Professor Werner S. Weiglhofer (1962–2003)

David R. Fearn

Professor Werner Weiglhofer of the Department of Mathematics, University of Glasgow, died on January 12, 2003, aged 40. He was struck down by an avalanche while snowshoeing alone on the slopes of Bispens, in the Trollstigen area of Norway, about 350 kilometers (220 miles) northwest of Oslo. The alarm was sounded later that day when he failed to return as expected. A search and rescue team found his body the next day, the day he had been scheduled to fly back to Glasgow. He had been on a week’s holiday to an area he knew very well.

The news of his untimely death came as a tremendous shock to all of his friends and colleagues, and tributes came in from all over the world. His is a tremendous loss to the University of Glasgow, and he will be sadly missed. He is survived by his parents Erich and Heide in Austria; he was their only child.

Since we heard the tragic news, I have talked to many people about Werner. We all have our personal memories and stories to tell, and I have been struck by the warmth and affection with which he is remembered by so many. It has been comforting to hear the stories that might not otherwise have been related. I have learned much I hadn’t previously known about Werner. There is so much to tell.

Born on 25 August 1962 in Bruck an der Mur, Steiermark, Austria, Werner obtained a doctorate in technical sciences from the Technical University of Graz in 1986. A prestigious Australian–European Fellowship then took him to the University of Adelaide. My own memories go back to May 1988, when Werner arrived in Glasgow to take up a three-year Research Assistant position, to work with me on a project investigating the stability of the Earth’s magnetic field. A car journey to a conference in Cambridge three days after he arrived gave me an early opportunity to hear about his enthusiasms. He had just returned from a year in Australia via a conference in China. We heard about river-rafting in Tasmania and the Australian grand prix in Adelaide.

At the end of his postdoc, Werner was successful in being appointed to a Lectureship in Applied Mathematics in Glasgow. Freed from the constraints of a research project, he quickly developed as an independent researcher, returning to the field he had learned as a postgraduate student: electromagnetics of complex materials. He developed a collaboration and very close friendship with Akhlesh Lakhtakia.
of The Pennsylvania State University. The collaboration was extraordinarily productive, and Lakhtakia & Weigloher papers became a very prominent feature of the Department of Mathematics preprint list. Werner’s growing status was recognised through promotion to Senior Lecturer, to Reader, and finally to Professor of Applied Mathematics in August 2002, in recognition of his internationally leading research role in the field of electromagnetic theory of complex materials. Werner was energetic in developing the mathematical methods and theoretical apparatus that is necessary to analyze, understand and eventually exploit novel electromagnetic effects in complex materials.

Figure 1 shows a very proud Werner on the day he was inducted into the University Senate. Werner received the letter announcing his promotion in March last year. He did not open that letter immediately. A friend, Willie Coupar, takes up the story later in the day: “I espied an unusually serious Werner making his way towards the South Front flagpole, clutching an unopened envelope. He informed me that he had applied for a professorship and that the university’s decision lay within that envelope which he had been reluctant to open all afternoon. I crossed
my fingers for him and watched as he made his way to the flagpole and began to open the envelope. To my delight I got an e-mail from him the next morning to say that it had contained good news.”

With his new status came a larger office, newly decorated and carpeted. Werner was very pleased with this. So woe betide friend and colleague Dr. Alec Mason, who had the temerity to enter the office immediately after a lecture, leaving chalky footprints on the brand-new carpet. Another close friend and colleague Dr. Ted Spence told me that he subsequently always removed his shoes before entering Werner’s office.

Werner had a very caring side to his character. Another of the many stories that have been related in recent weeks concerns Ted Spence’s last lecture preceding his retirement. Such an occasion deserves to be marked, but I certainly had not registered the significance of that day. Werner did though, and arrived in the lecture with a celebratory bottle of champagne.

Werner was extremely active in pursuing his research as well as promoting his field, and was meticulously organised in all he did. During his short career, he authored or co-authored more than 125 research publications in peer-reviewed international journals. His work was marked by an elegance that was spartan in style and extensive in scope. He was actively involved with conference organisation, including the very successful Bianisotropics’97, held in Glasgow. He raised money from several sources to fund the meeting and was keen that the participants gained a good impression of Glasgow and Scotland. He served on the editorial boards of two journals and was a prolific reviewer for more than 30 different international journals. He won several awards to support his research, including an SOEID/RSE Support Research Fellowship that allowed him to focus on his research for the year 2000.

I had the sad task of visiting Werner’s office to look for lecture notes to pass on to those who were to take on his duties. The notes were clearly arranged, with corresponding files easily found on his computer. An important work in progress was this book. Again, all the paperwork was neatly filed and electronic versions completely up-to-date.

While dedicated to his research, Werner was also an enthusiastic teacher. He co-authored an undergraduate textbook on ordinary differential equations, and was leading a review of the place of this important topic in the mathematics syllabus. He spent many hours devising numerous projects in applied mathematics for his students and planned to publish a collection of these to show that mathematics is not only a thing of beauty but eminently useful too. In his memory we have set up a fund that will award an annual prize, in his name, for the best project.

His enthusiasm for publication was not limited to his scientific work. His post-doctoral travels motivated several articles, including one on Glasgow, that were published by local newspapers in Bruck an der Mur and Graz. More recently, he was motivated to write to local and national newspapers on many issues.

The pre-eminent loves of Werner’s life were mountains. He hiked, he skied, he snowshoed, he photographed, read and wrote about them. The close proximity of...
the Highlands to Glasgow was one factor in attracting him here in 1988; and it took only four years for him to bag all the Munros (Scottish mountains over 3000 ft in altitude), many of which he since conquered several times. Latterly, he was set on adding the Munro Tops and the Corbetts (Scottish mountains between 2500 ft and 3000 ft) to his remarkable list of achievements. He kept very detailed records and diaries of all his hikes. Most of these were made alone, but there are several friends for whom he shifted down a gear or so to accompany up a Munro.

Vacation time took him to Norway, and in 1991 he discovered the peaks of Romsdal, Norway. He described this chance encounter in his guide to the peaks: “It was in the spring of 1991 that I was planning my third visit to Norway. Having spent some time in the National Parks of Jotunheimen and Rondane in the two previous years, I studied my maps for a new and interesting mountain area to explore. While doing so, the National Park of Dovrefjell caught my eye. Rather than travel there via Oslo, I decided to fly to Molde and continue to Dovrefjell with an overnight stop at a Youth Hostel in a small town named Åndalsnes. And so I found myself at the Vestnes ferry terminal in Molde on 3 July 1991 under a completely blue summer sky. Across the Romsdals-fjord, a landscape of mountains dominated the skyline that appeared to me as if it had been created in a world of fantasy. This first impression was emphasised later that day, when I walked across Setnesmoen just behind the Youth Hostel in Åndalsnes, surrounded by some of the most exciting peaks I had ever set my eyes upon. Since 1991, I have returned to Åndalsnes
on many occasions, to climb and hike in the marvellous mountains of Romsdal and for other, more significant, private reasons.”

He was never happier than when surrounded by snow above clouds, which is where he left his parents, his colleagues, numerous friends, students and admirers.

February 2003
My first encounter with Werner S. Weiglhofer took place in October 1996, when I attended his undergraduate lecture course on Mathematical Methods. At that time I was a mature part-time student in the University of Glasgow, with an interest in applied mathematics. I recall being greatly impressed by Werner’s meticulous lecturing style. His notes were precise and highly structured. Werner had an unconventional—and rather telling, I believe—strategy for ensuring the accuracy of his printed notes (as well as the attentiveness of his class). Each student who brought a typographical error to their teacher’s attention was rewarded with an Austrian chocolate. Needless to add, very few chocolates were ever handed out.

These initial impressions encouraged me to sign up as Werner’s first (and only, as it transpired) doctoral student in October 1998. As I had no experience of electromagnetic theory, our first few months together involved Werner patiently taking me step by step through the basics. His explanations were characteristically methodical, concise and honest. He was an approachable and unpretentious supervisor who always had time to help me out, even at the most antisocial of hours. As our relationship developed, our meetings would focus less on electromagnetics and more on Werner’s latest mountain trip. Typically, we would discuss work issues at length in the office and then adjourn to a nearby café to chat leisurely about hiking, skiing, snow conditions, etc. It was clear to me that while mathematics satisfied Werner’s intellectual appetite, the mountains were his abiding passion.

I completed my postgraduate studies under Werner’s supervision in the summer of 2001, and took up a lecturing position at the University of Edinburgh. After my arrival in Edinburgh, Werner and I collaborated on research projects and we remained good friends. In our collaborations, I was often grateful for his acute eye for detail and his uncanny ability to identify the subtlest of inconsistencies. Werner also took a keen interest in my career and was ever helpful in providing support and advice.

1 Subsequently, these notes formed the backbone of the textbook Ordinary Differential Equations & Applications by W.S. Weiglhofer and K.A. Lindsay.
Werner and I met for the last time three weeks before his death, when my wife and I were delighted to receive him at our wedding. He quickly endeared himself to my family, and it was a very happy occasion for all concerned. He left saying he was heading up to the North of Scotland to do some hiking over the Christmas period, and we wished each other well.

I shall remember Werner most for his integrity and humanity: he was a true friend to me.
Werner S. Weiglhofer—A Personal Tribute

Edward Spence

Werner came to Glasgow as a Research Assistant in 1988 at the age of 26; but it was not mathematics that brought us together initially, it was running. He was determined to keep himself fit, but unfortunately he was prone to injuries incurred while running, and this leisure activity gradually became secondary to his main love of the outdoors, which was, as all his friends knew, getting to the tops of mountains. Within a short time (four years to be exact), he had ascended all 284 peaks in Scotland over 3000 ft, the so-called Munros. Each trip made and each mountain climbed were meticulously recorded, initially in a notebook, but latterly on his computer. Moreover, with the advent of digital cameras, Werner was able to record his trips in photograph form, and these too were cataloged along with the written reports. Ultimately he built up a gallery containing more than 10,000 photographs, all of which were easily accessible. If he were to be asked, for example, “When was the last time you were up Sgurr nan Gillean (a mountain in Skye)?” he would be able in a moment to dig out the information along with a photographic record of his trip.

However, he was not content to sit back on his laurels. He was constantly looking for pastures anew, and in 1991 he discovered a range of mountains in Norway that were to become, in his mind, heaven on earth. These are the Romsdal Alps in the Norwegian province of Møre and Romsdal. Naturally, he set his sights on ascending all the summits in the area. I cannot say exactly how many summits there are, but I have seen a map with each summit conquered colored in red and it looks as if the map has measles! He returned to this particular area of Norway many times in the intervening years, and many of these mountains were climbed several times.

It was only in the last few years that I myself became interested in hiking, and consequently he and I, from being colleagues in the same department, became close friends. Discovering my interest, Werner gave me a present of a book on the Scottish mountains with an inscription telling me to have fun in the mountains, as he always did. He was the expert and I the novice, but he was very patient. He took me along the Aonach Eogach ridge in Glencoe (one of the most challenging...
ridge walks in the Scottish mainland), and this was certainly something I would not have done alone. By and large, Werner was happiest with the solitude that came with the mountains. He regarded them as a challenge and was not afraid of the physical effort that some mountains required. There is a group of mountains near Ben Nevis called the Mamores, which today incorporate 10 Munros with a total ascent of 3810 meters and which Werner conquered in 17 hours.

Werner was a man whose word you could trust. In all the time I knew him, I never heard him say a bad word about anyone. He was a man of integrity, and a perfectionist. Although English was not his first language, he spoke it and knew its grammar better than many native speakers, a fact with which some of the contributors to this volume might agree. In his role as editor, everything had to be just right. As another indication of his character and his thoughtfulness, I relate the following story. In December 2002, I was due to give my final lecture to the students as a member of staff of Glasgow University, and Werner knew this. Imagine my surprise, and delight, when Werner appeared at the end of my lecture with a bottle of champagne! I am sure that many of Werner’s friends will have similar tales to tell.

The two of us had a hike together just before Christmas 2002 and would have been together again before his fateful trip to Norway, but for unforeseen circumstances. Werner perished in the mountains that he loved so much and about which he had written a book, *The Summits of the Romsdal Alps*. I am sure that he would not mind that I quote from his book: “... as we move through our lives, it is not the final destinations that matter most but the encounters which happen on the way.” Werner encountered many people in his journey through life and left his mark wherever he went. He was a true friend to me, and I shall miss him.
Tiredness overcame me. It was about midnight. I had to indulge in one last e-mail fix before turning in. A couple of insignificant items had come; and a posting to the ComplexMediums yahoogroup, subject “Werner,” from Akhlesh Lakhtakia. Odd! I was expecting a communication from Werner anytime with a little push for me to send the revised version of my chapter for this book. But why via Akhlesh? The horror of what hit me next: I have just received terrible news. My best friend, Werner Weiglhofer died in an avalanche yesterday in Molde, Norway. His body was recovered today by a search party. Sincerely, Akhlesh. Sleep no longer possible, I telephoned Akhlesh. It seemed the only thing to do.

I first met Werner at Complex Mediums II held at San Diego in 2000, at which he gave an invited talk on homogenization of composite materials. Afterwards, I quickly became aware of his longstanding collaboration covering many topics with Akhlesh. In particular, their work during the 90’s on thin-film helicoidal bianisotropic mediums has been an inspiration and a springboard for me to carry out theoretical research on the same theme. As a relative newcomer to the complex mediums community, I’ve sometimes felt like a gatecrasher to a long-established party. But Werner and Akhlesh (for me the two names go together) always made me feel welcome and tolerated kindly the naivities of a “new kid on the block.” As a trio, we were beginning to find a unique synergy in our endeavors, fashioning papers of distinctive style: Akhlesh’s energy, my physicist’s eye, focused by Werner’s acute precision and somewhat irritating rigor with, of all things for a non-native, the English language. I believe this would have blossomed over the coming years. We worked together primarily on just one topic, entering into the current controversy on negative phase velocity mediums on which we published a few papers and wrote a chapter for this book.

Strangely for an Austrian, an Indian–American and an Englishman, the three of us shared an interest in cricket for which I often found myself having to make up some nonsense in defense of the game’s vagaries. Such were the discussions we would have away from science, and were as rich and fulfilling as befitted an atheist, an agnostic and a believer. The attraction of opposites also worked at the mundane level: at SPIE conferences, Werner and Akhlesh, both teetotallers, always donated to my benefit their beverage tickets!
Few of us work alone, and we take for granted, perhaps too much, the ease with which we can consult each other over research problems. To have part of that research connectivity suddenly wrenched out like this is bad enough at a professional level. To have lost a friend is terrible. No longer to hear that baritone “Werner here” when he answers the phone. His idiosyncratic conclusion of most sentences with “yerp,” with a rising inflection. His occasionally prickly temperament. All were the trademarks of his tireless and burgeoning intellect, and I will miss them all.

A note from a friend of mine summed it all up rather poignantly: Accidental deaths just seem so mind-blowingly pointless and frustrating, except to remind us to live each minute like we mean it. Let us live our moments in Werner’s memory like we mean them. Werner Weiglhofer, comrade and colleague, rest in peace.
My Friend Werner

Akhlesh Lakhtakia

Werner must have sent me a reprint request around September 1987, because I have a letter dated Dec. 30, 1987, from him acknowledging receipt of that reprint. He was then at the Department of Physics, University of Adelaide, South Australia, as the beneficiary of an European–Australian Fellowship.

In the same letter, he also pointed out that the derivation of a Green function I had published a few months earlier “seems to be a bit unsatisfactory,” although the result was correct. A few months thereafter, his own derivation appeared in print [1], along with a criticism of my derivation. Immediately, I fired off a comment, to which he replied on October 28, 1988, from the Department of Mathematics, University of Glasgow, UK. He acknowledged in his letter that my mathematical “manipulation is indeed permissible [sic],” and that is where the matter rested.

Hardly an auspicious beginning for a deep friendship, one would think. Yet, when it terminated on January 13, 2003, on my learning of his death in an avalanche, I was able to say that Werner Siegfried Weiglhofer was the closest of my friends ever; indeed, he had become my brother. Many relationships endure because of kinship and marriage, but only a few do because of a convergence in views that is broad enough to celebrate diversity too. Ours was like that. We met for dinner one evening in Stockholm, during the 1989 URSI International Symposium on Electromagnetic Theory. There was some talk of Werner spending a year at Penn State. It came to nought, but we became fast friends. He did visit Penn State often thereafter, most recently in the summer of 2000; and I visited him in Glasgow, the last time in early spring, 1999. I also spent a sabbatical semester in 1995 in Glasgow. We met every year at one conference, at least, and we corresponded several times every day by e-mail.

I am not going to recount here the various research topics that we tackled jointly over a dozen years. It suffices to state here that all of those topics fall under the rubric of time–harmonic electromagnetic fields in complex mediums. Instead, let me reminisce about my friend’s personality.

Werner was passionately devoted to research in electromagnetics. But it is not perhaps widely known, even in the electromagnetics community, that his passion for mountaineering stood a notch higher. During a short visit to Glasgow in March...
1995, I was asked by him to buy a lottery ticket for him at Safeway (a supermarket). He hoped that I would bring him better luck than he had; and I joked that, should he win lottery, he would found an *Institute of Mountaineering Electromagnetics*. Werner was not wise in his choice of lucky friends. He lost a round pound.

Anyhow, he went to Romsdal Alps in Norway so often during the 1990s, that the local newspapers, Åndalsnes Avis and Romsdals Budstikke, chronicled hiscomings and goings with his pictures. He hiked, he skied, he snow–shoed, and he climbed steep inclines. He was never happier than when in snow, with clouds floating far below. Mt. Bispen was perhaps the most challenging of the mountains he climbed; and, so perhaps, it is fitting that he left us all on the slope of that mountain. He taught himself the vernacular, and published probably the first guidebook in the English language to the Romsdal Alps [2].

Although the Norwegian mountainous terrain was his clear favorite, he often visited the Cascades in Washington State, U.S.A., as well. He had a special fondness for Mt. Rainier. In early summer 1995, he went to Alaska to explore the prospects of ascending Mt. Denali. However, he fell ill in Seattle, and his condition worsened enough for him to be evacuated to Glasgow from Anchorage. During his early years in Scotland, he climbed almost every Munro, and there are more than 300 of these relatively low peaks. He enjoyed happier times in the Alps of central Europe, where he climbed almost all of the major peaks, including Mont Blanc and Großglockner. He had entertained some notions for a while to attempt an Andean peak too, but resolutely kept away from the Himalayas.

Werner’s guidebook on the Romsdal Alps was a serious manifestation of what I used to call his listmania. He maintained meticulous records of every hike, every route, and every ascent. He had a fancy watch to measure altitudes, which were duly recorded within 24 hours of his return to Glasgow from every trip. Not only that, he could tell you if he took a flight on a certain day, the flight number, the type of aircraft, the seating arrangement, his seat number, and the arrival and departure times. His diaries are sure to be attractive to some graduate student in history, a hundred years hence, looking for a topic to prepare a doctoral dissertation on. Perhaps, that dissertation would be entitled: *Incidence of aircraft-experienced turbulence during the lifetime of a university professor from the late 20th century*. Had he lived longer, Werner would have shown the door many times to Samuel Pepys.

The managerial qualities of Werner greatly helped him in organizing *Bianisotropics*’97, a specialized three-day conference convened in Glasgow on complex materials. It was a great success, as can be gathered from the conference proceedings [3]. A group photograph of the attendees is reproduced in Figure 1. Werner also enthusiastically contributed to all the following conferences in the *Bianisotropics* series. A picture of him with several other attendees at *Bianisotropics 2000* in Lisbon, Portugal, is shown in Figure 2.

His flair for organization significantly benefitted two SPIE conferences—*Complex Mediums* in 2000 [4] and *Complex Mediums II* in 2001 [5]—as well as the two SPIE conferences bracketing those two.
Figure 1 Group photograph of the attendees of Bianisotropics’97, taken on June 5, 1997. Werner is in the top row, sixth from the left. He organized this conference at the University of Glasgow. [Photograph © Estate of Werner S. Weiglhofer.]

Figure 2 At Bianisotropics 2000 in Lisbon on September 26, 2000 (from left to right): Akhlesh Lakhtakia (Pennsylvania State University), Werner Weiglhofer (University of Glasgow), George Borzdov (Belarus State University), Stephen Sathiaraj (University of Botswana), Elif Ertekin (University of California, Berkeley), Bernhard Michel (Scientific Consulting GmbH), Alexander Borzdov (Belarus State University), Tom Mackay (University of Edinburgh), Gregory Slepyan and Sergey Maksimenko (Belarus State University). [Photograph © Akhlesh Lakhtakia.]
From about 1994, Werner rarely attended a conference alone. A stuffed toy rabbit named Svein Oskar Hansen accompanied him on most trips. Comfortably ensconced in Werner’s backpack, often peeking out, Svein would listen to speaker after speaker. Svein rarely said a word; at least, I never heard him. But Werner talked to him all the time. Occasionally, either my family or I would receive e-mails from sveinhansen@hotmail.com, with complaints of indifference from Werner. Svein appears in the 1997 picture reproduced in Figure 3.

Remarkably, Svein co-authored a research paper with Werner on Faraday chiral mediums. That paper appeared in an IEEE journal [6], which also carries authors’ biographies. Svein described himself as a Norwegian researcher of independent means, with research interests in dentistry, antennas, and underground prospecting. Werner had more than a chuckle on seeing the published version. I wonder what the editors of the journal would exclaim on finding out that they admitted a toy rabbit to the distinguished coterie of IEEE authors!

Werner was a fiercely political person, though he was so shy that he rarely held forth on nonscientific topics in public. He was devoted to Steiermark, Austria, and the European Union—in that order. He preferred Scotland to England, and

![Figure 3](https://www.spiedigitallibrary.org/ebooks/)

Figure 3 Akhlesh and Werner, with Svein in Werner's arm, in the Queen Elizabeth Forest Park, north of Glasgow, a day after Blanisotropics'97 ended. [Photograph © Akhlesh Lakhtakia.]
particularly detested the city of London. I could easily understand the causes for his dislike of London, for they are just about the same as for my dislike of New York City, where I have not set foot in 15 years. London charms me, however.

Werner was a pacifist. His family had borne the brunts of two world wars; perhaps, that is the reason for his opposition to war. With the passage of time, his antiwar convictions became more pronounced. In December 2002, he told me that he would not visit the United States ever again, if it bombed Iraq without United Nations sanction.

I am reminded of an argument that occurred between him and me in 1999. He was then guest-editing a special issue of *Electromagnetics* [7], to which I had contributed a paper. My paper was dedicated to *a better future for the Iraqi children, squeezed between a tyrannical oppressor at home and unfeeling wretches abroad*. One of the two referees objected, and Werner ruled that I should not mix politics and research. Eventually, we compromised, and the words *squeezed ... abroad* were eliminated. Late in 2002, one day Werner called to tell me that he had been wrong in making me delete those words. Mixing politics with research was wrong, but mixing research with love for others could not be more right.

Werner was unabashedly an European. He found many American (i.e., U.S.) attitudes inexplicable. I think I alternate between the left and the right on most social and political issues. Werner was always to my left. He did not appreciate excessive American cultural presence in Europe, and would not eat at McDonald’s even when very hungry, although he was very fond of Hollywood offerings. He was even more firmly a West European; for instance, after the Cold War ended, he could not stomach the dethroning (in West European magazines) of Mont Blanc as Europe’s highest peak by Mt. Elbrus at the border of Georgia and Kazakhstan. But he was always willing to learn. When I suggested in November 2001 that Mt. Elbrus had always (in historical times) been Europe’s highest peak but that West Europeans had remained misinformed for a long time, he relented.

So, Werner was a work in progress. He had splendid foundations, personally as well as professionally. Perfectionist that he was, he would only have become better. But that was not to be. A mountain that he loved claimed him at the young age of 40. Surely it must have been someone like Werner who inspired William Wordsworth to compose the following lines:¹

—It is the generous Spirit, who, when brought
Among the tasks of real life, hath wrought
Upon the plan that pleased his boyish thought:
Whose high endeavours are an inward light
That makes the path before him always bright:
Who, with a natural instinct to discern
What knowledge can perform, is diligent to learn;
Abides by this resolve, and stops not there,
But makes his moral being his prime care;

¹W. Wordsworth (1770–1850), *The Happy Warrior.*
References


---

2 The first edition appeared in 1999, the second two years later. The guidebook could be bought in Åndalsnes, Molde, and nearby towns in Norway, as well as directly from Werner himself.
Published Scientific Works of Werner S. Weiglhofer

Tom G. Mackay

During the period 1985 to 2003, Prof. Werner S. Weiglhofer contributed many works to the scientific literature. Various aspects of electromagnetic theory are described in his publications, including scalar and vector potentials, magnetohydrodynamic instabilities, dyadic Green functions, depolarization dyadics, wave propagation, constitutive relations and homogenization of particulate materials. Complex mediums provide the setting for many of these studies. There follows a comprehensive bibliography of Prof. Weiglhofer’s scientific publications.\(^1\) This compilation begins with books and book chapters, followed by journal articles, and finishes with conference publications.

1 Books


\(^1\)In addition to the scientific publications listed here, Prof. Weiglhofer also authored numerous nonscientific publications, mostly relating to his passion for mountain pursuits. These are published in various Austrian, British and Norwegian newspapers and magazines. He also wrote and published a monograph entitled *The summits of the Romsdal Alps.*

2 **Book chapters**


3 **Guest editorials for special issues of journals**


4 **Refereed journal articles**


---


\(^3\)Reprinted in *Selected papers on linear optical composite materials* (A. Lakhtakia, ed), SPIE Press, Bellingham, WA, USA, 1996.  


5 Replies to comments


6 Letters to the Editor


7 Book reviews


8 Conference reports


9 Conference proceedings: full papers


10 Conference proceedings: abstracts and extended abstracts


22. T.G. Mackay, A. Lakhtakia and W.S. Weiglhofer, Homogenisation via the strong-property-fluctuation theory: Third-order implementation and convergence, *NATO advanced research workshop Bianisotropics 2002, 9th in-

Index

A
A waves, 253–254
aberration, 357
ablation, 560, 562
absorbers, saturable, 107
absorption, 126, 356, 677, 680
– negative, 552
add-drop filter, 387
address pulse, 582
Aharonov–Bohm integral, 13
Aizu species, 179
aluminum, 438, 441
analysis of variance (ANOVA), 594
anapole (moment), 187
angle of rise, 483
angle selectivity, 427, 442
angular frequency, 403
anholonomic references, 12
anisotropic medium, xxvi, 29, 37–38, 51, 246, 255, 425, 612
anisotropy, 229–230, 236–239, 550, 677–678
anisotropy energy density, 228–230, 236, 238
antimony tin oxide (ATO), 420, 435
aperture in a screen, 401
armchair carbon nanotube, 510, 512
asymmetric magnetoresistance (AMR), 275
atomic force microscope (AFM), 560, 562
attenuation, 353
autocorrelation, 134, 136
axial conductivity of a carbon nanotube, 515
axial excitation, 488
axial propagation, 479–480, 486, 491–492
axial propagation in CSTFs, 480
axial tensor, 650
axial vector, 8

B
B waves, 253–254
backscattering, enhanced, 551
backward medium, 357
ballistic aggregation, 451–452
BaMnF4, 660
band diagram, 370
band structure, 111
band-to-band transitions in spontaneously ordered semiconductors, 677, 692
bandgap, 106
bandwidth, 484, 490
barium titanate, 122
Bateman, H., 19
beam combiner, 501
beam fanning, 123
beam router/combiner, 500
beam, optical, 551
beamsplitter, 464
beta distribution, 604
bianisotropic medium, xxvi, xxvii, 29, 37, 43, 51, 349, 458, 467, 481, 679
bianisotropy, 319
bixial medium, 45, 50–51, 454
bifurcation, 574
bifurcation diagram, 370
biisotropic medium, 51
bilocated approximation, 326
binary diagram, 370
biochip, 466
bioluminescence, 466
biophysics, xxvii
biopolymer, 661
birefringence, 109, 129, 454, 677, 679
– linear, 110
BisA, 125
bisector angle, 132
bismuth silicon oxide (BSO), 123
bismuth tin oxide, 122
bispherical analysis, 438
bistability, 389, 415, 574
Bloch waves, 379
Boltzmann constant, 128
Born, M., 8
boundary conditions, 404
bounded modes, 374
Boys–Post representation, 42, 51, 54
Bragg filter, 358, 370, 479–481 483–485, 492, 497, 552
Bragg phenomenon, 461, 480, 496
– circular, 461, 464. See also circular Bragg phenomenon.
Bragg regime, 462–463, 467, 480, 490, 492, 494, 497, 501
Bragg wavelength, 492–494, 496, 501–502
Brillouin zone, 112, 379, 511
Bruggeman, 322, 432, 436
Bruggeman formalism, 53–54, 318, 451
Busse balloon, 579
C
C₆₀, 125
C-153, 125
Cartan, E., 10, 12, 22
causality, xxvii, 36, 350
cavity, 385
cavity solitons, 581
center of symmetry, 8
characteristic functions, 320
characteristic waves, 256
charge density, electric, 31, 348
charge density, electron, 37
charge density, magnetic, 30
charge generation (CG), 124
charge-transport (CT), 122
chiral liquid crystals, 697
chiral medium, Faraday, 53
chiral medium, isotropic, 45, 51, 53, 358
chiral morphology, 480
chiral sculptured thin film (CSTF), 479–481, 483–504
chirality, xxvi, 550
– index, 667
– parameter, 45
chiroferrite, 54
chiroplasma, 54
chirping, 463
cholesteric liquid crystal, 480
Christiansen filter, 563
circular birefringence, 68, 645–646
circular Bragg phenomenon (CBP), 480, 489–490, 493, 502. See also Bragg phenomenon, circular
circular dichroism, 69, 358, 645–646
cluster, 425, 440–441, 452
coherence, 550, 554
coherence length, 557
coherent light propagation, 684
cold plasma, 248
collimation, 563
collisional cooling, 561
columnar morphology, 448–449
columnar nanostructure, 422
columnar thin film, 449, 457
comparison medium, 325
compensational charge, 128
complex field structure, 634
composite material, xxv, 295–298, 300–301, 308–309, 311–312, 350, 398
– ring-wire, 354
– unusual, 358
Condon, E., 21
conduction band, 370
conduction current, 128
conductivity, 398
conformal group, 19
constitutive relations, 4–6, 8, 29, 32, 41, 246, 248, 250–251, 255, 319, 349, 458, 481–482, 731
– Boys–Post, 42–43, 51
– constraints on, 34–35, 50–52
– Tellegen, 42, 44, 51, 458
constitutive tensor, 19
continuity condition, 32
continuum, xxvi, 448, 458, 461
– electromagnetic theory, 64
– nonhomogeneous, 449
convolution, 35–36, 39, 43
correlation, 133
– edge-enhanced, 133
– all-optical, 134
– joint transform, 134
correlation length, 326
coupled-wave theory, 460, 479–480, 484, 491–492, 501, 504
coupler, 3dB, 501
coupling, 600
covariance function, two-point, 327
covariance function, three-point, 327
cross-anisotropy films, 268
cross-correlation, 134, 136
cross-polarized fields, 493
cross-polarized reflectivities, 492, 495
crosstalk voltage, 597
crystallinity, 448
crystallographic, 110
Cunningham, E., 19
current density, electric, 31, 348
current density, electron, 37
current density, magnetic, 30
curvilinear coordinates, 12
cutoff frequency, 249, 255
D
damping, 39
DANS/MMA, 127
dark current, 130
de Rham, G., 16
de Rham cohomology, 18
defect, 372
defect modes, 385
defocusing, 132
degenerate four-wave mixing (DFWM), 133
degradation, 467
DEH, 125, 127
ΔE effect, 239–240
demagnetization energy, 228, 232, 236, 242
dendrimer 149, 155
density anisotropy, 453
depolarization, 563
depolarization dyadic, 321, 731
depolarizing optical systems, 682
deposition, pulsed laser, 559–560
dexter exchange mechanism, 148
dielectric displacement, 31, 458
dielectric medium, xxvi, 35, 39
dielectric thin film, 480
dielectric–magnetic medium, 35–36, 45, 50, 350
diffeo hierarchy, 23
diffeo(3), 12
diffeo(4), 10–11, 23
diffraction, 571
diffuser, 549, 563, 565
– designer, 563
Downloaded From: https://www.spiedigitallibrary.org/ebooks/ on 26 Aug 2019
Terms of Use: https://www.spiedigitallibrary.org/terms-of-use
diffusion, 112, 122, 128
diffusion equation, 552
dipole, 556
dipole-dipole interaction, 145–147
directional coupler, 499–501
dispersion, xxvii, 29, 249, 404
  – spatial, 38
  – temporal, 38, 461
dispersion law for graphene, 511
dispersion law for nanotubes, 512
dispersion relation, 257, 374
dispersions, xxvii, 29, 249, 404
  – spatial, 38
  – temporal, 38, 461
dispersion relations for graphene, 511
dispersion relations for nanotubes, 512
dispersion relation, 257, 374
dispersivity, 38
 dissipation, xxvii, 50, 350, 355
 dissipative system, 577
domain average engineering, 94
Doppler effect, 246
double negative medium, 357
drift, 122
Drude model, 701
Drude–Born–Fedorov relations, 72
duality, 30
dyads, 30
dyadics, 30, 41, 459
– rotation, 459
dyadic Green function, 321, 326, 533
dynamic measurements, 236, 238–239, 241
Dyson equation, 326
ellipsoidal particle, 320
ellipsometry data, 66, 689, 694
electron, 106
electron confinement, 466
electron localization, 398
electron recombination rate, 128
electron velocity, 37
electron-beam evaporation, 562
electronic chip, 465
electrostrictive medium, 330
electrotoroidic effect, 187
ellipticity, 66
emission, amplified spontaneous (ASE), 553, 555, 558
emission, pulse, 553
emission, stimulated, 552
emittance, 434
enantiofomorphism, 21, 23
energy conservation, 262, 353
energy exchange, 130
energy harvesting, 141
energy pooling, 142, 145, 151
energy-efficient paint, 426
environmental stability, 467
epitaxial growth, 112
equilibrium Fermi distribution function, 515
equilibrium, lack of, 550
Euler equations, 37
Faraday chiral medium, 53–54
Faraday rotation, 117
fast Fourier transform (FFT), 132
FDEA-MNST, 125
finite-difference time domain (FDTD), 246, 263
feedback, nonresonant, 552
feedback, positive, 408
feedback, resonant, 552
ferrite, 53
ferroelasticity, 178–181
ferroelectricity, 178–181
ferroics, 181–182
ferromagnetism, 178–181
ferromagnetism, 178–181
ferromagnetic resonance (FMR), 237–238
ferromagnetoelectricity, 169, 180
ferrotronics, 180
fiber Bragg gratings, 482, 484
– filters, 498
fiber, optical, 551
field enhancement, 397
figure of merit (FOM), 123, 298–300, 303–304, 306, 309, 311
finite-sized device, 380
fixed point, 573
flash ionization, 249
Floquet–Bloch theorem, 368
<table>
<thead>
<tr>
<th>Term</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Föppl, A., 11</td>
<td></td>
</tr>
<tr>
<td>Förster radius, 147</td>
<td></td>
</tr>
<tr>
<td>Fourier series, 129, 405</td>
<td></td>
</tr>
<tr>
<td>Fourier transform, 108</td>
<td></td>
</tr>
<tr>
<td>- combined, 41</td>
<td></td>
</tr>
<tr>
<td>- spatial, 40</td>
<td></td>
</tr>
<tr>
<td>- temporal, 31, 35, 43, 349</td>
<td></td>
</tr>
<tr>
<td>free space, 28, 348, 350, 454</td>
<td></td>
</tr>
<tr>
<td>frequency shift, 246, 262</td>
<td></td>
</tr>
<tr>
<td>frequency transformer, 246, 254</td>
<td></td>
</tr>
<tr>
<td>frequency, emission, 552</td>
<td></td>
</tr>
<tr>
<td>Fresnel reflections, 481, 494, 563</td>
<td></td>
</tr>
<tr>
<td>Fresnel zone, 356</td>
<td></td>
</tr>
<tr>
<td>Fresnel–Fizeau, 8</td>
<td></td>
</tr>
<tr>
<td>FRET, 145</td>
<td></td>
</tr>
<tr>
<td>fullerene, 510</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td></td>
</tr>
<tr>
<td>Galilei, G., 20</td>
<td></td>
</tr>
<tr>
<td>gallium arsenide, 106, 123</td>
<td></td>
</tr>
<tr>
<td>Gamow vector, 384–385</td>
<td></td>
</tr>
<tr>
<td>gas sensor, 495</td>
<td></td>
</tr>
<tr>
<td>Gaussian units, 400</td>
<td></td>
</tr>
<tr>
<td>generalized ellipsometry, 677</td>
<td></td>
</tr>
<tr>
<td>Generalized Ohm’s Law (see also Ohm’s Law), 430, 441</td>
<td></td>
</tr>
<tr>
<td>Gibbs, J.W., 11</td>
<td></td>
</tr>
<tr>
<td>Ginzburg–Landau equation, 573</td>
<td></td>
</tr>
<tr>
<td>Giorgi rationalization, 9–10</td>
<td></td>
</tr>
<tr>
<td>glass, 550</td>
<td></td>
</tr>
<tr>
<td>- ground, 563</td>
<td></td>
</tr>
<tr>
<td>- opal, 563</td>
<td></td>
</tr>
<tr>
<td>gold, 434, 559–560</td>
<td></td>
</tr>
<tr>
<td>Gothic symbols, 7</td>
<td></td>
</tr>
<tr>
<td>Graf’s formula, 381–382</td>
<td></td>
</tr>
<tr>
<td>granular metals, 440–441</td>
<td></td>
</tr>
<tr>
<td>graphene, 511</td>
<td></td>
</tr>
<tr>
<td>gratings, 126, 380</td>
<td></td>
</tr>
<tr>
<td>- absorption, 126</td>
<td></td>
</tr>
<tr>
<td>- higher-order, 127, 130</td>
<td></td>
</tr>
<tr>
<td>- primary, 127</td>
<td></td>
</tr>
<tr>
<td>Green function, 381</td>
<td></td>
</tr>
<tr>
<td>- dyadic, 49</td>
<td></td>
</tr>
<tr>
<td>group velocity, 356</td>
<td></td>
</tr>
<tr>
<td>gyration tensor, 648</td>
<td></td>
</tr>
<tr>
<td>gyrofrequency, 38, 255–256, 261</td>
<td></td>
</tr>
<tr>
<td>gyrotropic medium, 39, 45, 50, 53</td>
<td></td>
</tr>
<tr>
<td>Hamilton–Jacobi, 12</td>
<td></td>
</tr>
<tr>
<td>handed-reflector, 490</td>
<td></td>
</tr>
<tr>
<td>handedness, 66, 357, 462, 466</td>
<td></td>
</tr>
<tr>
<td>handedness-inverter, 463</td>
<td></td>
</tr>
<tr>
<td>harmonic generation, 113</td>
<td></td>
</tr>
<tr>
<td>Heaviside function, 327</td>
<td></td>
</tr>
<tr>
<td>Heisenberg, W.K., 12</td>
<td></td>
</tr>
<tr>
<td>Heisenberg uncertainty principle, 19</td>
<td></td>
</tr>
<tr>
<td>helical morphology, 487</td>
<td></td>
</tr>
<tr>
<td>helicoidal bianisotropic medium, 47, 489</td>
<td></td>
</tr>
<tr>
<td>- thin-film, 457, 459</td>
<td></td>
</tr>
<tr>
<td>helicon mode, 258</td>
<td></td>
</tr>
<tr>
<td>helix, 664</td>
<td></td>
</tr>
<tr>
<td>Helmholz equation, 129, 381, 479, 481–482</td>
<td></td>
</tr>
<tr>
<td>Hermitian properties, 21–22</td>
<td></td>
</tr>
<tr>
<td>hexagon, 576</td>
<td></td>
</tr>
<tr>
<td>high-accuracy universal polarimeter (HAUP), 645, 648</td>
<td></td>
</tr>
<tr>
<td>high-order harmonics, 524</td>
<td></td>
</tr>
<tr>
<td>higher-order generation, 130</td>
<td></td>
</tr>
<tr>
<td>histogram, 593</td>
<td></td>
</tr>
<tr>
<td>hole, 110</td>
<td></td>
</tr>
<tr>
<td>homogeneous medium, 482, 487, 489, 495</td>
<td></td>
</tr>
<tr>
<td>homogenization, xxvii, 53, 347, 355, 461, 731</td>
<td></td>
</tr>
<tr>
<td>- local, 461</td>
<td></td>
</tr>
<tr>
<td>hopping, 122</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td></td>
</tr>
<tr>
<td>impair (forms), 18</td>
<td></td>
</tr>
<tr>
<td>impedance, intrinsic, free-space, 350</td>
<td></td>
</tr>
<tr>
<td>incoherent light propagation, 686</td>
<td></td>
</tr>
<tr>
<td>incommensurate crystal, 648</td>
<td></td>
</tr>
<tr>
<td>index matching, 495</td>
<td></td>
</tr>
<tr>
<td>indium tin oxide (ITO), 127, 435</td>
<td></td>
</tr>
<tr>
<td>induced chiral inhomogeneities, 634</td>
<td></td>
</tr>
<tr>
<td>induced electrostatic field, 128</td>
<td></td>
</tr>
<tr>
<td>induced refractive index change, 129</td>
<td></td>
</tr>
<tr>
<td>induction fields, 31, 42, 348</td>
<td></td>
</tr>
<tr>
<td>information processing, 571</td>
<td></td>
</tr>
<tr>
<td>initial value problem, 259, 261</td>
<td></td>
</tr>
<tr>
<td>instability (in roll solutions), 579</td>
<td></td>
</tr>
<tr>
<td>insulator, 448</td>
<td></td>
</tr>
<tr>
<td>integrated optics and telecommunications, 495</td>
<td></td>
</tr>
<tr>
<td>intensity, 128</td>
<td></td>
</tr>
<tr>
<td>- dark, 128</td>
<td></td>
</tr>
<tr>
<td>interaction, resonant, 113</td>
<td></td>
</tr>
<tr>
<td>interbeam angle, 132</td>
<td></td>
</tr>
<tr>
<td>interference, 557</td>
<td></td>
</tr>
<tr>
<td>interferometry, 551</td>
<td></td>
</tr>
<tr>
<td>interlayer dielectric, 460, 466</td>
<td></td>
</tr>
<tr>
<td>intersecting spheres, 438</td>
<td></td>
</tr>
<tr>
<td>intramolecular relaxation, 145</td>
<td></td>
</tr>
<tr>
<td>inversion symmetry, 21</td>
<td></td>
</tr>
<tr>
<td>ion beam, 560</td>
<td></td>
</tr>
<tr>
<td>ion bombardment, 450</td>
<td></td>
</tr>
<tr>
<td>ion thruster, 468</td>
<td></td>
</tr>
<tr>
<td>ionization front, 249</td>
<td></td>
</tr>
<tr>
<td>isolator, 197</td>
<td></td>
</tr>
<tr>
<td>isotropic chiral medium, 64, 328</td>
<td></td>
</tr>
<tr>
<td>isotropic constitutive equations, 5</td>
<td></td>
</tr>
<tr>
<td>isotropic elastic medium, 615, 621</td>
<td></td>
</tr>
<tr>
<td>isotropic medium, 45, 350, 483, 498</td>
<td></td>
</tr>
<tr>
<td>isotropic plasma, 249, 251, 254–258</td>
<td></td>
</tr>
<tr>
<td>J</td>
<td></td>
</tr>
<tr>
<td>Jacobi technique, 323</td>
<td></td>
</tr>
<tr>
<td>Jones matrix, 656, 678</td>
<td></td>
</tr>
<tr>
<td>Joule effect, 224</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td></td>
</tr>
<tr>
<td>Kennard, E.H., 20</td>
<td></td>
</tr>
<tr>
<td>Kerr effect, 116, 389, 403–404, 408, 415, 578</td>
<td></td>
</tr>
<tr>
<td>Kottler, F., 10, 12, 22</td>
<td></td>
</tr>
<tr>
<td>Kramers–Kronig relations, 36, 70</td>
<td></td>
</tr>
<tr>
<td>kriging, 593, 599–600</td>
<td></td>
</tr>
<tr>
<td><strong>L</strong></td>
<td>753</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>LaB₆, 435</td>
<td></td>
</tr>
<tr>
<td>Lambertian scatter, 563</td>
<td></td>
</tr>
<tr>
<td>Laplace operator, 40</td>
<td></td>
</tr>
<tr>
<td>laser, 106, 408, 551–552</td>
<td></td>
</tr>
<tr>
<td>– random, 553–554, 557</td>
<td></td>
</tr>
<tr>
<td>– polymer, 555</td>
<td></td>
</tr>
<tr>
<td>– powder, 549, 553</td>
<td></td>
</tr>
<tr>
<td>– ring, 555</td>
<td></td>
</tr>
<tr>
<td>– self-organized, 552</td>
<td></td>
</tr>
<tr>
<td>laser ablation, 560</td>
<td></td>
</tr>
<tr>
<td>laser mirror, 463</td>
<td></td>
</tr>
<tr>
<td>Laurent series, 384</td>
<td></td>
</tr>
<tr>
<td>law of mixtures, 298–301, 308, 310</td>
<td></td>
</tr>
<tr>
<td>layered systems, 267</td>
<td></td>
</tr>
<tr>
<td>left-handed material (misnomer), 349, 357</td>
<td></td>
</tr>
<tr>
<td>Levi–Civita unit tensors, 15, 17</td>
<td></td>
</tr>
<tr>
<td>light-induced modulation, 404</td>
<td></td>
</tr>
<tr>
<td>linear birefringence, 68, 110, 645–646</td>
<td></td>
</tr>
<tr>
<td>linear dihroism, 69, 646</td>
<td></td>
</tr>
<tr>
<td>liquid crystal, 449, 465, 482</td>
<td></td>
</tr>
<tr>
<td>lithium niobate, 122</td>
<td></td>
</tr>
<tr>
<td>lithography, 560</td>
<td></td>
</tr>
<tr>
<td>localization, 556</td>
<td></td>
</tr>
<tr>
<td>– electron, 398</td>
<td></td>
</tr>
<tr>
<td>– plasmon, 398</td>
<td></td>
</tr>
<tr>
<td>localized fields, 372, 609, 624, 632</td>
<td></td>
</tr>
<tr>
<td>localized structures, 571</td>
<td></td>
</tr>
<tr>
<td>long-wavelength approximation, 326</td>
<td></td>
</tr>
<tr>
<td>longitudinal propagation, 255–257, 578</td>
<td></td>
</tr>
<tr>
<td>Lorentz, H.A., 19</td>
<td></td>
</tr>
<tr>
<td>Lorentz covariance, xxvi</td>
<td></td>
</tr>
<tr>
<td>Lorentz force, 37</td>
<td></td>
</tr>
<tr>
<td>Lorentz model, 352, 356</td>
<td></td>
</tr>
<tr>
<td>Lorentz plasma, 248–249</td>
<td></td>
</tr>
<tr>
<td>Lorentz reciprocity, 34, 50</td>
<td></td>
</tr>
<tr>
<td>Lorentz–Heaviside electromagnetics, xxvi</td>
<td></td>
</tr>
<tr>
<td>losslessness, 50</td>
<td></td>
</tr>
<tr>
<td>low dimensionality, 295, 296, 299, 301, 303–305</td>
<td></td>
</tr>
<tr>
<td>luminescence, 557</td>
<td></td>
</tr>
<tr>
<td>lysozyme, 663</td>
<td></td>
</tr>
<tr>
<td><strong>M</strong></td>
<td></td>
</tr>
<tr>
<td>macroscopic field, 348</td>
<td></td>
</tr>
<tr>
<td>macroscopic material, 297</td>
<td></td>
</tr>
<tr>
<td>magnetic anisotropy, 267</td>
<td></td>
</tr>
<tr>
<td>magnetic energy density, 225, 228</td>
<td></td>
</tr>
<tr>
<td>magnetic field, 31, 458</td>
<td></td>
</tr>
<tr>
<td>– quasi-static, 37</td>
<td></td>
</tr>
<tr>
<td>magnetic induction, 31, 458</td>
<td></td>
</tr>
<tr>
<td>magnetic medium, 35</td>
<td></td>
</tr>
<tr>
<td>magnetic point groups, 80</td>
<td></td>
</tr>
<tr>
<td>magnetic sensor, 267</td>
<td></td>
</tr>
<tr>
<td>magnetization, 47, 348</td>
<td></td>
</tr>
<tr>
<td>magneto-optic effect, linear, 182, 187</td>
<td></td>
</tr>
<tr>
<td>magneto-optics, 38, 49, 197</td>
<td></td>
</tr>
<tr>
<td>magnetoelastic energy density, 224–225, 231, 233–235, 238</td>
<td></td>
</tr>
<tr>
<td>magnetoelastic parameter, 231, 233–234</td>
<td></td>
</tr>
<tr>
<td>magnetoelasticity, 223–231, 233–242</td>
<td></td>
</tr>
<tr>
<td>magnetoelastic coefficients</td>
<td></td>
</tr>
<tr>
<td>– tensor form, bilinear effects, 173</td>
<td></td>
</tr>
<tr>
<td>– tensor form, linear effect, 170–171</td>
<td></td>
</tr>
<tr>
<td>magnetoelastic dyadics, 43</td>
<td></td>
</tr>
<tr>
<td>magnetoelastic effects, 48, 167, 458, 467</td>
<td></td>
</tr>
<tr>
<td>– applications of, 181–188</td>
<td></td>
</tr>
<tr>
<td>– bilinear, 172, 176</td>
<td></td>
</tr>
<tr>
<td>– induced, 172, 176</td>
<td></td>
</tr>
<tr>
<td>– linear, 172</td>
<td></td>
</tr>
<tr>
<td>– ME₃ and ME₄ effects, 177</td>
<td></td>
</tr>
<tr>
<td>– measurement, 177</td>
<td></td>
</tr>
<tr>
<td>– measuring units, 173</td>
<td></td>
</tr>
<tr>
<td>– spontaneous, 178</td>
<td></td>
</tr>
<tr>
<td>– theory, 188</td>
<td></td>
</tr>
<tr>
<td>– toroidal contributions, 185</td>
<td></td>
</tr>
<tr>
<td>magnetoimpedance, 267</td>
<td></td>
</tr>
<tr>
<td>magnetoionic theory, 256, 259</td>
<td></td>
</tr>
<tr>
<td>magnetoplasma medium, 246, 255</td>
<td></td>
</tr>
<tr>
<td>magnetostriction, 223–231, 233–242</td>
<td></td>
</tr>
<tr>
<td>magnetostriction parameter, 231, 234, 237</td>
<td></td>
</tr>
<tr>
<td>magnetostrictive strain, 231, 233</td>
<td></td>
</tr>
<tr>
<td>magneto toriodic effect, 187</td>
<td></td>
</tr>
<tr>
<td>manufacturing, 468</td>
<td></td>
</tr>
<tr>
<td>mass operator, 326</td>
<td></td>
</tr>
<tr>
<td>MathCad, 132</td>
<td></td>
</tr>
<tr>
<td>matrix differential equation, 460</td>
<td></td>
</tr>
<tr>
<td>matrix polynomial series, 460</td>
<td></td>
</tr>
<tr>
<td>Matteucci effect, 240</td>
<td></td>
</tr>
<tr>
<td>Maxwell, J.C., 5, 28</td>
<td></td>
</tr>
<tr>
<td>Maxwell equations, 30, 32, 49, 55, 348, 400, 449, 459, 481, 486, 556</td>
<td></td>
</tr>
<tr>
<td>Maxwell Garnett formalism, 53, 318, 322, 409, 432, 436, 438, 550</td>
<td></td>
</tr>
<tr>
<td>– differential, 323–324</td>
<td></td>
</tr>
<tr>
<td>– incremental, 323</td>
<td></td>
</tr>
<tr>
<td>mechanical loading, 467</td>
<td></td>
</tr>
<tr>
<td>medium, 28</td>
<td></td>
</tr>
<tr>
<td>mesomaterial, 296</td>
<td></td>
</tr>
<tr>
<td>metal, 403, 448, 559</td>
<td></td>
</tr>
<tr>
<td>metal shells, 441</td>
<td></td>
</tr>
<tr>
<td>metal vapor, 559</td>
<td></td>
</tr>
<tr>
<td>metal-dielectric film, 398</td>
<td></td>
</tr>
<tr>
<td>metallic film, 397, 415</td>
<td></td>
</tr>
<tr>
<td>metamaterial, 106, 295–301, 303–304, 306, 310, 312–313</td>
<td></td>
</tr>
<tr>
<td>metaparticle, 301, 306–307, 311</td>
<td></td>
</tr>
<tr>
<td>micelle, 559</td>
<td></td>
</tr>
<tr>
<td>microcavity, 578</td>
<td></td>
</tr>
<tr>
<td>microscopic field, 348</td>
<td></td>
</tr>
<tr>
<td>Mie, G., 425, 430, 441</td>
<td></td>
</tr>
<tr>
<td>Minkowski, H., 7, 10</td>
<td></td>
</tr>
<tr>
<td>mirrored pairs, 21</td>
<td></td>
</tr>
<tr>
<td>mobility, 128</td>
<td></td>
</tr>
<tr>
<td>mode, coherent, 556, 558</td>
<td></td>
</tr>
<tr>
<td>modelocking, 107</td>
<td></td>
</tr>
<tr>
<td>modulational instabilities, 580</td>
<td></td>
</tr>
<tr>
<td>molecular dynamics, 450</td>
<td></td>
</tr>
<tr>
<td>momentum, 112</td>
<td></td>
</tr>
<tr>
<td>– conservation of, 404</td>
<td></td>
</tr>
<tr>
<td>monoclinic crystal, 648</td>
<td></td>
</tr>
<tr>
<td>Monte Carlo sampling, 551, 593</td>
<td></td>
</tr>
<tr>
<td>Moore’s law, 551</td>
<td></td>
</tr>
<tr>
<td>morphology, xxv, 447–448, 452, 458, 468</td>
<td></td>
</tr>
<tr>
<td>– helicoidal, 456–457, 466</td>
<td></td>
</tr>
</tbody>
</table>
Index

– matchstick, 452
– nematic, 455
c surface, 559
moth-eye coating, 495
Mueller matrix, 678
multipass filtering, 479
multichromophore array, 155–156. See also dendrimers
multilayer filter, 499
multiply transmissive filter, 497
multipole, 147

N
NAN, 125
nanocrystal, 559–560
nanoengineering, xxv, xxvii, 47, 448
nanohole, 413, 415, 422, 430
– light-circuiting in, 413
nanohole array, 404, 409
nanoholes in metal, 440
nanoparticle, 422, 429, 434
– light-circuiting in, 422
nanoscate imaging, 427
nanostar, 149
nanowaveguide, 520
narrow tapered grooves, 430
narrow-band filtering, 479, 496–497
NAT, 125
natural optical activity, 21–22
near field, 556
near-field scanning optical microscope, 414
negative differential conductivity, 528
negative group-velocity medium, 357
negative phase-velocity medium, 347, 349, 357–358
negative-index medium, 357
nematic morphology, 455
Neumann, K.G., 9
Neumann principle, 21, 23
NNDN, 125
noise current, 533
noise, immunity to, 549–550
Noll, W., 13
non-Bragg order, 131
nondepolarizing optical systems, 682
nonhomogeneity, xxvi, xxvii, 29, 43, 458, 461, 480
nonlinear chromophore, 129
nonlinear dynamics, 550
nonlinear medium, 47
nonlinear optics, 106, 403, 551, 571
nonlinearity, xxvi, xxvii
nonlinearity enhancement, 335
nonlocality, 40, 43
nonreciprocal medium, 50–51
normal modes, 256
nucleation, 350

O
O wave, 256
observable, 593
Ohm’s Law, generalized, 397, 399, 414
one-dimensional photonic crystals, 367
opal glass, 563
optical activity, 45, 68, 456, 645, 647
optical bandwidth, 495
optical bistability, 415
optical cavity, 578
optical constants, 677
optical filter, 398, 461, 464, 467
optical homogeneity, 64
optical indicatrix, 648, 651
optical interconnect, 465
optical properties, uniformization of, 550, 563
optical rotation, 68, 75, 457, 651
optical switching, 398, 415
optical system, 677, 682
optoelectronic network, 495
orientability, 23
orientational enhancement, 129
orthonormal beams, 609, 611, 617, 621, 623, 628–629
orthorhombic crystal, 453
oscillation, relaxation, 553
Oseen transformation, 486

P
p-dci, 125
pair, 18
pattern formation, 571
PBPEs, 125
percolation, 398, 409
percolation threshold, 398, 415, 560
perfect lens, 347, 357
permeability, 34–35, 398
– relative, 35, 355
– negative real, 349, 356
permittivity, 34–35, 398
– relative, 35, 354
– negative real, 349, 356
permittivity dyadic, 43
permittivity modulation, 405
permittivity tensor, 678–680
phase discontinuity, 497
phase grating, 483
phase retarder, 455
phase-velocity, 351, 404
– negative, 351, 353
phase-conjugation, mutual, 551
phasor, 32, 41, 350, 459
phonon mode, 677, 692
photoactive material, 141
photoconductor, 122
photoelasticity, 620
photon, 550, 558
photon statistics, 552
photonic bandgap material, chiral, 464
photonic bandgap, 370
photonic bandgap material, 461
photonic crystals, 366
– nonreciprocal magnetic, 182
photorefractive polymer, 122–123
– fully functionalized, 126
photosensitive center, 128
photosynthesis, 142–143
photovoltaic effect, 122, 142
physical vapor deposition, 447–448, 455
piezoelectricity, 461
piezomagnetoelectric effect, 178
piezotoroidic effect, 187
pitchfork, 574
pixel, 584
plane wave, 109, 350, 353, 399–400, 610, 616, 618, 621, 627
plaser (powder laser), 550
plasma, 37, 40, 246, 253–254
plasma current, 250, 252, 262
plasma frequency, 38, 249, 252–253, 255, 433
plasma, magnetized, 28
– cold, 38, 54
– warm, 41
plasmon localization, 398
PMMA, 125
PNA, 125
PNP, 124
point group, 80
– symbols, 96
Poisson’s ratio, 234
polar tensor, 649
polar vector, 8
polarimeter, 645, 647
polarizability dyadic, 321–322
polarization, 108, 563
– circular, 462
– degree of, 563
– electric, 36, 47, 348
– magnetic, 36. See also magnetization
polarization crosstalk, 490
polarization filters, 455, 463, 467, 499
polarization management, 495
polarization multiplexing, 496
polarization routing, 479, 499
polarization sensitivity, 495
polarization-maintaining optical fiber, 495
polarization-sensitive filter, 492
polarization-specific filter, 498
polarizer, 455
polarizing beamsplitter, 499
pole, 384–385
poly-L-lactic acid, 661
polymer, 124, 440, 555, 557
porosity, 449, 466
positive phase-velocity medium, 358
Post constraint, 51–52, 54
potential, scalar, 402
powder laser, 549, 553
power intensification, 245, 261–263
Poynting vector, 383
– time-averaged, 42, 347, 350, 354
precession, 134
propagation, 350, 354
precipitation, 134
preprocessing, 134
pressure, electron, 37
pressure, radiation, 354
primitive fields, 31, 42, 349
principal value, 36
probability density function, 593
propagation, 109, 370
– guided-wave, 110, 117
– paraxial-wave, 117
property tensor, 82
protein, 647
pseudo-isotropy, 466
pseudoscalar, 20–21
pseudoscalar-valued integral, 10
pulse detection, 106
pulse generation, 106
pulse modulation, 106
pulse propagation, 106
pulse bleeding, 465
pulse shaper, 465
pulse shaping, 107
Purcell effect, 537
PVK, 124
quantum dot, 107, 550, 562
quantum electrodynamic (QED), 145, 148, 152, 157
quantum mechanics, 28, 49
quantum well, 105
– semiconductor, 105
– multiple, 112
quantum-well intermixing, 105
 quasi-normal modes, 384
quasi-patterns, 577
quasi–phase matching, 105
quasi-phase matching grating, 105
R
R wave, 256, 257
Raman spectroscopy, 415, 549, 559, 562
– surface-enhanced, 559
random cell, 430, 436
random laser, 553–554, 557
– liquid, 554
random material, 398
random preorganization, 550
randomness, 549–550, 559, 564
rare-earth material, 151
Rayleigh scattering, 403
Rayleigh–Wood anomaly, 464
reciprocity, 34, 50, 52
reflection, 8, 353, 375, 376, 402, 461, 681
reflector, 455, 464
refraction, 353
refractive index, 122, 258–259, 261, 349, 401
– complex, 350–351
– negative, 349, 355
– condition for, 351
regression, 594
relative permittivity tensor, 483
residue operator, 384
resonance, 111, 353, 385, 397, 404, 408, 411
resonance energy transfer, 145
resonance linewidth, 352
resonance wavelength, 352
resonant frequency, 255
resonant interaction, 117
resonant mode, 385
resonator, stochastic, 558
Rham cohomology, 10
Ricci-Curbastro, G. (Ricci), 12
Riemann–Christoffel tensor, 10, 15, 20
Riemannian world, 13
ring laser, 22
rugate filter, 464

S
Sagnac effect, 8, 20
sample, statistical, 592
saturable absorber, 578
scalar Bragg grating, 497
scanning electron microscope (SEM), 564
scatter, Lambertian, 563
scattering, 356, 367, 398, 400
– multiple, 555
– random, 551
scattering losses, 326
scattering matrix, 380, 382, 384
Schouten, J.A., 8, 18
Schrödinger, E., 12
Schultz, A.K., 22
sculptured nematic thin film, 457, 459, 464
sculptured solid-state dielectric films, 699
sculptured thin film, 47, 448, 456, 480, 482, 502.
See also chiral sculptured thin film
– chiral, 456, 459, 461
– slanted, 464
second harmonic, 105, 467
self-assembly, 559
self-conjugation, 551, 558
self-focusing, 107
self-organization, 549–551, 556, 564, 585
self-shading, 450, 452, 454
semiconductor, 49, 106, 448, 578
– compound, 113
sensor, fluid, 449, 460, 464
sensor, optical, 461
separatrix, 582
shape dyadic, 320
sieve, 467
silicon, 450
silver, 408, 429, 559
silver thiogallate, 669
simple medium, 34
simulation, 580
single feedback mirror, 577
skin effect, 404
slow-wave coefficient, 519
slowly varying amplitude approximation, 110
Snoek’s relation, 305
solar cell, 449
solar energy, 142, 425
solar selective absorbers, 427, 433
soliton, spatial, 107, 197, 571
Sölter filter, 464, 495
Sommerfeld, A., 12
sound waves in liquids, 615
SP resonance, 436
space-charge field, 122, 127
space-guide, 465

T
tantalum oxide, 455, 462
Tellegen representation, 42, 51, 54. See also constitutive relations, Tellegen
temporal discontinuity, 246–248, 252–253, 258
Index

757

tensor, 30
tensor distinction, domain pair, 86
tensor distinction, domains, 83
tensor distinction, global, 85
tensor invariants, 92
Terfenol-D, 224, 237, 240
thermal barrier, 467
thermoelectric material, 304
thin film, 267
third harmonic, 116, 526
three-layer film, 269
tight-binding approximation, 511, 513
time-varying medium, 245–246
titanium oxide, 455, 462
TNF, 124, 125
topological concepts, 10
toroidal moments, spontaneous, 180, 185–187
toroidal effects, 187
touching particles, 438, 440
transfer matrix, 686
transition energy, interband, 116
transition frequency, 112
– interband, 112
transmission, 355, 461
– light-induced, 408
– resonant, 404, 415
transmission matrix, 368, 373
transmittance, 375, 402
– extraordinary light. See extraordinary light trans-
mittance
– nonresonant, 406
transverse propagation, 256
trilocal approximation, 327
Truesdell, C.A., 13
tunability, 461
tunneling, 106, 122, 253
twinning group, 88
– completely transposable, 90
two-beam coupling, 123, 127, 130
two-dimensional photonic crystals, 378
two-wave approximation, 400

U
ultrasonic applications, 466
ultrasonic diffraction gratings, 636
uniaxial anisotropy, 45, 50, 228–229, 231, 324, 454, 467

uniformization, 550, 563
upconversion, 152, 155

V
vacuum, 28, 34, 454
van Dantzig, D., 10, 12, 22
vapor flux, 450
vector analysis, 8
vibration ellipse, 65
Villari effect, 239–240
virtual photon, 146, 157
virus entrapment, 467
void, 398, 452, 456
Voigt, W., 16, 197, 199
Voigt notation, 226
volume fraction, 321
volume magnetostriction, 230, 234

W
wave mixing, 127
wave propagation, 108, 459, 731
waveguide, 107
– planar, 116
– rib-loaded, 110
wavelength division multiplex, 106
wavelength, free-space, 352
wavenumber, 403
– free-space, 350
wavepacket, 376
waveplate, 456
wavevector, 110
whistler mode, 258, 261
Wiedemann effect, 240–242
wiggler magnetic field, 245, 252, 260, 262

X
X wave, 256

Y
Young’s modulus, 234, 239–240

Z
Zeeman energy, 228, 236
zigzag carbon nanotube, 510, 512
zinc oxide, 555
zirconium oxide, 455