# Brief Newsletter from World Scientific

February 2017

Exclusive Interview with
**2003 Nobel Laureate**
One of the Top Condensed Matter Theorists
and **World Scientific Author**

# Anthony Leggett

**Sir Professor Anthony James Leggett is a distinguished physicist who was awarded the Nobel Prize in Physics in 2003 for his pioneering contributions to the theory of superconductors and superfluids. He is currently a professor at the University of Illinois at Urbana-Champaign.**

**Prof Leggett gave a presentation at the 2016 APS March Meeting in Baltimore, USA on "Reflections on the past, present and future of condensed matter physics". In a phone interview, he shared with us some of his thoughts and further musings on the future of condensed matter physics.**

## Paradigm Shift and Our Quest for the Unknown

**Chad Hollingsworth**

***Your talk at the APS March Meeting 2016 mentioned developments that you classified as "paradigm shifts". Are there any recent discoveries that you would classify as paradigm shifts?***

Well, if we go slightly outside the area of condensed matter physics as it has been conventionally defined, then, undoubtedly, any revolution which overthrew the view of quantum mechanics as a complete account of the world would, I think, certainly qualify as a paradigm shift.

***What is the likelihood of a discovery in condensed matter physics in the next few decades that would classify as a "paradigm shift"?***

If we're asking for the next few decades, I don't know. I'd probably give the probability of something like a bit below fifty percent, but certainly not zero.

***You also mentioned the "rugged seashore" analogy and its focus on the relationship between what is "known" and what is "unknown".***

Right, and my point there was to refer to huge tips of land extending into the sea where we know an awful lot (about the land). Right next to them, though, are parts of the sea running inland where we know very little (of).

***Based on that analogy, do you find more value in exploring what is "known" and making sure no stone is left unturned? Or do you think it's better to continue on to the "unknown" and take risks with research?***

That probably depends on your current tenure status! Certainly, if you have a secure, tenured job (as I have been fortunate enough to have for the last few decades), then I think most certainly it's better to explore the unknown. But, of course, I appreciate that in the current employment situation, people who have not got a tenured job need to think about their future. This may well be a rather strong pressure to basically explore the known further.

***You also mentioned buzzwords such as "emergent" and "topological" in your presentation, and they've become more prevalent in condensed matter physics.***

Yes, you're probably referring to the graph in the presentation (displaying the increased use of the two terms in the past 50 years). So yes, there's been a huge explosion of these words, sometimes, I think, frankly, in a context that makes them rather meaningless. In my verbal talk, I mention that I am currently a member of something called the Center for Emergent Superconductivity, and I sometimes ask myself: What would "non-emergent" superconductivity be like? So I think certainly these terms can be overused, yes.

***So, in your opinion, are there any terms that have been around for the past 50 years like "emergent" or "topological" that you predict will start to become more common in physics publications in the next decade?***

That's an interesting question. Maybe "protected"? Of course, that goes along with "topological" to a large extent, but that seems to have become a lot more fashionable recently.

***You also mentioned in your presentation that the "outreach" to other disciplines has been a factor in the evolution of condensed matter physics in the past 60 years. Are there areas of discipline specifically in the Asia Pacific region that can enhance future areas of research?***

Well, I would think that the existing close connections between condensed matter and quantum information are certainly something which is quite well developed in the region. I'm not so clear about some of the other connections; for example, I don't know of much work going on in the so-called "econophysics". There may be some, but it's not something I've particularly studied.

***Is there a particular area of condensed matter physics in Asia Pacific countries where you've noticed they're leading the rest of the world?***

Yes, I would think that, in a sense, the birth of high temperature superconductivity in the cuprates way back in the 80's, was a good case in point as a rather substantial role has been played by groups in China and Japan. They involved rather sophisticated materials that show interesting collective properties like superconductors and some of these recent monolayer materials and so forth. For example, the iron solenoid compounds, I guess, were first developed in China, so I think this has been a major strength.

***Are there any areas where you would encourage countries in this region to focus on in future research?***

I don't think my advice for this particular area of the world would be much different from what it would be for any other reasonably economically developed area. I do think that pushing the boundaries of known condensed matter physics — for example, pushing it in the direction of seeing how quantum mechanical behavior changes as we go up from the microscopic towards the mesoscopic or macroscopic level — I think that's a very interesting general area but as I said, this wouldn't be particularly specific to just the East Asian area.

***There have been many initiatives in condensed matter physics dealing with energy research and applications. Are there any particular energy paradigms that have caught your attention?***

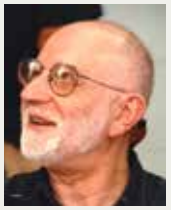
This is not something I've been into very deeply, but as far as I know, there are still only the same two major ways of using solar energy as it was way back about 50 years ago, namely, thermodynamic and photovoltaic, and I'm somewhat surprised there haven't been more developments along that front. But as I say, and it simply reflects my lack of knowledge, I'm somewhat impressed by the fact that at least until very recently, most of all the photovoltaic work does seem to be rather strongly concentrated on a particular, very special class of materials or a special class of semiconductor compounds. But again, I don't necessarily know the most up-to-date developments on that subject.

***Scientists, both young and old, will likely reach periods in their research where they might not know what questions to ask. What advice would you give to a scientist in this scenario?***

Teach! If you're in that kind of situation, of course you feel extremely frustrated. And if because of the nature of the job you've taken, or because of your current circumstances, you feel your main object in life is to do research, you're going to be extremely frustrated and depressed. I think a good remedy for that is to take a job where you can reasonably claim that your major activity is teaching. If you do a good teaching job, you've basically done your job for the week. I believe that will take you through these periods of depression about your research, so I would never let myself contemplate taking a full time job which is pure research.

# New and Upcoming Title

## World Scientific Announces Definitive Michael Berry Compendium



World Scientific is proud to announce that it will publish a definitive compendium of Sir Michael Berry's papers in 2017. Titled *A Half-Century of Physical Asymptotics and Other Diversions*, the volume is a unique summary of a career that has spanned 50 years and a body of work which continues to inspire generations of students and physicists. The collection presents to readers a selection of published and unpublished papers, reviews, tributes to other scientists, speeches and other works which ranges from the technical to the popular.

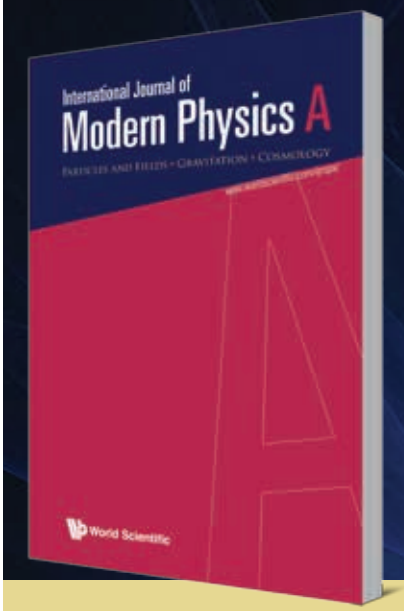
Berry phase is a phase difference acquired over the course of a cycle, when a system is subjected to cyclic adiabatic processes, which results from the geometrical properties of the parameter space of the Hamiltonian.

An important theoretical physicist who has contributed to a wide variety of areas in quantum mechanics, optics and related mathematics, Sir Michael is often associated with the Berry phase.

Sir Michael's contributions to the field have been acknowledged in the numerous awards he has garnered, including the Wolf Prize in Physics and the Lorentz Medal. Readers are invited to share his valuable insight via the careful selection of works presented in this volume.

Advance orders may be placed for the volume via the WSPC online store through the following link:
http://www.worldscientific.com/worldscibooks/10.1142/10480

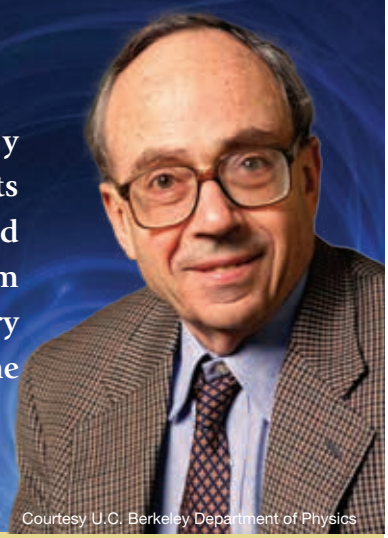
# In memory of Stanley Mandelstam (Part 1)




International Journal of Modern Physics A
Volume 32, No. 1 (2017)

**This special issue features articles by prominent physicists on the achievements of Stanley Mandelstam (1928–2016) and their personal reminiscences. Mandelstam pioneered the development of the theory of the analytic S-matrix. His work led to the discovery of dual resonance**

Part II includes articles by N. Berkovits, M. K. Gaillard, and others will be available in March/April 2017.



Courtesy U.C. Berkeley Department of Physics

**Stanley Mandelstam**, Berkeley Physics Professor Emeritus, was born in Johannesburg, South Africa. After earning his first degree at University of the Witwatersrand (Wits), in Johannesburg, he went on to earn a B.A. from Cambridge in 1954 and his Ph.D. from Birmingham University in 1956. He joined UC Berkeley in 1963 as a Professor of Physics and became Professor Emeritus in 1994. He was also an emeritus faculty member of the Berkeley Center for Theoretical Physics (BCTP).

Mandelstam's field of research was particle theory, specifically string theory. In 1958, he devised particle coding known as Mandelstam Variables — it was a way of representing the energy, momentum, and scattering angles of particles.

Prof Mandelstam was awarded the esteemed Dirac Medal for Theoretical Physics in 1991, an award given by the Abdus Salam International Centre for Theoretical Physics, Trieste, Italy to only a few of the most outstanding living theoretical physicists.

# International Journal of Modern Physics A

Particles and Fields; Gravitation; Cosmology

http://www.worldscientific.com/worldscinet/ijmpa

# Recollections of Stanley Mandelstam*

by **Geoffrey Chew** (UC Berkeley)

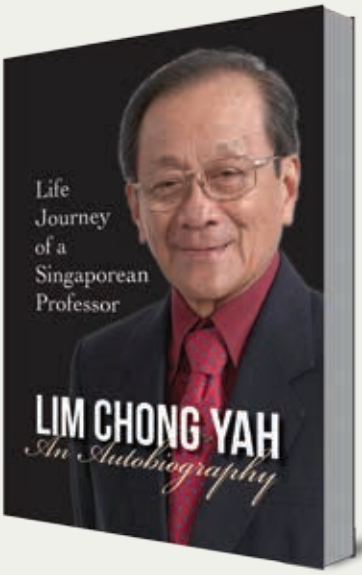
What Stanley had claimed to show was that scattering amplitudes were analytic functions of more than one complex variable. Up till then, it had been taken for granted that the scattering amplitudes are analytic functions of one complex vari- able, which was usually considered to be the energy of the scattering. But Stanley was proposing that not only the energy but also the angle involved in the scatter- ing was part of the functions of two complex variables. I became more and more persuaded that he was right, and our association continued. At the same time there was much skepticism among colleagues, questioning whether what he was proposing was correct. I can remember that another member of the faculty at Berkeley whose name was Eyvind Wichmann, who was especially skeptical. He was a very formal theoretical physicist and he simply could not believe what Stanley was proposing could be correct. He made a bet with me that within a year it would be shown that Stanley's idea was foundationally incorrect. As the year went along, more and more people became interested in what Stanley was proposing. I remember at the end of the year, Eyvind conceded (although he still did not believe that Stanley was correct) that I had won the bet, because Stanley was taken seriously by other very respectable theoretical physicists. Eyvind wrote on a sheet of paper that I had won the bet, and I believe that the bet was for 50 cents. So he attached the 50 cents to the sheet of paper and posted it on my office door where it stayed for about a year. I remember it with much amusement.

*This is a brief extract from the special IJMPA issue on Stanley Mandelstam. To access the full article and more on Stanley Mandelstam, please click on the following link
http://www.worldscientific.com/doi/abs/10.1142/s0217751x17400012

Geoffrey Chew, an American theoretical physicist, is a professor of physics at UC Berkeley since 1957 and has been an emeritus since 1991. Prof Chew is best known as a leader of the S-matrix approach to strong interaction and associated with a bootstrap theory of strong interactions. A student of Enrico Fermi, Prof Chew's students include David Gross, one of the winners of the 2004 Nobel Prize in Physics, and John H. Schwarz, one of the pioneers of string theory.

# News

## World Scientific Launches Autobiography of Renowned Professor




World Scientific launched the autobiography of Emeritus Professor Lim Chong Yah on 21 January 2017 at the National Library Building. Professor Su Guaning, President Emeritus, Nanyang Technological University (NTU), Singapore was the guest-of-honour.

Known by many as the Chairman of the National Wages Council and President of the Economic Society of Singapore, Professor Lim's autobiography recounts his experiences growing up in an occupied Malaya and explores the path of a career academic. Summarising his book, Professor Lim commented, "The 21 chapters cover the 84 years of my life from birth, childhood, school and college days, courtship, marriage, family formation, career development and the problems and challenges of the pro bono public services."

Exhibiting his sense of humour, Professor Lim quipped, "If some parts are dull or fall below your expectation, don't worry, I suggest you treat them as good antidotes against insomnia."

The royalties of the book are directed to the NTU Professor Lim Chong Yah Bursary Fund, which was established in 2007. The fund has seen contributions from 1,655 individuals and institutions and has helped 111 NTU undergraduates to date.

http://www.worldscientific.com/worldscibooks/10.1142/10340

# WSPC-ICAAS Award Winner Reports on Nobel Award Ceremony Experience

SIYSS Participants with Professor Ohsumi during the Nobel Reception

SIYSS Participants with Professor Feringa during the Nobel Reception

Limousines waiting for us outside Af Chapman

Nobel Prize Ceremony at Stockholm Concert Hall. The laureates are sitted in a row on the stage waiting to receive their prizes.

As part of World Scientific's efforts in encouraging the study and advancement of science among young people, a Singapore student is sponsored for an unforgettable trip to the Stockholm International Youth Science Seminar (SIYSS). Jointly presented by the Imperial College Alumni Association of Singapore (ICAAS), the annual WSPC-ICAAS award includes an invitation to the Nobel Award Ceremony dinner, a formal ceremony in which Nobel prizes are presented by members of the Nobel committee before being awarded to laureates by the King of Sweden.

Nan Zhihan from NUS High School was the latest winner in the 17-year history of the award. Commenting on the 2016 SIYSS, Mr Nan said, "One thing that sets the SIYSS apart from other science fairs is the exclusiveness. With a small group of 24 participants this year, there was ample opportunity for us to interact with each other and share our stories."

As part of the SIYSS, Mr Nan was also invited to visit the AstraZeneca Pharmaceutical factory and take part in cultural immersion programmes and games. Reflecting on the unique experience of interacting with Nobel laureates, he wrote, "I was inspired by the chemistry lectures as it perfectly showcases how an area of research develops over 20 years from the first discoveries to when it becomes significant and have many applications. I respect the dedication the laureates show towards their work and their passion for the science."

To read Mr Nan's report on his experience in Sweden in full, please visit
http://www.worldscientific.com/doi/story/10.1142/news.2017.01.22.241

# Vietnamese Fields Medallist Shares Valuable Insight

Fields Medallist, Professor Ngo Bao Chau, shared valuable insight in an interview session organised by the Institute of Advanced Studies (IAS) in December 2016. During the short interview, Professor Ngo shared stories of his childhood and described milestone events which sparked his interest in Mathematics at a young age. His early passion for mathematics eventually led him to the International Mathematics Olympiad, where he clinched two gold medals.

Professor Ngo also discussed previous challenges faced in his academic journey, one of which included his struggles with mathematical problems that place great emphasis on language. Though comfortable with elementary problem solving during his Olympiad years, he had difficulty adapting to problem-solving at an intermediate level, especially in terms of language utilised by the newer, tougher mathematical problems.

A breakthrough arrived when he met his supervisor, Gérard Laumon, in Paris. It was only through personally working with Laumon that he began to overcome the complexities of understanding Mathematics at a deeper level. In the eyes of Professor Ngo, Gérard Laumon was a mentor figure who possessed attributes that constitute a good PhD supervisor and left a positive impact on him.

When asked about academic goals, Professor Ngo stated that one should strike a balance between pursuing expertise in a specific area and the desire to acquire wide-ranging knowledge in the course of one's academic career. He believes that mathematicians should constantly seek new and significant problems to work on. Although working on the same problem and its variations allows one to become more specialised in that particular field, doing this may hinder the inventiveness of a person. As such, Professor Ngo finds motivation in working on new projects and expanding his vision, despite having attained the prestigious Fields Medal.

During the session, Professor Ngo also referred to a few key moments of his academic career, such as the period in which he worked on the proof of the fundamental lemma for the unitary groups. The paper he eventually published on the topic with Gérard Laumon clinched the Clay Research Award in 2004. Another significant moment was when he finally worked out the proof for the general case of the fundamental lemma. Previous fruitless research resulted in great frustration for Professor Ngo and the turning point occurred when he met Mark Govesky, one of the creators of the "perverse sheaf", after a seminar at IAS Princeton. Govesky provided him with crucial information on the sheaf property which helped Professor Ngo fill in the gaps almost instantly. Subsequently, Professor Ngo attained the Fields Medal for the proof of the general case of the fundamental lemma in 2010.

Besides his passion for Mathematics, Professor Ngo also has a deep interest in culture and the arts. To him, mathematics is an important part of culture as it emphasises precise expression, just like literature and visual arts, each of which have their unique modes of expressing specific concepts and feelings. Professor Ngo perceives Mathematics to be similar to these forms of art, as it too, captures the process in which the mathematician — like an artist — endures hardships to complete a piece of work.


Gain insight into Professor Ngo's work in *Proceedings of the International Congress of Mathematicians 2010 (ICM 2010)*, available on WSPC Online
http://www.worldscientific.com/worldscibooks/10.1142/7920

# Social Sciences New Titles

World Scientific Lecture Notes in Economics: Volume 3

## Econometric Models for Industrial Organization

By: **Matthew Shum** *(Caltech)*


Economic Models for Industrial Organization focuses on the specification and estimation of econometric models for research in industrial organization.

Recent empirical work in industrial organization has moved towards dynamic and equilibrium models, involving econometric methods which are distinct from those used in other areas of applied economics. These lecture notes are aimed at a first or second-year PhD course, seeking to motivate and explain these econometric methods, starting from simple models and building to models with the complexity observed in typical research papers.

Topics covered include discrete-choice demand analysis, models of dynamic behavior and dynamic games, multiple equilibria in entry games and partial identification, and auction models. Essential reading for graduate students and researchers in the field.

http://www.worldscientific.com/worldscibooks/10.1142/10033

## The Economies of China and India

Cooperation and Conflict (In 3 Volumes)


Volume 1: China and India: The International Context and Economic Growth, Manufacturing Performance and Rural Development

Volume 2: Competitiveness, External Cooperation Strategy and Income Distribution: Changes in China

Volume 3: Economic Growth, Employment and Inclusivity: The International Environment

Editor-in-chief: **John Whalley**

Edited by **Manmohan Agarwal** *(Centre for Development Studies, India & Research and Information Systems for Developing Countries, India),*

**Jing Wang** *(University of Western Ontario, Canada),* **John Whalley** *(University of Western Ontario, Canada & Centre for International Governance Innovation (CIGI), Canada & National Bureau of Economic Research (NBER), USA)*

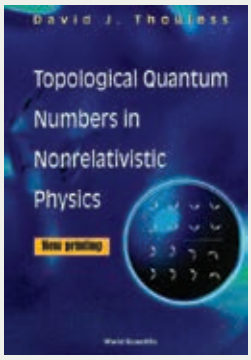
China and India, the two largest developing countries, are developing rapidly both internally and externally. This 3-volume set tries to answer questions regarding the nature of the relationship between the two economies by providing comprehensive analyses that cover the scope of varied economic issues.

This set covers both China's and India's strategies and objectives in international governance, their bilateral and multilateral trade agreement negotiations, financial liberalization, growth prospects, rural development and agriculture, income distribution, labor market mechanism, manufacturing and competitiveness upgrading, as well as environmental and other social issues.

The collected papers (most of which were previously unpublished) written by Chinese and Indian researchers who have rich experiences and strong backgrounds in policy analyses and are well-connected to Chinese and Indian policy makers. Thus, these papers contain valuable first-hand information about China's and India's development strategies. An invaluable source of reference for China–India comparisons and studies.

http://www.worldscientific.com/worldscibooks/10.1142/9993

# Reviews



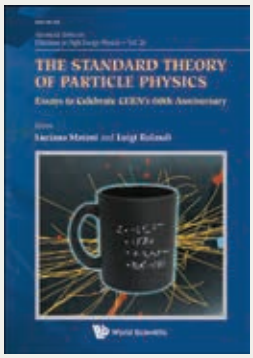

## Topological Quantum Numbers in Nonrelativistic Physics

by **David J Thouless** *(University of Washington, Seattle)*

***"This book is a collection, with commentary, of papers which over the last three decades of the last century pioneered some of the topological considerations which are today recognized as fundamental in many-body physics. As recognized by the award of the 2016 physics Nobel prize, David Thouless has been the dominant figure in this development, and his lucid and magisterial survey of the field is as useful to-day as when the book was first published. This is "must-read" for anyone starting research in the area of topological insulators or superconductors, the quantum Hall effect or indeed much of modern condensed matter physics."***

**Anthony J Leggett**
Nobel laureate in Physics

http://www.worldscientific.com/worldscibooks/10.1142/3318




Advanced Series on Directions in High Energy Physics: Volume 26

## The Standard Theory of Particle Physics

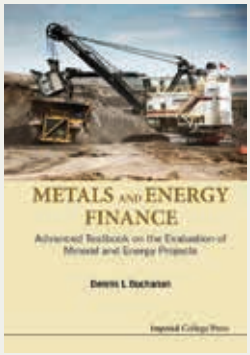
### Essays to Celebrate CERN's 60th Anniversary

Edited by **Luciano Maiani** *(INFN, Italy & University of Rome, Italy)* & **Luigi Rolandi** *(CERN, Switzerland & Scuola Normale Superiore di Pisa, Italy)*

***"The charm of this book is that it combines deep theoretical concepts at the origin of the theory, written by some of the most prominent historical pioneers of the field in an accessible way that makes a pleasant reading, with younger experimental authors who were leading analyses at recent and today's collider experiments, sharing their insider expertise."***

**Peter Jenni**
CERN

http://www.worldscientific.com/worldscibooks/10.1142/9878




## Metals and Energy Finance

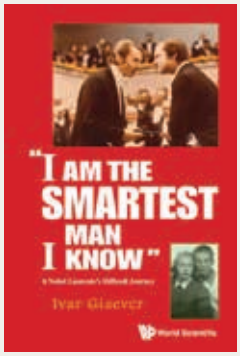
### Advanced Textbook on the Evaluation of Mineral and Energy Projects

by **Dennis L Buchanan** *(Imperial College London, UK)*

***"Dennis L Buchanan has managed in a fairly short textbook to include most of the important factors to consider when evaluating a mining, coal or oil project. Metals and Energy Finance has a strong academic basis, but could be very useful to professionals in the field of project finance and to investors wanting to equip themselves with knowledge before going out to look for funding.."***

**Mineral Economics**

http://www.worldscientific.com/worldscibooks/10.1142/P1051




## "I am the Smartest Man I Know"

### A Nobel Laureate's Difficult Journey

by **Ivar Giaever** *(Applied BioPhysics, Inc., USA)*

***"This is a wonderful story, from Ivar Giaever's life in a Norwegian village, through Canada, and to General Electric in Schenectady, his experiments on electron tunneling into superconductors, and the Nobel prize. It is told in his distinctive and unique way of speaking, making it like listening to the story over a cup of coffee, or a glass of Akvavit. Don't be put off by the title, which has a story of its own, but doesn't sound at all like the book reads. We are also treated to his views on life, which are always a little different from what one might have expected."***

**Walter A. Harrison**
Professor Emeritus of Applied Physics
Stanford University

http://www.worldscientific.com/worldscibooks/10.1142/10021