILY FOUND ELSEWHERE. PROVIDES AN ACCESSIBLE INTRODUCTION TO EINSTEIN'S GENERAL THEORY OF RELATIVITY GUIDES READERS FROM NEWTONIAN MECHANICS TO THE FRONTIERS OF MODERN RESEARCH EMPHASIZES SYMMETRY AND THE EINSTEIN-HILBERT ACTION COVERS TOPICS NOT FOUND IN STANDARD TEXTBOOKS ON EINSTEIN GRAVITY INCLUDES INTERESTING HISTORICAL ASIDES FEATURES NUMEROUS EXERCISES AND DETAILED APPENDICES IDEAL FOR STUDENTS, PHYSICISTS, AND SCIENTIFICALLY MINDED LAY READERS SOLUTIONS MANUAL (AVAILABLE ONLY TO TEACHERS)

THE COSMIC COCKTAIL KATHERINE FREESE 2016-05-17 THE ORDINARY ATOMS THAT MAKE UP THE KNOWN UNIVERSE—FROM OUR BODIES AND THE AIR WE BREATHE TO THE PLANETS AND STARS—CONSTITUTE ONLY 5 PERCENT OF ALL MATTER AND ENERGY IN THE COSMOS. THE REST IS KNOWN AS DARK MATTER AND DARK ENERGY, BECAUSE THEIR PRECISE IDENTITIES ARE UNKNOWN. THE COSMIC COCKTAIL IS THE INSIDE STORY OF THE EPIC QUEST TO SOLVE ONE OF THE MOST COMPELLING ENIGMAS OF MODERN SCIENCE—WHAT IS THE UNIVERSE MADE OF?—TOLD BY ONE OF TODAY'S FOREMOST PIONEERS IN THE STUDY OF DARK MATTER. BLENDING CUTTING-EDGE SCIENCE WITH HER OWN BEHIND-THE-SCENES INSIGHTS AS A LEADING RESEARCHER IN THE FIELD, ACCLAIMED THEORETICAL PHYSICIST KATHERINE FREESE RECOUNTS THE HUNT FOR DARK MATTER, FROM THE DISCOVERIES OF VISIONARY SCIENTISTS LIKE FRITZ ZWICKY—THE SWISS ASTRONOMER WHO COINED THE TERM "DARK MATTER" IN 1933—TO THE DELUGE OF DATA TODAY FROM UNDERGROUND LABORATORIES, SATELLITES IN SPACE, AND THE LARGE HADRON COLLIDER. THEORISTS CONTEND THAT DARK MATTER CONSISTS OF FUNDAMENTAL PARTICLES KNOWN AS WIMPS, OR WEAKLY INTERACTING MASSIVE PARTICLES. BILLIONS OF THEM PASS THROUGH OUR BODIES EVERY SECOND WITHOUT US EVEN REALIZING IT, YET THEIR GRAVITATIONAL PULL IS CAPABLE OF WHIRLING STARS AND

GAS AT BREAKNECK SPEEDS AROUND THE CENTERS OF GALAXIES, AND BENDING LIGHT FROM DISTANT BRIGHT OBJECTS. FREESE DESCRIBES THE LARGER-THAN-LIFE CHARACTERS AND CLASHING PERSONALITIES BEHIND THE RACE TO IDENTIFY THESE ELUSIVE PARTICLES. MANY COSMOLOGISTS BELIEVE WE ARE ON THE VERGE OF SOLVING THE MYSTERY. THE COSMIC COCKTAIL PROVIDES THE FOUNDATION NEEDED TO FULLY FATHOM THIS EPOCHAL MOMENT IN HUMANKIND'S QUEST TO UNDERSTAND THE UNIVERSE.

DARK MATTER AND DARK ENERGY BRIAN CLEGG 2019-08-08 ALL THE MATTER AND LIGHT WE CAN SEE IN THE UNIVERSE MAKES UP A TRIVIAL 5 PER CENT OF EVERYTHING. THE REST IS HIDDEN. THIS COULD BE THE BIGGEST PUZZLE THAT SCIENCE HAS EVER FACED. SINCE THE 1970S, ASTRONOMERS HAVE BEEN AWARE THAT GALAXIES HAVE FAR TOO LITTLE MATTER IN THEM TO ACCOUNT FOR THE WAY THEY SPIN AROUND: THEY SHOULD FLY APART, BUT SOMETHING CONCEALED HOLDS THEM TOGETHER. THAT 'SOMETHING' IS DARK MATTER – INVISIBLE MATERIAL IN FIVE TIMES THE QUANTITY OF THE FAMILIAR STUFF OF STARS AND PLANETS. BY THE 1990S WE ALSO KNEW THAT THE EXPANSION OF THE UNIVERSE WAS ACCELERATING. SOMETHING, NAMED DARK ENERGY, IS PUSHING IT TO EXPAND FASTER AND FASTER. ACROSS THE UNIVERSE, THIS REQUIRES ENOUGH ENERGY THAT THE EQUIVALENT MASS WOULD BE NEARLY FOURTEEN TIMES GREATER THAN ALL THE VISIBLE MATERIAL IN EXISTENCE. BRIAN CLEGG EXPLAINS THIS MAJOR CONUNDRUM IN MODERN SCIENCE AND LOOKS AT HOW SCIENTISTS ARE BEGINNING TO FIND SOLUTIONS TO IT.

OUR UNIVERSE JO DUNKLEY 2019-04-08 JO DUNKLEY COMBINES HER EXPERTISE AS AN ASTROPHYSICIST WITH HER TALENTS AS A WRITER AND TEACHER TO PRESENT AN ELEGANT INTRODUCTION TO THE STRUCTURE, HISTORY, AND ENDURING MYSTERIES OF THE UNIVERSE. AMONG THE CUTTING-EDGE PHENOMENA DISCUSSED ARE THE ACCELERATING EXPANSION OF THE UNIVERSE AND THE POSSIBILITY THAT OUR UNIVERSE IS ONLY ONE OF MANY.

THE SCIENCE OF CAN AND CAN'T CHIARA MARLETTO 2021-05-04 A LUMINOUS GUIDE TO HOW THE RADICAL NEW SCIENCE OF COUNTERFACTUALS CAN REVEAL THAT THE SCOPE OF THE UNIVERSE IS GREATER, AND MORE BEAUTIFUL, THAN WE EVER IMAGINED THERE IS A VAST CLASS OF THINGS THAT SCIENCE HAS SO FAR ALMOST ENTIRELY NEGLECTED. THEY ARE CENTRAL TO THE UNDERSTANDING OF PHYSICAL REALITY BOTH AT AN EVERYDAY LEVEL AND AT THE LEVEL OF THE MOST FUNDAMENTAL PHENOMENA IN PHYSICS, YET HAVE TRADITIONALLY BEEN ASSUMED TO BE IMPOSSIBLE TO INCORPORATE INTO FUNDAMENTAL SCIENTIFIC EXPLANATIONS. THEY ARE FACTS NOT ABOUT WHAT IS (THE ACTUAL) BUT ABOUT WHAT COULD BE (COUNTERFACTUALS). ACCORDING TO PHYSICIST CHIARA MARLETTO, LAWS ABOUT THINGS BEING POSSIBLE OR IMPOSSIBLE MAY GENERATE AN ALTERNATIVE WAY OF PROVIDING EXPLANATIONS. THIS FASCINATING, FAR-REACHING APPROACH HOLDS PROMISE FOR REVOLUTIONIZING THE WAY FUNDAMENTAL PHYSICS IS FORMULATED AND FOR PROVIDING ESSENTIAL TOOLS TO FACE EXISTING TECHNOLOGICAL CHALLENGES—FROM DELIVERING THE NEXT GENERATION OF INFORMATION-PROCESSING DEVICES BEYOND THE UNIVERSAL QUANTUM COMPUTER TO DESIGNING AIs. EACH CHAPTER IN THE BOOK DELINEATES HOW AN EXISTING VEXED OPEN PROBLEM IN SCIENCE CAN BE SOLVED BY

THIS RADICALLY DIFFERENT APPROACH AND IT IS AUGMENTED BY SHORT FICTIONAL STORIES THAT EXPLICATE THE MAIN POINT OF THE CHAPTER. AS MARLETTO DEMONSTRATES, CONTEMPLATING WHAT IS POSSIBLE CAN GIVE US A MORE COMPLETE AND HOPEFUL PICTURE OF THE PHYSICAL WORLD.

A BRIEF WELCOME TO THE UNIVERSE NEIL deGRASSE TYSON 2021-09-07 A POCKET-STYLE EDITION BASED ON THE NEW YORK TIMES BESTSELLER A BRIEF WELCOME TO THE UNIVERSE OFFERS A BREATHTAKING TOUR OF THE COSMOS, FROM PLANETS, STARS, AND GALAXIES TO BLACK HOLES AND TIME LOOPS. BESTSELLING AUTHORS AND ACCLAIMED ASTROPHYSICISTS NEIL deGRASSE TYSON, MICHAEL A. STRAUSS, AND J. RICHARD GOTT TAKE READERS ON AN UNFORGETTABLE JOURNEY OF EXPLORATION TO REVEAL HOW OUR UNIVERSE ACTUALLY WORKS. PROPELLING YOU FROM OUR HOME SOLAR SYSTEM TO THE OUTERMOST FRONTIERS OF SPACE, THIS BOOK BUILDS YOUR COSMIC INSIGHT AND PERSPECTIVE THROUGH A MARVELOUSLY ENTERTAINING NARRATIVE. HOW DO STARS LIVE AND DIE? WHAT ARE THE PROSPECTS OF INTELLIGENT LIFE ELSEWHERE IN THE UNIVERSE? HOW DID THE UNIVERSE BEGIN? WHY IS IT EXPANDING AND ACCELERATING? IS OUR UNIVERSE ALONE OR PART OF AN INFINITE MULTIVERSE? EXPLORING THESE AND MANY OTHER QUESTIONS, THIS POCKET-FRIENDLY BOOK IS YOUR PASSPORT INTO THE WONDERS OF OUR EVOLVING COSMOS.

NEUTRINO MASS GUIDO ALTARELLI 2003-09-08 REVIEWS THE CURRENT STATE OF KNOWLEDGE OF NEUTRINO MASSES AND THE RELATED QUESTION OF NEUTRINO OSCILLATIONS. AFTER AN OVERVIEW OF THE THEORY OF NEUTRINO MASSES AND MIXINGS, DETAILED ACCOUNTS ARE GIVEN OF THE LABORATORY LIMITS ON NEUTRINO MASSES, ASTROPHYSICAL AND COSMOLOGICAL CONSTRAINTS ON THOSE MASSES, EXPERIMENTAL RESULTS ON NEUTRINO OSCILLATIONS, THE THEORETICAL INTERPRETATION OF THOSE RESULTS, AND THEORETICAL MODELS OF NEUTRINO MASSES AND MIXINGS. THE BOOK CONCLUDES WITH AN EXAMINATION OF THE POTENTIAL OF LONG-BASELINE EXPERIMENTS. THIS IS AN ESSENTIAL REFERENCE TEXT FOR WORKERS IN ELEMENTARY-PARTICLE PHYSICS, NUCLEAR PHYSICS, AND ASTROPHYSICS.

EINSTEIN AND THE QUANTUM A. DOUGLAS STONE 2015-10-06 EINSTEIN AND THE QUANTUM REVEALS FOR THE FIRST TIME THE FULL SIGNIFICANCE OF ALBERT EINSTEIN'S CONTRIBUTIONS TO QUANTUM THEORY. EINSTEIN FAMOUSLY REJECTED QUANTUM MECHANICS, OBSERVING THAT GOD DOES NOT PLAY DICE. BUT, IN FACT, HE THOUGHT MORE ABOUT THE NATURE OF ATOMS, MOLECULES, AND THE EMISSION AND ABSORPTION OF LIGHT--THE CORE OF WHAT WE NOW KNOW AS QUANTUM THEORY--THAN HE DID ABOUT RELATIVITY. A COMPELLING BLEND OF PHYSICS, BIOGRAPHY, AND THE HISTORY OF SCIENCE, EINSTEIN AND THE QUANTUM SHARES THE UNTOLD STORY OF HOW EINSTEIN--NOT MAX PLANCK OR NIELS BOHR--WAS THE DRIVING FORCE BEHIND EARLY QUANTUM THEORY. IT PAINTS A VIVID PORTRAIT OF THE ICONIC PHYSICIST AS HE GRAPPLED WITH THE APPARENTLY CONTRADICTORY NATURE OF THE ATOMIC WORLD, IN WHICH ITS INVISIBLE CONSTITUENTS DEFY THE CATEGORIES OF CLASSICAL PHYSICS, BEHAVING SIMULTANEOUSLY AS BOTH PARTICLE AND WAVE. AND IT DEMONSTRATES HOW EINSTEIN'S LATER WORK ON THE EMISSION AND ABSORPTION OF LIGHT, AND ON ATOMIC GASES, LED DIRECTLY TO ERWIN SCHRÖDINGER'S

BREAKTHROUGH TO THE MODERN FORM OF QUANTUM MECHANICS. THE BOOK SHEDS LIGHT ON WHY EINSTEIN ULTIMATELY RENOUNCED HIS OWN BRILLIANT WORK ON QUANTUM THEORY, DUE TO HIS DEEP BELIEF IN SCIENCE AS SOMETHING OBJECTIVE AND ETERNAL.

COME & GET IT! ROBERT DIRKS 2011 TRACING THE COURSE OF THE HISTORY OF COOKING AND DINING IN McLEAN COUNTY AND THE BLOOMINGTON-NORMAL AREA TAKES US BACK 180 YEARS. EARLY SETTLERS FROM THE SOUTHERN STATES AND PARTS OF THE NORTHEAST BROUGHT WITH THEM DIVERGENT TASTES, BUT IRRESPECTIVE OF THEIR CULINARY LEANINGS THEY GENERALLY MADE DO WITH FOODS THEY EITHER RAISED OR COLLECTED THEMSELVES. LATER ON, NEWCOMERS FROM IRELAND AND CONTINENTAL EUROPE ESTABLISHED HOMES IN VARIOUS PARTS OF THE COUNTY. AS A RESULT, AREA FOODWAYS INCREASED IN COMPLEXITY, AND A VARIETY OF NEW FOOD-RELATED INDUSTRIES DEVELOPED. RESIDENTS MADE BEER, CANDY, ICE CREAM, PICKLES, SAUSAGES, SODA WATER, AND VINEGAR. THEY MANUFACTURED STOVES AND REFRIGERATORS, MILLED FLOUR, BAKED VARIOUS TYPES OF BREAD, PACKED PORK, AND CANNED TOMATOES. BLOOMINGTON COMPANIES DISTRIBUTED PRODUCE AND GROCERIES THROUGHOUT CENTRAL ILLINOIS. STILL, MANY FAMILIES BEYOND THE CITY LIMITS PRODUCED AND PROCESSED NEARLY EVERYTHING THEY ATE AND ONLY OCCASIONALLY VISITED A GROCERY STORE. BY THE END OF THE SECOND MILLENNIUM IT WAS HARD TO FIND LOCALLY PRODUCED FOOD IN McLEAN COUNTY, LET ALONE PEOPLE WITH MANY FOOD-RELATED SKILLS. THE AREA'S TELEPHONE DIRECTORIES LISTED NO CHEESE SHOPS OR FISHMONGERS. SKILLED BUTCHERS AND BREAD BAKERS BARELY EXISTED. A COUPLE OF ARTISANAL CONFECTIONERS STILL HAD SHOPS IN BLOOMINGTON, BUT YOU COULD FORGET IT IF YOU WANTED TO BUY MILK FROM A LOCAL DAIRY. FINDING GROCERIES AND FRESH PRODUCE OUTSIDE OF A CHAIN SUPERMARKET WAS A CHALLENGE, NOT TO MENTION LOCATING A CHEF-OWNED RESTAURANT.

FIRST LIGHT EMMA CHAPMAN 2020-11-26 ASTRONOMERS HAVE SUCCESSFULLY OBSERVED A GREAT DEAL OF THE UNIVERSE'S HISTORY, FROM RECORDING THE AFTERGLOW OF THE BIG BANG TO IMAGING THOUSANDS OF GALAXIES, AND EVEN TO VISUALISING AN ACTUAL BLACK HOLE. THERE'S A LOT FOR ASTRONOMERS TO BE SMUG ABOUT. BUT WHEN IT COMES TO UNDERSTANDING HOW THE UNIVERSE BEGAN AND GREW UP WE ARE LITERALLY IN THE DARK AGES. IN EFFECT, WE ARE MISSING THE FIRST ONE BILLION YEARS FROM THE TIMELINE OF THE UNIVERSE. THIS BRIEF BUT FAR-REACHING PERIOD IN THE UNIVERSE'S HISTORY, KNOWN TO ASTROPHYSICISTS AS THE 'EPOCH OF REIONISATION', REPRESENTS THE START OF THE COSMOS AS WE EXPERIENCE IT TODAY. THE TIME WHEN THE VERY FIRST STARS BURST INTO LIFE, WHEN DARKNESS GAVE WAY TO LIGHT. AFTER HUNDREDS OF MILLIONS OF YEARS OF DARK, UNEVENTFUL EXPANSION, ONE BY THE ONE THESE STARS SUDDENLY CAME INTO BEING. THIS WAS THE POINT AT WHICH THE CHAOS OF THE BIG BANG FIRST BEGAN TO YIELD TO THE ORDER OF GALAXIES, BLACK HOLES AND STARS, KICK-STARTING THE PATHWAY TO PLANETS, TO COMETS, TO MOONS, AND TO LIFE ITSELF. INCORPORATING THE VERY LATEST RESEARCH INTO THIS BRANCH OF ASTROPHYSICS, THIS BOOK SHEDS LIGHT ON THIS TIME OF DARKNESS, TELLING THE STORY OF THESE FIRST STARS, HUNDREDS OF TIMES THE SIZE OF THE SUN AND A

MILLION TIMES BRIGHTER, LONELY GIANTS THAT LIVED FAST AND DIED YOUNG IN POWERFUL EXPLOSIONS THAT SEEDED THE UNIVERSE WITH THE HEAVY ELEMENTS THAT WE ARE MADE OF. EMMA CHAPMAN TELLS US HOW THESE STARS FORMED, WHY THEY WERE SO UNUSUAL, AND WHAT THEY CAN TEACH US ABOUT THE UNIVERSE TODAY. SHE ALSO OFFERS A FIRST-HAND LOOK AT THE IMMENSE TELESCOPES ABOUT TO COME ON LINE TO PEER INTO THE PAST, SEARCHING FOR THE ECHOES AND FOOTPRINTS OF THESE STARS, TO TAKE THIS PERIOD IN THE UNIVERSE'S HISTORY FROM THE REALM OF THEORETICAL PHYSICS TOWARDS THE WONDER OF OBSERVATIONAL ASTRONOMY.

THE AMAZING STORY OF QUANTUM MECHANICS JAMES KAKALIOS 2011-11-01 MOST OF US ARE UNAWARE OF HOW MUCH WE DEPEND ON QUANTUM MECHANICS ON A DAY-TO-DAY BASIS. USING ILLUSTRATIONS AND EXAMPLES FROM SCIENCE FICTION PULP MAGAZINES AND COMIC BOOKS, THE AMAZING STORY OF QUANTUM MECHANICS EXPLAINS THE FUNDAMENTAL PRINCIPLES OF QUANTUM MECHANICS THAT UNDERLIE THE WORLD WE LIVE IN. WATCH A VIDEO

CALCULATING THE COSMOS IAN STEWART 2016-10-25 A PRIZE-WINNING POPULAR SCIENCE WRITER USES MATHEMATICAL MODELING TO EXPLAIN THE COSMOS. IN CALCULATING THE COSMOS, IAN STEWART PRESENTS AN EXHILARATING GUIDE TO THE COSMOS, FROM OUR SOLAR SYSTEM TO THE ENTIRE UNIVERSE. HE DESCRIBES THE ARCHITECTURE OF SPACE AND TIME, DARK MATTER AND DARK ENERGY, HOW GALAXIES FORM, WHY STARS IMplode, HOW EVERYTHING BEGAN, AND HOW IT'S ALL GOING TO END. HE CONSIDERS PARALLEL UNIVERSES, THE FINE-TUNING OF THE COSMOS FOR LIFE, WHAT FORMS EXTRATERRESTRIAL LIFE MIGHT TAKE, AND THE LIKELIHOOD OF LIFE ON EARTH BEING SNUFFED OUT BY AN ASTEROID. BEGINNING WITH THE BABYLONIAN INTEGRATION OF MATHEMATICS INTO THE STUDY OF ASTRONOMY AND COSMOLOGY, STEWART TRACES THE EVOLUTION OF OUR UNDERSTANDING OF THE COSMOS: HOW KEPLER'S LAWS OF PLANETARY MOTION LED NEWTON TO FORMULATE HIS THEORY OF GRAVITY. HOW, TWO CENTURIES LATER, TINY IRREGULARITIES IN THE MOTION OF MARS INSPIRED EINSTEIN TO DEVISE HIS GENERAL THEORY OF RELATIVITY. HOW, EIGHTY YEARS AGO, THE DISCOVERY THAT THE UNIVERSE IS EXPANDING LED TO THE DEVELOPMENT OF THE BIG BANG THEORY OF ITS ORIGINS. HOW SINGLE-POINT ORIGIN AND EXPANSION LED COSMOLOGISTS TO THEORIZE NEW COMPONENTS OF THE UNIVERSE, SUCH AS INFLATION, DARK MATTER, AND DARK ENERGY. BUT DOES INFLATION EXPLAIN THE STRUCTURE OF TODAY'S UNIVERSE? DOES DARK MATTER ACTUALLY EXIST? COULD A SCIENTIFIC REVOLUTION THAT WILL CHALLENGE THE LONG-HELD SCIENTIFIC ORTHODOXY AND ONCE AGAIN TRANSFORM OUR UNDERSTANDING OF THE UNIVERSE BE ON THE WAY? IN AN EXCITING AND ENGAGING STYLE, CALCULATING THE COSMOS IS A MATHEMATICAL QUEST THROUGH THE INTRICATE REALMS OF ASTRONOMY AND COSMOLOGY.

Cosmic Cocktail KATHERINE FREESE

AT THE EDGE OF TIME DAN HOOPER 2021-04-06 A NEW LOOK AT THE FIRST FEW SECONDS AFTER THE BIG BANG—AND HOW RESEARCH INTO THESE MOMENTS CONTINUES TO REVOLUTIONIZE OUR UNDERSTANDING OF OUR UNIVERSE SCIENTISTS IN RECENT DECADES HAVE

MADE CRUCIAL DISCOVERIES ABOUT HOW OUR COSMOS EVOLVED OVER THE PAST 13.8 BILLION YEARS. BUT WE STILL KNOW LITTLE ABOUT WHAT HAPPENED IN THE FIRST SECONDS AFTER THE BIG BANG. AT THE EDGE OF TIME FOCUSES ON WHAT WE HAVE LEARNED AND ARE STRIVING TO UNDERSTAND ABOUT THIS MYSTERIOUS PERIOD AT THE BEGINNING OF COSMIC HISTORY. DELVING INTO THE REMARKABLE SCIENCE OF COSMOLOGY, DAN HOOPER DESCRIBES MANY OF THE EXTRAORDINARY QUESTIONS THAT SCIENTISTS ARE ASKING ABOUT THE ORIGIN AND NATURE OF OUR WORLD. HOOPER EXAMINES HOW THE LARGE HADRON COLLIDER AND OTHER EXPERIMENTS RE-CREATE THE CONDITIONS OF THE BIG BANG, HOW WE MAY FINALLY DISCOVER THE WAY DARK MATTER WAS FORMED DURING OUR UNIVERSE'S FIRST MOMENTS, AND HOW, WITH NEW TELESCOPES, WE ARE LIFTING THE VEIL ON THE ERA OF COSMIC INFLATION. AT THE EDGE OF TIME PRESENTS AN ACCESSIBLE INVESTIGATION OF OUR UNIVERSE AND ITS BIRTH.

THE COSMIC COCKTAIL KATHERINE FREESE 2014-05-04 THE INSIDE STORY OF THE EPIC QUEST TO SOLVE THE MYSTERY OF DARK MATTER THE ORDINARY ATOMS THAT MAKE UP THE KNOWN UNIVERSE—FROM OUR BODIES AND THE AIR WE BREATHE TO THE PLANETS AND STARS—CONSTITUTE ONLY 5 PERCENT OF ALL MATTER AND ENERGY IN THE COSMOS. THE REST IS KNOWN AS DARK MATTER AND DARK ENERGY, BECAUSE THEIR PRECISE IDENTITIES ARE UNKNOWN. THE COSMIC COCKTAIL IS THE INSIDE STORY OF THE EPIC QUEST TO SOLVE ONE OF THE MOST COMPELLING ENIGMAS OF MODERN SCIENCE—WHAT IS THE UNIVERSE MADE OF?—TOLD BY ONE OF TODAY'S FOREMOST PIONEERS IN THE STUDY OF DARK MATTER. BLENDING CUTTING-EDGE SCIENCE WITH HER OWN BEHIND-THE-SCENES INSIGHTS AS A LEADING RESEARCHER IN THE FIELD, ACCLAIMED THEORETICAL PHYSICIST KATHERINE FREESE RECOUNTS THE HUNT FOR DARK MATTER, FROM THE DISCOVERIES OF VISIONARY SCIENTISTS LIKE FRITZ ZWICKY—THE SWISS ASTRONOMER WHO COINED THE TERM "DARK MATTER" IN 1933—TO THE DELUGE OF DATA TODAY FROM UNDERGROUND LABORATORIES, SATELLITES IN SPACE, AND THE LARGE HADRON COLLIDER. THEORISTS CONTEND THAT DARK MATTER CONSISTS OF FUNDAMENTAL PARTICLES KNOWN AS WIMPS, OR WEAKLY INTERACTING MASSIVE PARTICLES. BILLIONS OF THEM PASS THROUGH OUR BODIES EVERY SECOND WITHOUT US EVEN REALIZING IT, YET THEIR GRAVITATIONAL PULL IS CAPABLE OF WHIRLING STARS AND GAS AT BREAKNECK SPEEDS AROUND THE CENTERS OF GALAXIES, AND BENDING LIGHT FROM DISTANT BRIGHT OBJECTS. FREESE DESCRIBES THE LARGER-THAN-LIFE CHARACTERS AND CLASHING PERSONALITIES BEHIND THE RACE TO IDENTIFY THESE ELUSIVE PARTICLES. MANY COSMOLOGISTS BELIEVE WE ARE ON THE VERGE OF SOLVING THE MYSTERY. THE COSMIC COCKTAIL PROVIDES THE FOUNDATION NEEDED TO FULLY FATHOM THIS EPOCHAL MOMENT IN HUMANKIND'S QUEST TO UNDERSTAND THE UNIVERSE.

THE LARGE HADRON COLLIDER DON LINCOLN 2020-09-29 AS ACCESSIBLE AS IT IS FASCINATING, THE LARGE HADRON COLLIDER REVEALS THE INNER WORKINGS OF THIS MASTERFUL ACHIEVEMENT OF TECHNOLOGY, ALONG WITH THE MIND-BLOWING DISCOVERIES THAT WILL KEEP IT AT THE CENTER OF THE SCIENTIFIC FRONTIER FOR THE FORESEEABLE FUTURE.

THE COSMIC COCKTAIL KATHERINE FREESE 2014 BLENDING CUTTING-EDGE SCIENCE WITH HER OWN BEHIND-THE-SCENES INSIGHTS AS A LEADING RESEARCHER IN THE FIELD, ACCLAIMED THEORETICAL PHYSICIST KATHERINE FREESE RECOUNTS THE HUNT FOR DARK MATTER, FROM THE DISCOVERIES OF VISIONARY SCIENTISTS LIKE FRITZ ZWICKY--THE SWISS ASTRONOMER WHO COINED THE TERM "DARK MATTER" IN 1933--TO THE DELUGE OF DATA TODAY FROM UNDERGROUND LABORATORIES, SATELLITES IN SPACE, AND THE LARGE HADRON COLLIDER.

EINSTEIN'S TELESCOPE: THE HUNT FOR DARK MATTER AND DARK ENERGY IN THE UNIVERSE EVALYN GATES 2010-02-22 "SPLENDIDLY SATISFYING READING, DESIGNED FOR A NONSPECIALIST AUDIENCE."—KIRKUS REVIEWS, STARRED REVIEW EVALYN GATES, A

TALENTED ASTROPHYSICIST, TRANSPORTS READERS TO THE EDGE OF CONTEMPORARY SCIENCE TO EXPLORE THE REVOLUTIONARY TOOL—"EINSTEIN'S TELESCOPE"—THAT IS UNLOCKING THE SECRETS OF THE UNIVERSE. EINSTEIN'S TELESCOPE, OR GRAVITATIONAL LENSING, IS SO-CALLED FOR THE WAY GRAVITY CAUSES SPACE TO DISTORT AND ALLOW MASSIVE OBJECTS TO ACT LIKE "LENSES," AMPLIFYING AND DISTORTING THE IMAGES OF OBJECTS BEHIND THEM. BY ALLOWING FOR THE DETECTION OF MASS WHERE NO LIGHT IS FOUND, SCIENTISTS CAN MAP OUT THE DISTRIBUTION OF DARK MATTER AND COME A STEP CLOSER TO TEASING OUT THE EFFECTS OF DARK ENERGY ON THE UNIVERSE—WHICH MAY FOREVER UPEND LONG-HELD NOTIONS ABOUT WHERE THE UNIVERSE CAME FROM AND WHERE IT IS GOING.