Kakalios

Twenty-four years ago, Hellmut Fritzsche came to our laboratory to evaluate our work in amorphous materials. He came many times, sometimes bringing his violin to play with our youngest son, to talk, to help, to discover, and to teach. The times with him were always exciting and rewarding. There was a camaraderie in the early years that has continued and a friendship that has deepened among Iris and me and Hellmut, Sybille and their children. The vision that Hellmut Fritzsche shared with me, the many important contributions he made, the science that he helped so firmly to establish, the courage he showed in the time of our adversity, and the potential that he recognized put all of us in the amorphous field, not only his close friends and collaborators, in his debt. He helped make a science out of intuition, and played an important role not only in the experimental field but also in the basic theoretical aspects. It has been an honor to work with Hellmut through the years.

This Festschrift is an outgrowth of a collection of papers presented as a conference in honor of Professor Heinz K. Henisch on his sixty-fifth birthday held at the Institute for Amorphous Studies. Bloomfield Hills. Michigan. It is our great pleasure to be editors of the Festschrift volume to honor Heinz and his work.

Professor Henisch has a long and distinguished career and has many accomplishments in semiconductor materials and devices. He has made seminal contributions to the understanding of semiconductor switching devices and contact properties. He has an outstandin~ reputation as an expositor of science. His seminars and lectures are always deep. lucid and witty. He received his doctorate in Physics from the University of Reading and then joined the faculty. In 1963. he accepted a position in the Department of Physics at Pennsylvania State University. While at Penn State. Dr. Henisch broadened his research interest to include the History of Photography. At the present time. Dr. Henisch holds parallel appointments as a Professor of Physics and a Professor of the History of Photography at Pennsylvania State University. He is a Fellow of the American Physical Society. the Institute of Physics. London. the Royal Photographic society and is a Corresponding Member of the Deutsche Gesellschaft fur Photographie. In addition to his considerable publication in the fields of physics and the history of photography. Dr. Henisch is the founder and editor of the Journal of the History of Photography published quarterly by Taylor and Francis. Ltd .. London.

"Presentations of the 'Symposium on Photovoltaics for the 21st Century II' ... part of the 199th Meeting of the Electrochemical Society held in Washington, D.C. in

March 2001"--Pref.

This volume is the proceedings of the NATO Advanced Study Institute, "Diffusion in Materials", held at "Centre Paul Langevin", Aussois, during March 12-25, 1989. There were 105 participants of whom 24 were lecturers and members of the international advisory committee. In addition to the participants from NATO countries, a small number of participants came from Australia, Hungary, Poland and Tunisia. The principal aim of the organizing committee was to bring together scientists of wide interest and expertise in the field of diffusion and to familiarize the young workers in material science with the wide range of theoretical models and methods and of experimental techniques . The Institute was concerned with the study of diffusion and related phenomena in solids which are at the cutting edge of novel technologies. The discussion of basic theories of defects in solids and their transport, with their applications in the understanding of diffusion processes in "simple solids" was followed by the wide range of current theoretical models and methods, experimental techniques and their potential. The lectures on the diffusion in specific materials included : metals, dilute and concentrated alloys, simple and compound semiconductors, stoichiometric and non-stoichiometric oxides, high-Tc compounds, carbides, nitrides, silicates, conducting polymers and thin films, ionic, superionic, amorphous and irradiated

materials.

A short and entertaining introduction to thermodynamics that uses real-world examples to explain accessibly an important but subtle scientific theory A romantic description of the second law of thermodynamics is that the universe becomes increasingly disordered. But what does that actually mean? Starting with an overview of the three laws of thermodynamics, MacArthur "genius grant" winner R. Stephen Berry explains in this short book the fundamentals of a fundamental science. Readers learn both the history of thermodynamics, which began with attempts to solve everyday engineering problems, and ongoing controversy and unsolved puzzles. The exposition, suitable for both students and armchair physicists, requires no previous knowledge of the subject and only the simplest mathematics, taught as needed. With this better understanding of one science, readers also gain an appreciation of the role of research in science, the provisional nature of scientific theory, and the ways scientific exploration can uncover fundamental truths. Thus, from a science of everyday experience, we learn about the nature of the universe.

A guide to America's weather features full-color graphics from "USA Today" and discussions of hurricanes, blizzards, heat waves, cold fronts, tornadoes and draughts

Explains the principles of relativity, profiling leading minds such as Albert Einstein, Brian Greene, and Stephen Hawking to simplify their theories on time dilation, extra dimensions, and relative motion.

Exploring the science in George R. R. Martin's fantastical world, from the physics of an ice wall to the genetics of the Targaryens and Lannisters. Game of Thrones is a fantasy that features a lot of made-up science—fabricated climatology (when is winter coming?), astronomy, metallurgy, chemistry, and biology. Most fans of George R. R. Martin's fantastical world accept it all as part of the magic. A trained scientist, watching the fake science in Game of Thrones, might think, “But how would it work?” In Fire, Ice, and Physics, Rebecca Thompson turns a scientist's eye on Game of Thrones, exploring, among other things, the science of an ice wall, the genetics of the Targaryen and Lannister families, and the biology of beheading. Thompson, a PhD in physics and an enthusiastic Game of Thrones fan, uses the fantasy science of the show as a gateway to some interesting real science, introducing GOT fandom to a new dimension of appreciation. Thompson starts at the beginning, with winter, explaining seasons and the very elliptical orbit of the Earth that might cause winter to come (or not come). She tells us that ice can behave like ketchup, compares regular steel to Valyrian steel, explains that dragons are “bats, but with fire,” and considers Targaryen inbreeding. Finally she offers scientific explanations of the various types of fatal justice meted out, including beheading, hanging, poisoning (reporting that the effects of “the Strangler,”

administered to Joffrey at the Purple Wedding, resemble the effects of strychnine), skull crushing, and burning at the stake. Even the most faithful Game of Thrones fans will learn new and interesting things about the show from Thompson's entertaining and engaging account. Fire, Ice, and Physics is an essential companion for all future bingeing.

"Explanations about the extraordinary physics that invisibly guides our daily lives"--

Amorphous Metals and Semiconductors contains the proceedings of an international workshop held at Coronado, California, USA on May 12-18, 1985. Organized into five parts, this book first looks into the historical perspective on semiconductors and metals. This book then explains the glass formation, magnetic glasses, and amorphous semiconductors. The mechanical and chemical properties of these materials are also given.

An exploration of the science behind the powers of popular comic superheroes and villains illustrates the physics principles underlying the supernatural abilities of such characters as Superman, Magneto, and Spider-Man.

Your alarm goes off, and you head to the kitchen to make yourself some toast and a cup of coffee. Little do you know, as you savor the aroma of the steam rising from your cup, that your ordinary morning routine depends on some of the weirdest phenomena ever discovered. The world of quantum physics is generally thought of as hopelessly esoteric. While classical physics gives us the laws governing why a ball rolls downhill,

how a plane is able to fly, and so on, its quantum cousin gives us particles that are actually waves, "spooky" action at a distance, and Schrodinger's unlucky cat. But, believe it or not, even the most mundane of everyday activities is profoundly influenced by the abstract and exotic world of the quantum. In Breakfast with Einstein, Chad Orzel illuminates the strange phenomena lurking just beneath the surface of our ordinary lives by digging into the surprisingly complicated physics involved in his (and anyone's) morning routine. Orzel, author of How to Teach Quantum Physics to Your Dog, explores how quantum connects with everyday reality, and offers engaging, layperson-level explanations of the mind-bending ideas central to modern physics. From the sun, alarm clocks, and the red glow of a toaster's hot filaments (the glow that launched quantum mechanics) to the chemistry of food aroma, a typical day is rich with examples of quantum weirdness. Breakfast with Einstein reveals the hidden physics all around us, and after reading this book, your ordinary mornings will never seem quite as ordinary again.

Graph grammars originated in the late 60s, motivated by considerations about pattern recognition and compiler construction. Since then, the list of areas which have interacted with the development of graph grammars has grown quite impressively. Besides the aforementioned areas, it includes software specification and development, VLSI layout schemes, database design, modeling of concurrent systems, massively parallel computer architectures, logic programming, computer animation,

developmental biology, music composition, visual languages, and many others.The area of graph grammars and graph transformations generalizes formal language theory based on strings and the theory of term rewriting based on trees. As a matter of fact, within the area of graph grammars, graph transformation is considered as a fundamental computation paradigm where computation includes specification, programming, and implementation. Over the last three decades, graph grammars have developed at a steady pace into a theoretically attractive and important-for-applications research field.Volume 2 of the indispensable Handbook of Graph Grammars and Computing by Graph Transformations considers applications to functional languages, visual and object-oriented languages, software engineering, mechanical engineering, chemical process engineering, and images. It also presents implemented specification languages and tools, and structuring and modularization concepts for specification languages. The contributions have been written in a tutorial/survey style by the top experts in the corresponding areas. This volume is accompanied by a CD-Rom containing implementations of specification environments based on graph transformation systems, and tools whose implementation is based on the use of graph transformation systems.

Hydrogen plays an important role in silicon technology, having a profound effect on a wide range of properties. Thus, the study of hydrogen in semiconductors has received much attention from an interdisciplinary assortment of researchers. This sixteen-

chapter volume provides a comprehensive review of the field, including a discussion of hydrogenation methods, the use of hydrogen to passivate defects, the use of hydrogen to neutralize deep levels, shallow acceptors and shallow donors in silicon, vibrational spectroscopy, and hydrogen-induced defects in silicon. In addition to this detailed coverage of hydrogen in silicon, chapters are provided that discuss hydrogen-related phenomena in germanium and the neutralization of defects and dopants in III*b1V semiconductors. Provides the most in-depth coverage of hydrogen in silicon available in a single source**Includes an extensive chapter on the neutralization of defects in III*b1V semiconductors**Combines both experimental and theoretical studies to form a comprehensive reference

The first-ever full reckoning with Marvel Comics' interconnected, half-million-page story, a revelatory guide to the "epic of epics"—and to the past sixty years of American culture—from a beloved authority on the subject who read all 27,000+ Marvel superhero comics and lived to tell the tale The superhero comic books that Marvel Comics has published since 1961 are, as Douglas Wolk notes, the longest continuous, self-contained work of fiction ever created: over half a million pages to date, and still growing. The Marvel story is a gigantic mountain smack in the middle of contemporary culture. Thousands of writers and artists have contributed to it. Everyone recognizes its protagonists: Spider-Man, the Avengers, the X-Men. Eighteen of the hundred highest-grossing movies of all time are based on parts of it. Yet not even the people telling the

story have read the whole thing—nobody's supposed to. So, of course, that's what Wolk did: he read all 27,000+ comics that make up the Marvel Universe thus far, from Alpha Flight to Omega the Unknown. And then he made sense of it—seeing into the ever-expanding story, in its parts and as a whole, and seeing through it, as a prism through which to view the landscape of American culture. In Wolk's hands, the mammoth Marvel narrative becomes a fun-house-mirror history of the past sixty years, from the atomic night terrors of the Cold War to the technocracy and political division of the present day—a boisterous, tragicomic, magnificently filigreed epic about power and ethics, set in a world transformed by wonders. As a work of cultural exegesis, this is sneakily significant, even a landmark; it's also ludicrously fun. Wolk sees fascinating patterns—the rise and fall of particular cultural aspirations, and of the storytelling modes that conveyed them. He observes the Marvel story's progressive visions and its painful stereotypes, its patches of woeful hackwork and stretches of luminous creativity, and the way it all feeds into a potent cosmology that echoes our deepest hopes and fears. This is a huge treat for Marvel fans, but it's also a revelation for readers who don't know Doctor Strange from Doctor Doom. Here, truly, are all of the marvels.

A complete update to the hit book on the real physics at work in comic books, featuring more heroes, more villains, and more science Since 2001, James Kakalios has taught "Everything I Needed to Know About Physics I Learned from Reading Comic Books," a hugely popular university course that generated coast-to-coast media attention for its

unique method of explaining complex physics concepts through comics. With The Physics of Superheroes, named one of the best science books of 2005 by Discover, he introduced his colorful approach to an even wider audience. Now Kakalios presents a totally updated, expanded edition that features even more superheroes and findings from the cutting edge of science. With three new chapters and completely revised throughout with a splashy, redesigned package, the book that explains why Spider-Man's webbing failed his girlfriend, the probable cause of Krypton's explosion, and the Newtonian physics at work in Gotham City is electrifying from cover to cover.

This book presents the most recent important ideas and developments in the field of Hydrogenated Amorphous Silicon and related materials. Each contribution is authored by an outstanding expert in that particular area. Contents:Structural Aspects:Structural Heterogeneities in Device-Quality Amorphous Hydrogenated Semiconductors (J A Reimer & M A Petrich)Local Structure of Dopants in Hydrogenated Amorphous Silicon (J B Boyce & S E Ready)Plasma Deposition of Amorphous and Crystalline Silicon: The Effect of Hydrogen on the Growth, Structure Electronic Properties (C C Tsai)Defects and Defect Dynamics:Thermal Equilibrium Effects in Doped Hydro-genated Amorphous Silicon (J Kakalios & R A Street)Kinetics of Carrier-Induced Metastable Defect Formation in Hydrogen Amorphous Silicon (W B Jackson & J Kakalios)Transient Photocapacitance Studies of Deep Defect Transitions in Hydrogenated Amorphous Silicon (J D Cohen & A V Gelatos)The Microscopic Structure of Defects in a-Si:H and

Related Materials (M Stutzmann & D K Biegelsen)Electronic Transport, Trapping and Recombination:Transport and Tail State Interactions in Amorphous Silicon (W E Spear)Recombination in a-Si:H — Temperature and Field Quenching of the Photoluminescence (W Fuhs & K Jahn)Photo-luminescence in a-Si:H Films and Multilayers (W-C Wang & H Fritzsche)Amorphous Si-Ge Alloys:Optoelectronic Properties and the Gap State Distribution in a-Si, Ge Alloys (S Aljishi et al.)Multilayers and Interfaces:Differential Absorption Spectroscopy on Amorphous Silicon Quantum Well Structures (K Hattori et al.)Growth and Structure of Interfaces in a-Si:H/a-SiOx and a-Si:H/a-SiNx:H Multilayers and Heterojunctions (L Yang & B Abeles)and others Readership: Solid state physicists and electrical engineers.

A fun foray of escapism grounded in sound science, Becoming Batman provides the background for attaining the realizable—though extreme—level of human performance that would allow you to be a superhero.

The award-winning "Ask a Physicist" columnist for io9.com explains how space, time and everything in between are shaped by hidden symmetries that have driven recent discoveries about the universe, sharing narrative and accessible coverage of genius Holocaust escapee Emmy Noether and her critical theorem.

The International Conference on Noise in Physical Systems and 1/f Fluctuations brings together physicists and engineers interested in all aspects of noise and fluctuations in materials, devices, circuits, and physical and biological systems. The experimental research on novel devices and systems and the theoretical studies included in this volume provide the

reader with a comprehensive, in-depth treatment of present noise research activities worldwide. Contents: Noise in Nanoscale Devices (S Bandyopadhyay et al.); 1/f Voltage Noise Induced by Magnetic Flux Flow in Granular Superconductors (O V Gerashchenko); Low Frequency Noise Analysis of Different Types of Polysilicon Resistors (A Penarier et al.); Low Frequency Noise in CMOS Transistors: An Experimental and Comparative Study on Different Technologies (P Fantini et al.); Modeling of Current Transport and 1/f Noise in GaN Based HBTs (H Unlu); Low Frequency Noise in CdSe Thin Film Transistors (M J Deen & S Rumyanstsev); NIST Program on Relative Intensity Noise Standards for Optical Fiber Sources Near 1550 nm (G Obarski); Physical Model of the Current Noise Spectral Density Versus Dark Current in CdTe Detectors (A Imad et al.); Time and Frequency Study of RTS in Bipolar Transistors (A Penarier et al.); Neural Network Based Adaptive Processing of Electrogastrogram (S Selvan); Shot Noise as a Test of Entanglement and Nonlocality of Electrons in Mesoscopic Systems (E V Sukhorukov et al.); The Readout of Time, Continued Fractions and 1/f Noise (M Planat & J Cresson); Longitudinal and Transverse Noise of Hot Electrons in 2DEG Channels (J Liberis et al.); 1/f Noise, Intermittency and Clustering Poisson Process (F Gruneis); Noise Modeling for PDE Based Device Simulations (F Bonani & G Ghione); Methods of Slope Estimation of Noise Power Spectral Density (J Smulko); and other papers. Readership: Researchers, academics and graduate students in electrical and electronic engineering, biophysics, nanoscience, applied physics, statistical physics and semiconductor science.

Much has been learned about the subject of noise and random fluctuations over the last 170 years (some old milestones: Brownian motion, 1826; Einstein's diffusion theory, 1905; Johnson-

Nyquist thermal noise, 1926), but much remains to be known. This volume will be interesting reading for physicists, engineers, mathematicians, biologists and PhD students. The invited papers in the volume survey classical unsolved problems while the regular papers present new problems and paradoxes.

This scientific work focuses on computer-aided computational models in architecture. The author initially investigates established computational models and then expands these with newer approaches to modeling. In his research the author integrates approaches to analytical philosophy, probability theory, formal logic, quantum physics, abstract algebra, computer-aided design, computer graphics, glossematics, machine learning, architecture, and others. For researchers in the fields of information technology and architecture.

Filled with entertaining history, archival images, pop culture ephemera, and interviews with NASA scientists, The Big Book of Mars is the most comprehensive look at our relationship with Mars—yesterday, today, and tomorrow. Mars has been a source of fascination and speculation ever since the Ancient Sumerians observed its blood-red hue and named it for their god of war and plague. But it wasn't until 1877, when "canals" were observed on the surface of the Red Planet, suggesting the presence of water, that scientists, novelists, filmmakers, and entrepreneurs became obsessed with the question of whether there's life on Mars. In The War of the Worlds, H.G. Wells suggested that we wouldn't need to make contact with Martians—they'd come for us—while, many years later, Nikola Tesla claimed that he did make contact. Since then, Mars has fully invaded pop culture. It has its own day of the week (Tuesday, or martis in Latin), candy bar, and iconic Looney Tunes character. It has been the subject of novels and movies, from Ray Bradbury's The Martian Chronicles to Mars Attacks! to

The Martian. And it has sparked a space-race feud between Elon Musk and Jeff Bezos, who both hope to send a manned mission to Mars in the near future.

Physics professor, bestselling author, and dynamic storyteller James Kakalios reveals the mind-bending science behind the seemingly basic things that keep our daily lives running, from our smart phones and digital “clouds” to x-ray machines and hybrid vehicles. Most of us are clueless when it comes to the physics that makes our modern world so convenient. What’s the simple science behind motion sensors, touch screens, and toasters? How do we glide through tolls using an E-Z Pass, or find our way to new places using GPS? In The Physics of Everyday Things, James Kakalios takes us on an amazing journey into the subatomic marvels that underlie so much of what we use and take for granted. Breaking down the world of things into a single day, Kakalios engages our curiosity about how our refrigerators keep food cool, how a plane manages to remain airborne, and how our wrist fitness monitors keep track of our steps. Each explanation is coupled with a story revealing the interplay of the astonishing invisible forces that surround us. Through this “narrative physics,” The Physics of Everyday Things demonstrates that—far from the abstractions conjured by terms like the Higgs Boson, black holes, and gravity waves—sophisticated science is also quite practical. With his signature clarity and inventiveness, Kakalios ignites our imaginations and enthralls us with the principles that make up our lives.

“YOU HAVE CHANGED MY LIFE” is a common refrain in the emails Walter Lewin receives daily from fans who have been enthralled by his world-famous video lectures about the wonders of physics. “I walk with a new spring in my step and I look at life through physics-colored eyes,” wrote one such fan. When Lewin’s lectures were made available online, he

became an instant YouTube celebrity, and The New York Times declared, “Walter Lewin delivers his lectures with the panache of Julia Child bringing French cooking to amateurs and the zany theatricality of YouTube’s greatest hits.” For more than thirty years as a beloved professor at the Massachusetts Institute of Technology, Lewin honed his singular craft of making physics not only accessible but truly fun, whether putting his head in the path of a wrecking ball, supercharging himself with three hundred thousand volts of electricity, or demonstrating why the sky is blue and why clouds are white. Now, as Carl Sagan did for astronomy and Brian Green did for cosmology, Lewin takes readers on a marvelous journey in For the Love of Physics, opening our eyes as never before to the amazing beauty and power with which physics can reveal the hidden workings of the world all around us. “I introduce people to their own world,” writes Lewin, “the world they live in and are familiar with but don’t approach like a physicist—yet.” Could it be true that we are shorter standing up than lying down? Why can we snorkel no deeper than about one foot below the surface? Why are the colors of a rainbow always in the same order, and would it be possible to put our hand out and touch one? Whether introducing why the air smells so fresh after a lightning storm, why we briefly lose (and gain) weight when we ride in an elevator, or what the big bang would have sounded like had anyone existed to hear it, Lewin never ceases to surprise and delight with the extraordinary ability of physics to answer even the most elusive questions. Recounting his own exciting discoveries as a pioneer in the field of X-ray astronomy—arriving at MIT right at the start of an astonishing revolution in astronomy—he also brings to life the power of physics to reach into the vastness of space and unveil exotic uncharted territories, from the marvels of a supernova explosion in the Large Magellanic Cloud to the unseeable depths of black holes.

“For me,” Lewin writes, “physics is a way of seeing—the spectacular and the mundane, the immense and the minute—as a beautiful, thrillingly interwoven whole.” His wonderfully inventive and vivid ways of introducing us to the revelations of physics impart to us a new appreciation of the remarkable beauty and intricate harmonies of the forces that govern our lives.

This is a useful textbook for graduate students in the fields of solid state physics and chemistry as well as electronic engineering. Presenting the fundamentals of amorphous semiconductors clearly, it will be essential reading for young scientists intending to develop new preparation techniques for more ideal amorphous semiconductors e.g. a-Si:H, to fabricate stable and efficient solar cells and thin film transistors and new artificial amorphous materials such as multilayers for quantum devices.A large portion is devoted to the latest developments of amorphous semiconductors including electronic properties of a-Si:H, nature of weak bonds and gap states in a-Si:H, mechanisms for light-induced defect creation in a-Si:H and chalcogenides, quantum phenomena in multilayer films.

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

The Physics of SuperheroesAvery

Science meets fantasy in this behind-the-scenes look at the Marvel Cinematic Universe—now you can experience the magic of the movies, and learn how to replicate it in real-life. The Marvel Cinematic Universe is filled with extraordinary humans and abilities. There are teenaged geniuses swinging through the streets of New York, billionaires creating

impenetrable armor in hidden caves, and aliens flying through wormholes to Earth. All of these characters seem to lie firmly in the realm of fantasy—but the technology behind them might not be as farfetched as you think… The Science of Marvel pulls back the curtain and reveals the secrets behind Marvel movie magic, and shows us how to recreate these comic book wonders in our everyday life. Using quantum physics, a little bit of mechanical engineering, and some out-of-the-box thinking, you'll be amazed to discover that it's possible to create a real-life Captain America, Incredible Hulk, or Black Panther. The perfect gift or collectible for Marvel fans everywhere, The Science of Marvel brings beloved movies and characters to life like never before.