The Shaw Prize

The Shaw Prize is an international award to honour individuals who are currently active in their respective fields and who have recently achieved distinguished and significant advances, who have made outstanding contributions in academic and scientific research or applications, or who in other domains have achieved excellence. The award is dedicated to furthering societal progress, enhancing quality of life, and enriching humanity's spiritual civilization.

Preference is to be given to individuals whose significant works were recently achieved and who are currently active in their respective fields.

Founder of The Shaw Prize

Mr Shaw, born in China in 1907, was a native of Ningbo County, Zhejiang Province. He joined his brother's film company in China in the 1920s. During the 1950s he founded the film company Shaw Brothers (HK) Limited in Hong Kong. He was one of the founding members of Television Broadcasts Limited (TVB) launched in Hong Kong in 1967. As an established figure in the film and media industry, Mr Shaw gained insight into the needs of the people, and as a visionary he saw how, in addition to the fleeting escapism of entertainment, the more substantial benefits of education and healthcare would greatly impact lives for the better. He established two charities: The Shaw Foundation Hong Kong and The Sir Run Run Shaw Charitable Trust, both dedicated to the promotion of education, scientific and technological research, medical and welfare services, and culture and the arts.

The Shaw Foundation quickly gained momentum in a wide range of philanthropic work: supporting educational institutions as well as hospitals and clinics in Hong Kong, the rest of China and beyond. Expanding his vision into new areas convinced him that the quest

Mr Run Run Shaw

for knowledge is key to sustaining the advancement of civilization, and strengthened his belief that scientists focussed on unmasking the mysteries of nature are pivotal to the well-being of mankind. He decided to use his modest influence, by establishing the Shaw Prize, to inspire and recognize imaginative individuals committed to scientific research and to highlight their discoveries. The Award continues to gain in stature, casting a beam of recognition on outstanding scientific achievements, and firing the imagination of pioneers who follow him in spirit and in deed, sustaining the continued success of the Shaw Foundation and the Shaw Prize Foundation as lasting tributes to his wisdom and generosity.

Messsage from the Chief Executive

I would like to extend the most cordial congratulations to the five laureates of the Shaw Prize this year.

Their exceptional achievements represent a profound advance for the frontiers of our knowledge in the fields of Astronomy, Life Science & Medicine, and Mathematical Sciences. The pursuit of deepening human understanding has always been a formidable and delicate task. The Shaw Prize Laureates of 2017 have shown brilliant dedication in approaching this work of a lifetime.

I believe that the accomplishments of these five Laureates are an affirmation of humankind's potential to strive for a positive future. Like any other time, there will be many remarkable challenges for society in ours. We only know to surmount them with time and patience, perseverance and extraordinary efforts. The Shaw Laureates of 2017 have

**The Honourable
Mrs Carrie Lam
Cheng Yuet-ngor**

spoken for our hopeful possibilities in their contributions to civilization.

I leave the 2017 Shaw Laureates with my best wishes for the future. May they continue to serve as an inspiration to all who aspire to follow in their footsteps.

Mrs Carrie Lam
Chief Executive
Hong Kong Special Administrative Region

Message from the Chairman of the Board of Adjudicators

The Shaw Prize was established by the late Mr Run Run Shaw in 2002 to honour international scientists in the fields of Astronomy, Life Science and Medicine, and Mathematical Sciences. Since the first prizes were awarded in 2004, many Shaw Prize Laureates have gone on to gain recognition by other prestigious international awards including the Nobel Prize. It gives me great pleasure to introduce the 2017 Laureates.

The 2017 Prize in Astronomy is awarded to Simon D M White of the Max-Planck-Institut für Astrophysik for his contributions to the understanding of structure formation in the Universe. With powerful numerical simulations he has shown how small density fluctuations in the early Universe developed into galaxies and other nonlinear structures.

The Prize in Life Science and Medicine is awarded to Ian R Gibbons of the University of California, Berkeley and Ronald D Vale of the University of California, San Francisco, for their discovery of microtubule-associated motor proteins: engines that power cellular and intracellular movements essential to the growth, division, and survival of human cells.

The Prize in Mathematical Sciences is awarded to János Kollár of Princeton University and Claire Voisin of College de France for their remarkable results in many central areas of algebraic geometry which have transformed the field and led to the solutions of long-standing problems that had appeared to be out of reach.

Yuet-Wai Kan

Yuet-Wai Kan
Chairman, Board of Adjudicators
Shaw Prize 2017

The Shaw Prize Medal

The front of the medal displays a portrait of
Run Run Shaw, next to which are the words and
Chinese characters for the title of "The Shaw Prize".
On the reverse, the medal shows the award category,
the relevant year and the name of the prizewinner.
A seal of imprint of the Chinese phrase "制天命而用之"
(quoted from Xun Zi – a thinker in the warring states
period of Chinese history in 313 – 238 BCE) meaning
"Grasp the law of nature and make use of it"
appears in the upper right corner.

AGENDA

Arrival of Officiating Guest and Laureates

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Welcome Speech by Professor Yuet-Wai Kan
Member of the Council
Chairman of the Board of Adjudicators, The Shaw Prize

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Speech by Professor Reinhard Genzel
Member of the Board of Adjudicators
Chairman of the Selection Committee for the Prize in Astronomy

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Speech by Professor Randy W Schekman
Member of the Board of Adjudicators
Chairman of the Selection Committee for
the Prize in Life Science and Medicine

****

Speech by Professor W Timothy Gowers
Member of the Board of Adjudicators
Chairman of the Selection Committee for
the Prize in Mathematical Sciences

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Award Presentation

Grand Hall
Hong Kong Convention and Exhibition Centre
26 September 2017

AWARD PRESENTATION

Astronomy

Professor Simon D M White

Life Science and Medicine

Professor Ian R Gibbons

and

Professor Ronald D Vale

Mathematical Sciences

Professor János Kollár

and

Professor Claire Voisin

Professor Reinhard Genzel

Member of the Board of Adjudicators
Chairman of the Selection Committee for the Prize in Astronomy

Professor Reinhard Genzel, born in 1952 in Germany, is the Director and Scientific Member at the Max Planck Institute for Extraterrestrial Physics, Garching, Germany, Honorary Professor at the Ludwig Maximilian University, Munich since 1988 and Professor in the Graduate School, UC Berkeley (since 2017).

He received his PhD from the University of Bonn in 1978. He was a Postdoctoral Fellow at Harvard-Smithsonian Center for Astrophysics, Cambridge, Massachusetts (1978–1980), an Associate Professor of Physics and Associate Research Astronomer at Space Sciences Laboratory (1981–1985) and a Full Professor of Physics at UC Berkeley (1985–1986).

Professor Genzel has received many awards, including Newton Lacy Pierce Prize (1986), Leibniz Prize (1990), Janssen Prize (2000), Balzan Prize (2003), Petrie Prize (2005), the Shaw Prize in Astronomy (2008), Jansky Prize (2010), Karl Schwarzschild Medal (2011), Crafoord Prize in Astronomy (2012) and Tycho Brahe Prize (2012), Herschel Medal of the Royal Astronomical Society (2014), Great Cross of Merit (with Star) of Germany (2014), Honorary Doctorate (Dr.h.c.), Paris Observatory OPSPM (2014), Harvey Prize in Science and Technology, Technion Israel Institute of Technology (2014).

He is a member of the European Academy of Sciences, the German Academy of Natural Sciences Leopoldina, the Bavarian Academy of Sciences. He is also a Foreign Member/Foreign Corresponding Member/Associate of the Academy of Sciences of France, the US National Academy of Sciences, the Royal Spanish Academy, and the Royal Society of London. He is also Member of the Order Pour Le Merite for Science and Arts of the Republic of Germany.

The Prize in Astronomy 2017

Simon D M White

**for his contributions to understanding
structure formation in the Universe.
With powerful numerical simulations
he has shown how small density fluctuations
in the early Universe develop into galaxies
and other nonlinear structures,
strongly supporting a cosmology
with a flat geometry,
and dominated by dark matter
and a cosmological constant.**

An Essay on the Prize in Astronomy 2017

Perhaps the most important recent result in cosmology is the development of a cosmological standard model that explains a remarkable variety of observational phenomena in the Universe. In this model, small initial fluctuations in density existed near the Big Bang, perhaps generated via quantum fluctuations. Between that time and the present, 13.8 billion years later, these small fluctuations developed into the rich observed structure that characterizes the current Universe: galaxies with a wide range of sizes, masses, luminosities, and appearance; groups and gigantic clusters of galaxies, and a vast, complex cosmic web of gas and galaxies connecting the largest clusters. The evolution of this cosmic structure is determined in principle by the well-known laws of gravity, hydrodynamics, and relativity; but solving these equations has been an immense challenge.

Over the past four decades Simon White, together with an exceptional group of collaborators and students, has developed *N*-body computer simulations as a new tool of extraordinary power, yielding fundamental insights into cosmic structure formation. The recent "Millennium simulation" captures with great precision the time evolution of cosmic structure between 10 million years after the Big Bang to the present, with over 10,000 million particles representing dark matter distributed in a cube of 2.2 billion light years on a side. In post-processing of this simulation, White, Springel and their colleagues also added models of the small-scale physical processes that govern the evolution of normal matter within the dark matter halos. The formation of stars in galaxies results from a competition between gas cooling and the ejection of matter from the galaxies through the action of supernovae and massive black holes. These semianalytic methods were first proposed by White and Frenk in 1991, and their current predictions for galaxy properties match a remarkable variety of observations, such that such simulations are beginning to approach the age-old dream of "creating the Universe in a computer".

White has investigated and illuminated almost every aspect of the current paradigm of nonlinear structure formation. Already in 1976 he conducted numerical experiments showing that strong sub-clustering was expected during gravitational collapse, plausibly explaining the lumpy structure of many nearby clusters of galaxies. In 1978 White and Rees were the first to suggest that galaxies form by the collapse of dissipative, normal matter gas to the centres of much larger halos composed of dissipationless dark matter of unknown nature. In the early 1980s White and his collaborators Davis, Efstathiou, and Frenk carried out the most influential early numerical studies of nonlinear structure formation in a realistic cosmological model. They showed that if neutrinos have enough mass

to account for most of dark matter, then their relativistic motion in the early universe would have inhibited the growth of structure, contradicting observations. This deduction set an upper limit to neutrino masses — one of the first times that cosmology produced important new constraints on the properties of elementary particles.

As an alternative to neutrinos, White and his collaborators argued that the dark matter was probably "cold", i.e., the initial velocity dispersion of the dark-matter particles relative to the overall expansion of the Universe was negligible. Some years later, Navarro, Frenk and White showed from *N*-body simulations that the density profiles of halos of cold dark matter are described remarkably well by a simple two-parameter empirical law now known universally as the NFW profile.

In 1993 White, Evrard, Frenk and Navarro noted that the ratio of normal to dark matter in clusters of galaxies is much larger than the ratio expected based on the relative abundances of hydrogen and helium produced in the Big Bang, and assuming a critical density Universe dominated by dark matter. Their observation provided a strong argument for a lower density of dark matter, so that the majority of the mass-energy in the Universe is in the form of a cosmological constant, now often called dark energy.

The problem of determining the origin of galaxies and other structures in the Universe has occupied cosmologists for a century. The remarkable advances in our theoretical understanding, with White as a leader over several generations of increasingly realistic modelling, will form the foundation for even more sophisticated work in the decades to come, which will finally allow a detailed understanding of how these structures came to be. These outstanding achievements make White a fitting recipient for the 2017 Shaw Prize.

Recent precision observations of the cosmic background radiation and the spatial distribution of galaxies, the distribution of intergalactic gas, and many other phenomena have verified the validity of the cosmological standard model. Powerful telescopes and surveys are probing the predictions of White and his colleagues with unprecedented accuracy, and much of the scientific motivation of billion dollar ground- and space-based telescopes that are now being planned or are under construction is to further test our understanding of cosmic structure formation and what it tells us about the age, size, geometry, content, and origin of the Universe, and in addition what it tells us about fundamental physics.

Simon D M White
Laureate in Astronomy

I was born on 30 September 1951 to Gwynneth Hallett, a housekeeper in a small seaside boarding house in Kent. I never met my father. My mother and I moved from one live-in job to another until 1956 when she married her then employer, George Symmons, a retired naval cook 30 years her senior. That year, I entered a one-room rural primary school, walking two miles each way from our cottage in South-East Cornwall. Struck by my precociousness, the teacher alerted the county educational psychologist and a few years later I took the entrance exams for Christ's Hospital, a school for poor children founded in 1552 in the City of London but now located in the Sussex countryside.

I attended CH (then a boarding school for boys only) from 1962 until 1968. A reserved schoolboy, my academic strengths were in languages, mathematics and physical sciences, I enjoyed choral and instrumental music-making and I was an indifferent but enthusiastic sportsman. In late 1968 I won an Exhibition to study mathematics at Jesus College, Cambridge. Between school and university I spent six months in Paris following courses in French civilization at the Sorbonne. This created a lifelong interest in French language, literature, art and culture.

In Cambridge, I found myself gradually more attracted to Applied than to Pure Mathematics. I also took up rowing and spent part of my summers on student-run holiday camps for disadvantaged German children, resulting in greatly improved spoken German which was to be useful later. In my final year I was particularly enthused by a stellar dynamics course from Donald Lynden-Bell, so when Donald offered me a PhD place at the Institute of Astronomy, I gladly accepted.

First, however, I spent a year in Toronto, learning some observational astronomy and spending three weeks in Chile on a project which led to my first publication, a photometric study of a young star cluster. During this year, I became interested in the mystery of the "missing mass" and formulated the main project for my PhD, an exploration of whether the dark matter in galaxy clusters could be bound to the individual galaxies. I addressed this with my first computer experiment, a simulation of cluster formation where all mass was attached to galaxies. Finishing my thesis early, I spent my last few student months simulating galaxy mergers and working with Martin Rees on what has become the standard paradigm for galaxy formation, the cooling and condensation of gas within massive halos that grow gravitationally out of pre-existing dark matter.

Over the next six years, I had postdocs in Berkeley and Cambridge and made extended visits to the National Radioastronomy Observatory, the Institute for

Advanced Study, the Institut d'Astrophysique de Paris and the Institute for Theoretical Physics. During this period I met Carlos Frenk, who became a lifelong collaborator, and Judith Jennings, a Californian engineer with whom I shared an enthusiasm for English Folk Dance. We got married in 1984. In Berkeley, Carlos and I worked with Marc Davis to show that dark matter could not be made of massive neutrinos, and then joined with George Efstathiou in a simulation project which showed that Cold Dark Matter (CDM), a new kind of elementary particle, could explain the observed large-scale structure of the Universe.

Although the CDM hypothesis was viewed with scepticism in the 1980's, it had enough impact that I was offered a tenured faculty post at the University of Arizona in 1984, and within a few years I became Full Professor in the Steward Observatory. Theoretical astrophysics grew substantially during my time in Arizona, but by the end of the decade I had become unhappy with my personal and social situation and in 1990 I moved back to Europe to a post at the Institute of Astronomy in Cambridge.

At IoA, I worked with Carlos to put my early galaxy formation ideas into a CDM context. This was extended by my student and second wife Guinevere Kauffmann to create "semi-analytic modelling", a technique which later allowed us to populate cosmological simulations with galaxies, culminating in the well-known Millennium Simulation of 2005. In 1994 I became director of the Max Planck Institute for Astrophysics (MPA) in Garching, and moved there with Guinevere who subsequently provided key observational constraints for semi-analytic models using large galaxy surveys, and was appointed scientific director at MPA in 2013. Our son Jonathan was born in 1996. In this period, I also worked with Carlos Frenk and Julio Navarro on my most highly cited work, showing that dark matter halos have a simple structure which is closely related to the properties of the universe in which they form.

For two decades my MPA group and I have worked with collaborators worldwide to produce ever more realistic simulations of cosmic structure formation. This programme would have been impossible without my former MPA student, Volker Springel who created much of the necessary software infrastructure and carried out some of the highest impact simulations, in particular, the Millennium Simulation. In 2017 Volker was offered a directorship at MPA as my successor. For 40 years I have been lucky to ride a tidal wave of progress both in numerical simulation technology and in our understanding of cosmic structure formation. This has been extraordinarily exciting, and I am grateful to the Max Planck Society for providing an ideal context for the second half of this career. On June 24 2016, the day after the Brexit vote, I filed papers for German citizenship.

Professor Randy W Schekman

Member of the Board of Adjudicators
Chairman of the Selection Committee for the Prize in Life Science and Medicine

Professor Randy W Schekman is a Professor in the Department of Molecular and Cell Biology, University of California, Berkeley, and an Investigator of the Howard Hughes Medical Institute. When he joined the faculty at Berkeley, he developed a genetic and biochemical approach to the study of eukaryotic membrane traffic, which reveals how proteins enter and move between membrane-bound compartments of cells.

Among the honours he has earned are the Gairdner International Award, the Albert Lasker Award in Basic Medical Research in 2002, and the Nobel Prize in Physiology or Medicine in 2013 — which he shared with James Rothman of Yale University and Thomas Südhof of Stanford University — for their discoveries of the mechanism regulating vesicle traffic, a major cellular transport system. In 2011, he was appointed Editor-in-Chief of the open access journal, "eLife", sponsored by the HHMI, The Wellcome Trust/UK and the Max Planck Society.

The Prize in Life Science and Medicine 2017

Ian R Gibbons

and

Ronald D Vale

**for their discovery of
microtubule-associated motor proteins: engines that
power cellular and intracellular movements
essential to the growth, division,
and survival of human cells.**

An Essay on the Prize in
Life Science and Medicine 2017

Animals and plants possess an elaborate network of intracellular filaments that organize the transport of the cell's building blocks with the precision of a well-engineered motorway. Some cargoes being transported within cells move over short distances (a millionth of a meter) whereas other cargoes, particularly those in nerve cells, must traverse distances as large as a meter from the cell body to the tip of a nerve terminal. All of this transport is produced by molecular motors, proteins that themselves are less than one ten millionth of a meter in size.

The first such molecular motor system was discovered in muscle. The filaments are composed of a protein called actin. During muscle contraction, actin filaments slide past one another, powered by a motor protein called myosin. This action of myosin was first described in muscle tissues in the 1950s and was discovered in the 1970s to power contractile events in non-muscle cells as well.

Eukaryotic cells also have another type of filamentous network composed of a protein called tubulin, which assembles into cylindrical tracks called microtubules. Membrane compartments and other cargoes are moved long distances along microtubules inside of the cell. Microtubules and their associated motors also provide the basis of the beating motion of cilia, such as those found in the cells lining the respiratory tract, or in the flagella, which propel sperm in their fluid environment. During cell division, microtubules and motor proteins also organize the segregation of chromosomes, the hereditary material that duplicates and then partitions equally into the two daughter cells.

Ian Gibbons and Ron Vale discovered the two families of microtubule motor proteins – dynein and kinesin. Humans have more than sixty genes encoding different dyneins and kinesins that generate all of the forms of motility described above and many more. These motors are essential for all eukaryotic life.

In order to isolate dynein from the single-cell eukaryote Tetrahymena, Gibbons used an enzyme assay that measures the hydrolysis of ATP, the chemical energy source used by molecular motors to power motion. His elegant experiments showed that the enzyme activity of dynein is tightly coupled to the bending waves of axonemes, the microtubule structure that comprises cilia and flagella. Perhaps the most breathtaking experiment from this early period was the demonstration of dynein-driven sliding of neighbouring microtubules within the axoneme after solubilizing the membrane and adding ATP. Gibbons devoted the rest of his career

to understanding how dynein works. He cloned and sequenced the dynein gene, which revealed that dynein is an unusual type of ATPase with six linked domains in one polypeptide. We now appreciate that dynein activity contributes not only to the motility of axonemes of cilia and flagella, but also to all forms of intracellular transport including membrane transport and chromosome segregation.

As a very young scientist, Vale developed ways of studying, in a test tube, the intracellular transport system of nerve cells. These new motility assays led to the discovery of kinesin, the third type of cytoskeletal motor protein. His discovery opened a biologically important field of research that has flourished over the subsequent 30 years, resulting in more than 6000 papers in the literature.

Having opened this field of research, Vale attacked the central question of how these motors work. He developed single molecule assays for kinesin and dynein that showed how these motors walk along a microtubule. Vale and colleagues also determined the first crystal structures of kinesin (which revealed to great surprise ancient structural homology with myosin) and dynein. He also uncovered how ATP hydrolysis leads to structural changes in these motor proteins, which drive motion and force production.

Vale also has contributed in significant ways to science education. He co-directed the Physiology Course at the Marine Biological Labs at Woods Hole, Massachusetts. He has advanced science education and culture in India, where he has founded an annual light microscopy course, an annual meeting for young scientists, and a website and organization for Indian biologists (IndiaBioscience). Perhaps most impressive, Vale created a free, online educational programme called iBiology. iBiology, whose videos are viewed in 175 countries, has the future ambition of explaining scientific discoveries to the general public.

The microtubule motors discovered by Gibbons and Vale lie at the heart of key aspects of human biology. Without these motors, embryonic development, cell division, and the function of the nervous system and other organs would be impossible. Indeed, diseases ranging from neuropathy, neurodegeneration, kidney disease, developmental disorders and infertility have been linked to genes that encode these motor proteins. Once again, a discovery in basic science illuminates a fundamental property of cells that is so critical to human health.

Ian R Gibbons
Laureate in Life Science and Medicine

I was born 30 October 1931 in Rye, a small town in the south-east of England. Both of my parents came from generations of small family farmers. One of my earliest childhood memories is of listening to Prime Minister Neville Chamberlain's radio broadcast on the day war broke out in September 1939 after which I began avidly following the news on the radio that my parents allowed by my bedside. Soon after, I managed to construct a short wave radio with a purchased kit, and began listening to news broadcasts from around the globe. My fascination with radio led to a subscription to Wireless World magazine, which further encouraged my enthusiasm for science with its famously prescient 1945 article by Arthur C Clarke on the potential for radio broadcasting from geostationary satellites.

Starting in 1943, I attended Faversham Grammar School, then a state-funded school that had been originally founded by Queen Elizabeth I in 1665, where I obtained an excellent education with a strong emphasis on mathematics, physics and chemistry. Although I enjoyed maths, my real enthusiasm was for practical physics, where my liking for details encouraged me to try small changes that might improve the final accuracy of my experiments.

Following an 18-month detour performing National Service as a radar mechanic in the Royal Air Force, I entered King's College Cambridge in 1951 to read for a degree in physics. My advisor foresaw the future expansion of biological research and recommended that I prepare myself by taking side courses in physiology and biochemistry. After graduation, I was offered a research studentship on biological applications of electron microscopy in the Cavendish lab at Cambridge. My colleagues in the EM Unit were the first real social group that I had joined since leaving home and formed my first group of scientific kindred spirits.

Upon leaving Cambridge, I obtained an electron microscopy position at Harvard University with the agreement of devoting half my time to my own research. My supervisor, George Wald, invited me to join his active lunch group, where by good fortune I met my future wife, research biochemist Barbara Hollingworth. In addition to science, Barbara and I shared interests in hiking and classical chamber music, as well as a strong belief in non-religious family bonds. We were fortunate enough to have an enduringly happy marriage, as well as a highly productive research collaboration until her death in 2013.

For 50 years, I continued working on the biomolecular mechanisms of cell motility, first at Harvard, where I discovered, named and characterised the founding member of the dynein ATPase family of motor proteins and other microtubular components in cilia and flagella. Then in 1967 we moved to the University of Hawaii's Kewalo Marine Laboratory, where Barbara and I combined biochemical techniques with light and electron microscopy of sea urchin sperm flagella, to advance our understanding of microtubule-based motility.

By 1971, we were able to produce structurally-weakened flagella that seemed to just disappear upon exposure to ATP under a regular light microscope. I knew that dark field microscopy with a very powerful light source, such as the sun, was the way to see how the apparent "disappearance" of the flagella actually occurred. But our most powerful light source was a simple 6 volt lamp. Not to be deterred, Barbara and I returned to the lab after dark one evening to test an idea. With Barbara watching over my shoulder I was rewarded by being able to see for the first time the actual sliding apart of the weakened flagella into their component doublet microtubules in response to the addition of ATP. To a well dark-adapted eye, the faint scattered light from individual microtubules was visible even with just that 6 volt lamp. Our elation over the clarity and significance of this demonstration of ATP-dependent microtubule sliding certainly marked one of the major high points of life with dynein.

Over the next two decades, our lab continued to develop innovative techniques such as using a modified polymerase chain-reaction to determine a complete sequence for the exceptionally heavy polypeptide subunit forming a dynein motor. This opened dynein to study by molecular biological procedures in many laboratories, rapidly revealing the highly conserved structure and broad functional importance of the dynein motor family in eukaryotes.

By 2005, after I had retired from Hawaii and was working part-time at the University of California Berkeley, my lab had designed and synthesized multiple stabilized forms of dynein's microtubule-binding domain with different binding affinities for microtubules, some of which yielded well-diffracting protein crystals. Analysis of binding affinity of the different forms, in collaboration with Ron Vale's lab, enabled description of the sliding coiled-coil mechanism involved in modulating dynein's affinity for microtubule binding during its mechanochemical ATPase cycle. Continuing the collaboration, X-ray analysis of the crystals enabled us to determine an atomic structure for this domain, the first functional region of the dynein motor studied at this resolution.

Given the recent discoveries of dynein's critical importance in human health, my fifty years with it were a well spent journey.

Ronald D Vale
Laureate in Life Science and Medicine

My roots did not originate in science. I was born in Hollywood; my mother, Evelyn, was a former stage actress and my father, Eugene, a novelist and screen/television writer. I went to elementary school with Michael Jackson and many of my high school friends pursued theatrical careers. However, I was attracted to science rather than drama. My parents, neither college educated, had broad interests and were voracious readers. My mother stimulated my interest in science by taking me to science museums. In middle school, my father took me to public lectures in astrophysics. I learned that science was as creative as the arts. There were amazing mysteries of nature waiting to be solved; perhaps one day I could solve one. If you had asked me what I wanted to become when I was 8 years old, I would have said "a scientist".

The dream of becoming a scientist became more real in high school. For my 10th grade science project at Hollywood High, I turned our basement into an experimental lab to measure circadian rhythms (the 24 hr biological clock) of the leaf movements of bean plants. Based upon this project, my high school counselor contacted Dr. Karl Hammer at UCLA, and he allowed me to continue my own experiments there. Doing science, in contrast to studying it in school, was seducing, captivating and cemented my desire to become a scientist. My high school counselor encouraged me to submit my work to the Westinghouse Science Competition and I was lucky to be selected as one of the top 40 students in the country. While I did not win a medal, I did meet other high school students who shared my interest in science, which was eye-opening and encouraging.

I attended the College of Creative Studies at the University of California Santa Barbara, which promoted independent study. I went there partially because I admired Dr Beatrice Sweeney's work on circadian rhythms. She was a dynamo; through her, I witnessed how a passion for science could remain strong throughout a career and into older age. During the summers, I worked on hormones and growth control in C Fred Fox's laboratory at UCLA. Fred was very generous and allowed me to work on my own project. During my senior year, I also worked for six months with Robert Lefkowitz at Duke University during the exciting time when his Nobel Prize winning work was being conducted.

After college, I entered the MD/PhD programme at Stanford University in 1980 and was a PhD student with Eric Shooter, a wonderful mentor, working on nerve growth factor receptors. I became interested in axonal transport and was fascinated by the breakthrough made by Mike Sheetz and Jim Spudich on developing an in vitro assay for muscle motility. After talking to Mike, we decided to work on the mechanism of axonal transport at the Marine Biological Laboratory, Woods Hole where we teamed up with Bruce Schnapp and Tom Reese. This great collaboration led to the development of in vitro microtubule-based motility assays and the discovery of a new microtubule motor protein, kinesin.

Given how well research was going, I decided not to finish my MD degree and instead accepted a faculty position at UCSF. UCSF was an energizing environment for a young cell biologist, and I had fantastic junior and senior colleagues. At UCSF, I continued my pursuit of motor proteins, including an early collaboration with my fellow Shaw Prize laureate and hero Ian Gibbons. In the 1990s, the mechanism by which kinesin works got filled in step-by-step like solving a jigsaw puzzle, aided by advances in single molecule assays and clues from crystal structures. This tiny machine, unknown 15 years earlier, became alive with vivid details of how it converts ATP energy into movement. In 2004, our attention turned to cytoplasmic dynein, which is ~8-fold larger than kinesin. We began a new journey to understand its mechanism, and, over the next ten years, details of how dynein works began to unfold. This exciting adventure also involved collaborations with Dr Gibbons. Our recent work extended in new directions including T cell signaling, mitosis, and RNA biology.

My love of science also nucleated an interest in science education and outreach. I feel a sense of responsibility to ignite in others the same wonderment and interest in science that I have felt since my childhood. These interests led me to co-direct a course at the MBL, promote science in India, start the iBiology.org project, found ASAPbio.org, and tackle additional projects to democratize global access to science.

Receiving the Shaw Prize is an unexpected and wonderful honour, and one for which I am very grateful. However, my biggest reward has been the opportunity to pursue my childhood dream of becoming a scientist and pursue a career devoted to curiosity and learning.

**Professor
W Timothy Gowers**

*Member of the Board of
Adjudicators
Chairman of the Selection
Committee for the Prize in
Mathematical Sciences*

Professor Timothy Gowers was born in Marlborough, England, in 1963. From 1973 to 1976 he was a chorister in the choir of King's College, Cambridge, after which he went as a scholar to Eton College. He studied mathematics at Trinity College, Cambridge, where he also did his PhD, under the supervision of Bèla Bollobàs. In 1989 he became a research fellow at Trinity, moving to University College London two years later as a lecturer. In 1995 he returned to Cambridge, and Trinity, where he was first a Lecturer and then a Professor. He is currently a Royal Society Research Professor and also holder of the Rouse Ball Chair in Mathematics. In the early part of his career he solved some old problems in Banach space theory, including two of Banach himself. He then discovered the first quantitative proof of Szèmèrèdi's theorem and has subsequently worked in additive combinatorics. For this work he was awarded a Fields Medal in 1998.

The Prize in Mathematical Sciences 2017

János Kollár

and

Claire Voisin

**for their remarkable results in
many central areas of algebraic geometry,
which have transformed the field and
led to the solution of long-standing problems
that had appeared out of reach.**

An Essay on the Prize in
Mathematical Sciences 2017

Since ancient times, a central theme in mathematics has been the study of polynomials and their solutions. Algebraic geometry is the study of the properties of sets of solutions to polynomial equations in several variables. A simple example of such an equation is $x^2+y^2+z^2 = 1$, the solution set of which is the surface of a sphere of radius 1.

As this example demonstrates, solution sets of polynomial equations, which are known as *varieties*, are geometric objects. Examining the interplay between the algebra and the geometry has turned out to be remarkably fruitful, and algebraic geometry is a major branch of mathematics, the study of which has profound consequences not just for algebra and geometry but also for several other areas ranging from number theory to mathematical physics.

For each type of mathematical structure, there is normally a notion of when two examples are essentially the same. For varieties, the notion is called birational equivalence: two varieties are said to be *birationally equivalent* if, after removing lower-dimensional subvarieties if necessary, there is a rational map from one to the other with a rational inverse. (A rational map is a ratio of two polynomials.) Rational varieties are those that are birationally equivalent to ordinary n-dimensional space, for some n. To give an example, for every real number t one can check that $\left(\frac{2t}{1+t^2}\right)^2 + \left(\frac{1-t^2}{1+t^2}\right)^2 = 1$, from which it follows that the map that takes a real number t to the point $\left(\frac{2t}{1+t^2}, \frac{1-t^2}{1+t^2}\right)$ sends an infinite line to the unit circle. One can check further that sending a point (x, y) in the unit circle to the real number $(1 - y)/x$ inverts this map. There is a small problem here in that no value of t maps to the point $(0, -1)$, but this point on its own is a zero-dimensional subset, which we are allowed to ignore. Thus, a circle is birationally equivalent to ordinary 1-dimensional space, which means that it is a rational variety.

Some of the most exciting advances in algebraic geometry over the past few decades have been in better understanding the birational classification of higher-dimensional varieties. For example, Shigefumi Mori won the Fields Medal for his "Minimal Model Program", which attempts to find in each birational equivalence class a unique simplest variety. There have also been very important breakthroughs

in characterizing rational varieties: that is, in finding ways of telling whether a variety is rational.

Along with his work on birational classification, Kollár's most recent work stands out in a direction that will greatly affect algebraic geometry in the decades to come, as an important complement of the Minimal Model Program: the definition and study of moduli of higher-dimensional varieties, which can be thought of as sophisticated geometrical structures whose points represent equivalence classes of these varieties. The importance of this area can be seen in the immense wealth of papers on the moduli problem in dimension 1, which today occupies topologists, combinatorialists and, perhaps most of all, physicists. Already for surfaces the treatment of moduli is an extremely subtle and difficult problem. Kollár's ideas have almost defined the field of higher-dimensional moduli.

Among Voisin's major achievements is the solution of the Kodaira problem, which starts with the observation that every deformation of a complex projective manifold is a Kähler manifold (which roughly speaking means a geometric set that locally has a structure compatible with the complex numbers) and asks whether the converse is true. She found counterexamples: that is, Kähler manifolds that do not just fail to be deformations of projective manifolds but are not even topologically equivalent to projective manifolds. Another of Voisin's pioneering accomplishments is the establishment a new technique for showing that a variety is not rational, a breakthrough that has led to results that would previously have been unthinkable. A third remarkable result is a counterexample to an extension of the Hodge conjecture, one of the hardest problems in mathematics (it is one of the Clay Mathematical Institute's seven Millennium Problems), which rules out several approaches to the conjecture.

Algebraic geometry is a central area of mathematics that has seen many remarkable developments in its history, and these developments continue to the present day. In their different ways, János Kollár and Claire Voisin have made profound contributions to algebraic geometry that will deeply influence the future of the subject.

János Kollár
Laureate in Mathematical Sciences

I was born in 1956 in Budapest, Hungary, the oldest of six children in a close family full of engineers and musicians. I was a bookish child, interested mostly in history, adventure stories and the sciences. Around age eight I developed a strong stammer, which further led me to reading. The stammering gradually subsided over the next fifteen years, but hints of it remain with me, especially when I am tired of giving talks.

In elementary school I was an undistinguished student, getting middling grades in many classes but doing well in the few that interested me. Luckily my parents had confidence in me, and for high school sent me to the Piarist Fathers. Their school, called the Budapesti Piarista Gimnázium, was founded in 1717. During the communist years it was barely tolerated by the government, but it was probably the best school in Hungary. After getting many failing grades in the first weeks, I came to understand that I had to work hard, and by the end of the first year I was near the top of my class. This was really the experience that started me on the path toward knowledge and science. My two most influential teachers were János Pogány, who taught mathematics, and Zoltán Fórián-Szabó, who taught physics and chemistry.

It was also at this time that I got involved in mathematics competitions. These had a long tradition in Hungary; the first competition for high school students was established in 1894. Those who did well were invited to participate in a monthly meeting where we worked on developing our problem-solving skills. This was a great opportunity to meet other students who were also interested in mathematics, and spur each other on to do better. Each year the best of us were sent to the International Mathematical Olympiad. I was selected twice and returned with a gold medal both times.

After a year of mandatory military service, I enrolled in Eötvös Loránd University in Budapest as a mathematics student. Here I was mostly influenced in my first year by László Babai and later by Ervin Fried. They told me that there was this large branch of mathematics, called algebraic geometry, which was completely unknown in Hungary at that time. So I decided to learn it. For two years I worked

completely alone, with only a few books. It was slow going, with nobody to consult, but it resulted in my learning the foundations very well. After that I spent two semesters in Moscow as an exchange student, where I attended the lectures of Iskovskikh and Manin, and the seminar of Shafarevich. At the end of university I applied to enter the PhD programme in Moscow. I had strong support from the Russian mathematicians, but, to my surprise, the examiner failed me on the required Marxism-Leninism exam. I was very disheartened, but this turned out to be one of the great lucky twists in my life.

I had met David Eisenbud when he visited Hungary during my undergraduate years, so when Moscow fell through I wrote to him, asking to be a student in the USA. This was somewhat illegal at that time, so my whole application consisted of that letter. He arranged for a full scholarship for me, and in 1981 I arrived at Brandeis University, where I studied with Teruhisa Matsusaka. He taught me to aim to be not only a technician but a scientist, maybe even a natural philosopher. It was also there that I met my wife, Jennifer Johnson.

I graduated in 1984 and started a Junior Fellowship at Harvard. The Fellowship gave me an opportunity to spend three months in Nagoya and begin my collaboration with Shigefumi Mori. This turned out to have a decisive influence on my work, both in our joint papers, books and in my work ever since.

In 1987 I accepted an invitation from Herb Clemens and joined the mathematics department at the University of Utah in Salt Lake City. The next twelve years were very fruitful, with several visits by Mori, Miyaoka, Voisin, and three intense Summer Seminars where dozens of young algebraic geometers came together to work on the rapidly developing minimal model programme, the moduli theory of canonical models and the early stages of the study of rationally connected varieties. These three topics have been the main areas of my research ever since. It is also in Salt Lake City that our daughter Alicia was born; she is currently a Postdoc at Princeton in experimental physics.

In 1999 we moved to Princeton University, where we have been ever since. Since then I have learned the most from my students, especially from ongoing collaborations with Alessio Corti, Sándor Kovács and Chenyang Xu. I hope to continue learning for many years to come.

Claire Voisin
Laureate in Mathematical Sciences

I was born in 1962 in a small town in the Northern suburbs of Paris. My parents married in 1945 and had nine children before me (they ended-up with twelve children), so I grew up with many sisters and brothers, most of them older than me, in a curious atmosphere influenced by the 60's spirit but also very much turned towards intellectual life. My father was an engineer who liked science and taught me a lot of classical geometry (circle and triangle) and my mother, who had stopped studying during the Second World War, was very fond of art. She was extremely enthusiastic about Impressionist painting and the subsequent development of Modern Art. She began studying history of art at Ecole du Louvres when she was in her 50's. I left the family home when I was seventeen having gained a Fellowship from the government, and studied first for two years in Classes préparatoires at Lycée Louis-le-Grand. I then entered Ecole normale supérieure of Sèvres: at that time the female branch of ENS was still separated from Ulm, which accepted only male students. There and at Jussieu I studied most sorts of mathematics until I started my PhD thesis at Orsay under the direction of Arnaud Beauville. My thesis, proving the Torelli theorem for cubic fourfolds, already involved the theory of Hodge structures developed by Griffiths, which is still an ingredient of a large part of my research, being a rich tool to study many different sorts of questions concerning algebraic varieties and their moduli.

I defended my PhD thesis in 1986, the same year I got a permanent research position at CNRS, which I kept until 2016. I am now Professor at Collège de France, which is a different institution. In 1984, I married Mathematician Jean-Michel Coron and we have five children, born between 1987 and 1997. In 1987, I met Kollár who at that time was Professor at the University of Utah in Salt Lake City where I was supposed to stay as a postdoc with Herb Clemens but having left my baby in Paris, I found the separation too hard and after one month finally decided to return. Starting from that period, for many years I spent most of my time at home, except of course for attending seminars, and found it very convenient doing research there. Now that our children are grown up, I travel much more, but sometimes I regret the period where my life was mostly centred

at home and divided between doing research and raising my children. Of course, I owe much to the French system of childcare and also to my husband who always shared all the family duties with me. In the 2000's, at the week-ends we used to work in a quiet place close to our house: I went there to work in the morning when I felt more fresh, and Jean-Michel worked there in the afternoon.

For a long period, between 1989 and 2012, we lived in Bourg-la-Reine in the South of Paris, in a big family house that was perfect for a large family and had a lot of character, but proved hard to sell when we decided to start a new life in Paris as our children had started to leave. We now live in the 5th arrondissement, a very quiet part of Paris where many institutes are traditionally located, like Sorbonne, Institut Henri Poincaré, Collège de France and Ecole Normale Supérieure. I like this area of Paris, sometimes called Montagne Sainte-Geneviève or Quartier latin, where I had previously lived when I was a student in Lycée Louis-le-Grand, and also later on when I attended courses at Jussieu.

The period 2002–2005 has been quite good for my research. I obtained results on syzygies of curves (the Green conjecture for generic canonical curves), a part of my research which does not involve Hodge theory, then I solved negatively the Kodaira problem, constructing compact Kähler manifolds not homeomorphic to projective ones. This work, to the contrary, was entirely based on the formal study of Hodge structures. The next work I am particularly proud of is my recent contribution to the Lüroth problem, giving a method to detect irrational varieties. This work has known many spectacular further developments. There are many other aspects of algebraic geometry I am interested in, like Chow groups and the Bloch conjectures, hyper-Kähler manifolds (construction and moduli), positivity problems for cycles, variations of Hodge structures etc. In fact, as I get older, I find there are more and more open problems I would like to attack.

What I like in algebraic geometry is a good balance between algebra and geometry and also a good balance between the theory (due to the major foundational work of the 1950–60's) and the objects: the geometry provides a rich sample of classes of objects and discovering the adequate tools to understand these various classes and distinguish them is actually interesting and makes us fully appreciate the general theoretical machinery at our disposal (e.g. Hodge theory, or K-theory and Chow groups, and of course, more general algebraic geometry, schemes, cohomology theory, moduli, Hilbert schemes…).

Organization

Preparatory Committee (Until July 2003)★

Front row, from right to left

★ Professor Kwok-Pui Fung (Member)
Head, United College, The Chinese University of Hong Kong;

★ Professor Lin Ma (Promoter)
Chairman, Board of Trustees, Shaw College, The Chinese University of Hong Kong;

Professor Chen-Ning Yang (Chairman, Board of Adjudicators)

The late Mr Run Run Shaw (Founder of The Shaw Prize) (1907 – 2014)

★ Professor Yue-Man Yeung (Chairman)
Director, Hong Kong Institute of Asia-Pacific Studies,
The Chinese University of Hong Kong;

★ Mrs Mona Shaw (Member)
Chairperson, The Shaw Prize Foundation.

Back row, from right to left

★ Mr Raymond Wai-Man Chan (Member)
Director, Shaw Movie City Hong Kong Limited;

★ Professor Pak-Chung Ching (Member)
Pro-Vice-Chancellor & Head of Shaw College,
The Chinese University of Hong Kong;

★ Professor Samuel Sai-Ming Sun (Member)
Chairman, Department of Biology, Faculty of Science, The Chinese University of Hong Kong;

★ Professor Kwok-Kan Tam (Member)
Department of English, Faculty of Arts, The Chinese University of Hong Kong;

★ Professor Sunny Kai-Sun Kwong (Member)
Associate Professor, Department of Economics, Faculty of Social Sciences,
The Chinese University of Hong Kong;

Mr Charles Cheuk-Kai Cheung

Mr Koon-Fai Chor (Secretary)

Remarks: Titles of Members were then as of July 2003.

The Shaw Prize 2004

From right to left

The late Sir Richard Doll (1912–2005)
Laureate in Life Science and Medicine

Professor James Peebles
Laureate in Astronomy

Professor Stanley Cohen
Laureate in Life Science and Medicine

The late Mr Run Run Shaw (1907–2014)
Founder of The Shaw Prize

Mr Chee-Hwa Tung
The then Chief Executive of HKSAR

Professor Herbert W Boyer
Laureate in Life Science and Medicine

Professor Yuet-Wai Kan
Laureate in Life Science and Medicine

The late Professor Shiing-Shen Chern (1911–2004)
Laureate in Mathematical Sciences

The Shaw Prize 2005

From right to left

Professor Michel Mayor
Laureate in Astronomy

Professor Geoffrey Marcy
Laureate in Astronomy

The late Mr Run Run Shaw (1907–2014)
Founder of The Shaw Prize

Mr Rafael Hui
The then Acting Chief Executive of HKSAR

Sir Michael Berridge
Laureate in Life Science and Medicine

Professor Andrew Wiles
Laureate in Mathematical Sciences

SHAW PRIZE

The Shaw Prize 2006

From right to left

Professor Brian Schmidt
Laureate in Astronomy

Professor Adam Riess
Laureate in Astronomy

Professor Saul Perlmutter
Laureate in Astronomy

Mr Donald Tsang
The then Chief Executive of HKSAR

The late Mr Run Run Shaw (1907–2014)
Founder of The Shaw Prize

Professor Xiaodong Wang
Laureate in Life Science and Medicine

Professor David Mumford
Laureate in Mathematical Sciences

The late Professor Wentsun Wu (1919–2017)
Laureate in Mathematical Sciences

The Shaw Prize 2007

From right to left

Professor Peter Goldreich
Laureate in Astronomy

Professor Robert Lefkowitz
Laureate in Life Science and Medicine

The late Mr Run Run Shaw (1907–2014)
Founder of The Shaw Prize

Mr Henry Tang
The then Acting Chief Executive of HKSAR

Professor Robert Langlands
Laureate in Mathematical Sciences

Professor Richard Taylor
Laureate in Mathematical Sciences

The Shaw Prize 2008

From right to left

Professor Reinhard Genzel
Laureate in Astronomy

Sir Ian Wilmut
Laureate in Life Science and Medicine

The late Professor Keith H S Campbell (1954–2012)
Laureate in Life Science and Medicine

The late Mr Run Run Shaw (1907–2014)
Founder of The Shaw Prize

Mr Donald Tsang
The then Chief Executive of HKSAR

Professor Shinya Yamanaka
Laureate in Life Science and Medicine

The late Professor Vladimir Arnold (1937–2010)
Laureate in Mathematical Sciences

The late Professor Ludwig Faddeev (1934–2017)
Laureate in Mathematical Sciences

The Shaw Prize 2009

From right to left

Professor Frank H Shu
Laureate in Astronomy

The late Professor Douglas L Coleman (1931–2014)
Laureate in Life Science and Medicine

The late Mr Run Run Shaw (1907–2014)
Founder of The Shaw Prize

Mr Donald Tsang
The then Chief Executive of HKSAR

Professor Jeffrey M Friedman
Laureate in Life Science and Medicine

Professor Simon K Donaldson
Laureate in Mathematical Sciences

Professor Clifford H Taubes
Laureate in Mathematical Sciences

The Shaw Prize 2010

From right to left

Professor Charles L Bennett
Laureate in Astronomy

Professor Lyman A Page Jr
Laureate in Astronomy

Professor David N Spergel
Laureate in Astronomy

The late Mr Run Run Shaw (1907–2014)
Founder of The Shaw Prize

Mr Donald Tsang
The then Chief Executive of HKSAR

Professor David Julius
Laureate in Life Science and Medicine

Professor Jean Bourgain
Laureate in Mathematical Sciences

THE SHAW PRIZE 2010
邵 逸 夫 獎

The Shaw Prize 2011

From right to left

Dr Enrico Costa
Laureate in Astronomy

Dr Gerald J Fishman
Laureate in Astronomy

Professor Jules A Hoffmann
Laureate in Life Science and Medicine

Professor Ruslan M Medzhitov
Laureate in Life Science and Medicine

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Professor Bruce A Beutler
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Professor Demetrios Christodoulou
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Professor Richard S Hamilton
Laureate in Mathematical Sciences

THE SHAW PRIZE 2011
邵逸夫獎

The Shaw Prize 2012

From right to left

Professor Arthur L Horwich
Laureate in Life Science and Medicine

Professor Franz-Ulrich Hartl
Laureate in Life Science and Medicine

Mr CY Leung
The then Chief Executive of HKSAR

Professor David C Jewitt
Laureate in Astronomy

Professor Jane Luu
Laureate in Astronomy

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Laureate in Mathematical Sciences

The Shaw Prize 2013

From right to left

Professor Michael W Young
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Professor Michael Rosbash
Laureate in Life Science and Medicine

Professor Jeffery C Hall
Laureate in Life Science and Medicine

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The then Chief Executive of HKSAR

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The Shaw Prize 2014

From right to left

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Laureate in Astronomy

Professor Shaun Cole
Laureate in Astronomy

Professor John A Peacock
Laureate in Astronomy

Mr CY Leung
The then Chief Executive of HKSAR

Professor Kazutoshi Mori
Laureate in Life Science and Medicine

Professor Peter Walter
Laureate in Life Science and Medicine

Professor George Lusztig
Laureate in Mathematical Sciences

The Shaw Prize 2015

From right to left

Mr William J Borucki
Laureate in Astronomy

Professor Bonnie L Bassler
Laureate in Life Science and Medicine

Professor E Peter Greenberg
Laureate in Life Science and Medicine

Mr CY Leung
The then Chief Executive of HKSAR

Professor Gerd Faltings
Laureate in Mathematical Sciences

Professor Henryk Iwaniec
Laureate in Mathematical Sciences

The Shaw Prize 2016

From right to left

Professor Kip S Thorne
Laureate in Astronomy

Professor Rainer Weiss
Laureate in Astronomy

Mr CY Leung
The then Chief Executive of HKSAR

Professor Adrian P Bird
Laureate in Life Science and Medicine

Professor Huda Y Zoghbi
Laureate in Life Science and Medicine

Professor Nigel Hitchin
Laureate in Mathematical Sciences

Remarks: The late Professor Ronald W P Drever (1931–2017),
Laureate in Astronomy, was unable to participate in the ceremony

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Professor Chen-Ning Yang

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Professor Yuet-Wai Kan

Professor Kenneth Young

Professor Pak-Chung Ching

Professor Wai-Yee Chan

Founding Member

**Professor
Lin Ma**

Professor Lin Ma is Senior Advisor of the Board of Trustees of Shaw College and was Professor of Biochemistry (1972–1978) and Vice-Chancellor (1978–1987) of The Chinese University of Hong Kong; he is Emeritus Professor of Biochemistry and has published largely on protein chemistry. Professor Ma also served as Chairman of the Board of Trustees of Shaw College, The Chinese University of Hong Kong (1987–2011) since its inauguration. He has received honours from Great Britain, Japan and Germany, and honorary degrees from several international universities as well as from universities in Hong Kong, Macau and China.

Professor Ma was the Convenor of two sub-groups of the Hong Kong Basic Law Drafting Committee: (1) Education, Science and Arts, and (2) Hong Kong Flag and Emblem.

Founding Member

**Professor
Chen-Ning Yang**

Professor Chen-Ning Yang, an eminent physicist, was Albert Einstein Professor of Physics at the State University of New York at Stony Brook until his retirement in 1999. He has been Distinguished Professor-at-large at The Chinese University of Hong Kong since 1986 and Professor at Tsinghua University, Beijing, since 1998.

Professor Yang has received many awards: Nobel Prize in Physics (1957), Rumford Prize (1980), US National Medal of Science (1986), Benjamin Franklin Medal (1993), Bower Award (1994) and King Faisal Prize (2001). He is a Member of the Chinese Academy of Sciences, the Academia Sinica in Taiwan, the US Academy of Sciences, the Royal Society of London, the Russian Academy of Sciences and the Japan Academy.

Since receiving his PhD from the University of Chicago in 1948, he has made great impacts in both abstract theory and phenomenological analysis in modern physics.

Council Member

**Mrs
Mona Shaw**

Mrs Mona Shaw, wife of the founder, the late Sir Run Run Shaw, is Chairperson of The Sir Run Run Shaw Charitable Trust, The Shaw Foundation Hong Kong Limited and The Shaw Prize Foundation. A native of Shanghai, China, she is an established figure in the Hong Kong media and entertainment industry and Chairperson of the Shaw Group of Companies.

Council Member

**Professor
Yuet-Wai Kan**

Professor Yuet-Wai Kan is currently the Louis K Diamond Professor of Hematology at the University of California, San Francisco and he focuses his research on the use of gene and cell therapy to treat sickle cell anemia and thalassemia. Professor Kan was born in Hong Kong, graduated from the Faculty of Medicine at the University of Hong Kong and trained at Queen Mary Hospital, Hong Kong, before going to the United States for further studies.

Professor Kan's contributions led to the innovation of DNA diagnosis and the discovery of human DNA polymorphism that have found wide application in genetics and human diseases. For his work, he has received many national and international awards including the Albert Lasker Clinical Medical Research Award, the Gairdner Foundation International Award and the Shaw Prize. He is the first Chinese elected to the Royal Society, London, and is a Member of the US National Academy of Sciences, Academia Sinica, the Third World Academy of Sciences and the Chinese Academy of Sciences. He has received honorary degrees from The University of Caglieri, Italy, The Chinese University of Hong Kong, The University of Hong Kong and The Open University of Hong Kong.

Council Member

**Professor
Kenneth Young**

Professor Kenneth Young is a theoretical physicist, and is Emeritus Professor of Physics at The Chinese University of Hong Kong. He pursued studies at the California Institute of Technology, USA, 1965–1972, and obtained a BS in Physics (1969) and a PhD in Physics and Mathematics (1972). He joined The Chinese University of Hong Kong in 1973, where he has held the position of Chairman, Department of Physics and later Dean, Faculty of Science, Dean of the Graduate School and Pro-Vice-Chancellor. He was elected a Fellow of the American Physical Society in 1999 and a Member of the International Eurasian Academy of Sciences in 2004. He was also a Member of the University Grants Committee, HKSAR and Chairman of its Research Grants Council. He served as Secretary and then Vice-President of the Association of Asia Pacific Physical Societies. His research interests include elementary particles, field theory, high energy phenomenology, dissipative systems and especially their eigenfunction representation and application to optics, gravitational waves and other open systems.

Council Member

**Professor
Pak-Chung Ching**

Professor Pak-Chung Ching is Director of Shun Hing Institute of Advanced Engineering and Choh-Ming Li Professor of Electronic Engineering of The Chinese University of Hong Kong. He received his Bachelor in Engineering (First Class Honours) and PhD degrees from the University of Liverpool, UK, in 1977 and 1981 respectively. Professor Ching is a Fellow of IEEE, IEE, HKIE and HKAES. He is Chairman of the Veterinary Board of Hong Kong and Chairman of the Board of Directors of the Nano and Advanced Materials Institute, and also member of the Board of Directors of the Hong Kong Applied Science and Technology Research Institute. Professor Ching was awarded the IEEE Third Millennium Award in 2000, and the HKIE Hall of Fame in 2010. In addition, Prof. Ching also plays an active role in community services. He was awarded the Silver Bauhinia Star (SBS) and the Bronze Bauhinia Star (BBS) by the HKSAR Government in 2017 and 2010, respectively, in recognition of his long and distinguished public and community services. His research interests include adaptive digital signal processing, time delay estimation and target localization, blind signal estimation and separation, automatic speech recognition, speaker identification / verification and speech synthesis, and advanced signal processing techniques for wireless communications.

Council Member

**Professor
Wai-Yee Chan**

Professor Wai-Yee Chan is Master of CW Chu College, Professor of Biomedical Sciences and Director of School of Biomedical Sciences, Faculty of Medicine, The Chinese University of Hong Kong (CUHK), Hong Kong. Professor Chan obtained his BSc (First Class Honours) from CUHK in 1974 and PhD from the University of Florida, Gainesville, Florida, USA in 1977. Prior to assuming his current position in June of 2009, he was Professor of Pediatrics, Georgetown University, Washington, DC, and Head and Principal Investigator, Section on Developmental Genomics, National Institute of Child Health and Human Development, National Institutes of Health, Bethesda, MD, USA.

His expertise is in developmental genomics and molecular genetics of endocrine disorders. He received the 1988 Merrick Award for Outstanding Biomedical Research and the 2008 Presidential Award from the Association of Chinese Geneticists in America. He serves on the editorial board of a number of international scientific journals and on review panels of regional and international research funding agencies.

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Selection Committee Member

**Professor
Victoria Kaspi**

Astronomy Committee

Professor Victoria Kaspi is a Professor of Physics at McGill University, where she holds the Lorne Trottier Chair in Astrophysics and Cosmology, and a Canada Research Chair in Observational Astrophysics. She is also Director of McGill Space Institute. She received a BSc (Honours) in Physics from McGill University in 1989, and an MA and PhD in Physics from Princeton University in 1991 and 1993 respectively.

Professor Kaspi uses techniques of radio and X-ray astronomy to study rapidly rotating, highly magnetized neutron stars. She has done significant work involving radio pulsars and magnetars. More specifically, she has contributed among other things to the study of binary pulsar dynamics, the neutron star population, as well as the study of magnetars, the most highly magnetized objects known in the Universe.

Professor Kaspi has received numerous awards and honours, including the Killam Prize in 2015, NSERC's John C Polanyi Award in 2011, the Prix du Quebec in 2009 and the Harvard University Sackler Lectureship in 2009. She is a Fellow of the Royal Society of Canada and the Royal Society of London, and elected to the US National Academy of Sciences and the American Academy of Arts and Sciences.

Selection Committee Member

**Professor
John A Peacock**

Astronomy Committee

Professor John A Peacock studied Natural Sciences as an undergraduate at Jesus College, Cambridge, where he also completed a PhD in Radio Astronomy in 1981. He then moved to Edinburgh, initially working as a Research Astronomer at the Royal Observatory Edinburgh, before joining the University of Edinburgh as Professor of Cosmology in 1998. He was Head of Astronomy there between 2007 and 2013. Between 2015 and 2020, he will hold an Advanced Grant from the European Research Council.

His research interests lie at the interface of observational and theoretical cosmology: the evolution of active galaxies; gravitational lensing; galaxy formation and evolution; large-scale clustering. He was UK Chairman of the 2dF Galaxy Redshift Survey (1999–2005). He is the author of "Cosmological Physics", a highly successful postgraduate textbook.

Professor Peacock has received many significant awards for his work: most notably election as a Fellow of the Royal Society (2007) and the Shaw Prize in Astronomy (2014).

Selection Committee Member

**Professor
Scott Tremaine**

Astronomy Committee

Professor Scott Tremaine received his undergraduate degree from McMaster University in Canada and his PhD in Physics from Princeton. He has held faculty positions at MIT, the University of Toronto, and Princeton.

At the University of Toronto he was the first Director of the Canadian Institute for Theoretical Astrophysics, from 1985 to 1996, and at the Princeton University he chaired the Department of Astrophysical Sciences from 1998 to 2006. He is currently the Richard Black Professor of Astrophysics at the Institute for Advanced Study in Princeton.

He is a Fellow of the Royal Societies of London and of Canada and a member of the US National Academy of Sciences. His awards include the Dannie Heinemann Prize for Astrophysics, the Tomalla Foundation Prize for Gravity Research, the Dirk Brouwer Award, and honorary doctorates from McMaster, Toronto, and St. Mary's University.

His research has been focused on the dynamics of astrophysical systems, including planet formation and evolution, planetary rings, comets, supermassive black holes, star clusters, galaxies, and galaxy systems.

Selection Committee Member

**Professor
Ewine van Dishoeck**

Astronomy Committee

Professor Ewine F van Dishoeck is a Professor of Molecular Astrophysics at Leiden University, the Netherlands, and External Scientific Member of the Max Planck Institute for Extraterrestrial Physics in Garching.

She graduated at Leiden University, and held positions at Harvard, Princeton and Caltech from 1984–1990. The research of her group is at the boundary of astronomy, laboratory astrophysics and chemistry and uses ground-based and space-based observatories. The current focus is on the physical and chemical evolution of material from interstellar clouds to planet-forming disks and the importance of molecules as diagnostics of the star-formation process.

Professor van Dishoeck holds many national and international science policy functions, including Scientific Director of the Netherlands Research School for Astronomy (NOVA), President-elect of the International Astronomical Union, former member of the ALMA Board and Co-PI of the JWST-MIRI instrument.

She has received the Dutch Spinoza Award, an ERC Advanced Grant, and the Dutch Academy Prize. She is a Member of the Dutch Royal Academy of Sciences and the Leopoldina German Academy of Sciences, Foreign Associate of the US National Academy of Sciences, and Foreign Member of the American Academy of Arts and Sciences.

Selection Committee Member

Professor
Bruce A Beutler

Life Science and Medicine Committee

Professor Bruce A Beutler is a Regental Professor and Director of the Center for the Genetics of Host Defense at UT Southwestern Medical Center in Dallas, Texas. He received his medical training at the University of Chicago, graduating in 1981. As a postdoctoral fellow at The Rockefeller University (1983–1986), he isolated mouse tumor necrosis factor (TNF) and discovered its importance as a mediator of inflammation. Subsequently, at UT Southwestern, he analyzed mammalian responses to bacterial lipopolysaccharide. This work culminated in the identification of Toll-like receptors as key sensors of the innate immune system, used to detect infection. In further studies, Professor Beutler employed a forward genetic strategy to elucidate many aspects of mammalian immunity.

He has received numerous awards for his work including the Balzan Prize (2007), the Albany Medical Center Prize (2009), the Shaw Prize (2011), and election to both the US National Academy of Sciences and the Institute of Medicine (2008). In 2011, he shared the Nobel Prize in Physiology or Medicine for "discoveries concerning the activation of innate immunity".

Selection Committee Member

**Professor
Carol Greider**

*Life Science and
Medicine Committee*

Professor Carol Greider received a BA from UC Santa Barbara in 1983 and a PhD in 1987 from UC Berkeley. In 1984, together with Elizabeth Blackburn, she discovered telomerase, an enzyme that maintains chromosome ends. In 1988, Professor Greider was appointed as a Fellow at Cold Spring Harbor Laboratory, and in 1994 was promoted to Investigator. In 1997, Professor Greider moved to Johns Hopkins University School of Medicine. In 2004, she was appointed as the Daniel Nathans Professor and Director of the Department of Molecular Biology and Genetics at Johns Hopkins University.

Professor Greider's lab currently studies telomeres and telomerase in cancer and age-related degenerative disease. Professor Greider shared the Nobel Prize in Physiology or Medicine with Professors Elizabeth Blackburn and Jack Szostak in 2009.

Selection Committee Member

**Professor
Franz-Ulrich Hartl**

*Life Science and
Medicine Committee*

Professor Franz-Ulrich Hartl is a Director at the Max Planck Institute of Biochemistry in Martinsried, Germany. After completing his medical studies he earned a D med degree in Biochemistry from the University of Heidelberg and then worked as postdoctoral fellow and group leader at the University of Munich. From 1991 to 1997 he was a Professor at Memorial Sloan-Kettering Cancer Center in New York where he was appointed HHMI Investigator in 1994. Professor Hartl's laboratory has elucidated the role of molecular chaperones in protein folding and discovered that the chaperonins — a class of ATP-driven chaperones — function as nano-cages for single protein molecules to fold unimpaired by aggregation. His recent research has focused on understanding the mechanisms underlying the toxicity of protein misfolding in neurodegenerative disease.

Among Professor Hartl's honors are the Gairdner International Award, the Louisa Gross Horwitz Prize, The Rosenstiel Award, The Wiley Prize, the Albert Lasker Award for Basic Medical Research, the Heineken Prize and the Shaw Prize in Life Science and Medicine. He was elected as a Foreign Associate of the US National Academy of Sciences in 2011.

Selection Committee Member

**Professor
Robert J Lefkowitz**

*Life Science and
Medicine Committee*

Professor Robert J Lefkowitz, MD is James B Duke Professor of Medicine and Professor of Biochemistry at the Duke University Medical Center. He has been an Investigator of the Howard Hughes Medical Institute since 1976. He has received numerous awards and honours for his research, including the National Medal of Science, the Shaw Prize, the Albany Prize, and the 2012 Nobel Prize in Chemistry. He was elected to the US National Academy of Sciences in 1988, the American Academy of Arts and Sciences in 1988, and the Institute of Medicine in 1994.

He is best known for his studies of G protein coupled receptors, a field which he has pioneered for more than forty-five years.

Selection Committee Member

**Professor
Eve E Marder**

*Life Science and
Medicine Committee*

Professor Eve E Marder received her PhD from UCSD in 1974 and did postdoctoral work at the Ecole Normale Superieure, Paris. She is the Beinfield Professor of Neuroscience at Brandeis University. In the year 2007–2008, she served as President of the Society for Neuroscience, USA.

Her honours include membership in the US National Academy of Sciences, the American Academy of Arts and Sciences, the Salpeter Award from WIN, the Gerard Prize from the SfN, the George A Miller Award from the Cognitive Neuroscience Society, the Karl Spenser Lashley Prize from the American Philosophical Society, an Honorary Doctorate from Bowdoin College, and the 2013 Gruber Prize in Neuroscience. She served on the NIH Director's BRAIN Working Group.

Professor Marder's studies in the dynamics of small neural circuits was instrumental in demonstrating that neuronal circuits are not "hard-wired" but can be reconfigured by neuromodulatory neurons and substances. Her lab pioneered studies of homeostatic regulation of intrinsic membrane properties, and stimulated work on the mechanisms by which brains remain stable while allowing for change during development and learning. Professor Marder now studies how similar network performance can arise from different sets of underlying network parameters, opening up rigorous studies of the variations in individual brains of normal healthy animals.

Selection Committee Member

**Professor
Shinya Yamanaka**

*Life Science and
Medicine Committee*

Professor Shinya Yamanaka is most recognized for his discovery of induced pluripotent stem (iPS) cells, which are differentiated cells that have been reprogrammed to the pluripotent state. He is Director of the Center for iPS Cell Research and Application (CiRA) at Kyoto University and Senior Investigator at the Gladstone Institutes in San Francisco.

Since his breakthrough finding, he has received many prestigious awards including the Shaw Prize, the Albert Lasker Basic Medical Research Award, the 100th Imperial Prize, Japan Academy Prize, and the Wolf Prize in Medicine. The significance of iPS cells was culminated with Professor Yamanaka being awarded the Nobel Prize in 2012. He was elected to the US National Academy of Sciences, the US National Academy of Medicine, the Insitute de France, the Pontifical Academy of Sciences, and the Japan Academy. In 2014, he received an honorary degree from The University of Hong Kong and was named Dr Lui Che Woo Distinguished Professor by The Chinese University of Hong Kong.

Selection Committee Member

Professor Sir John M Ball

Mathematical Sciences Committee

Professor Sir John M Ball is Sedleian Professor of Natural Philosophy and Fellow of the Queen's College at the University of Oxford, where he is Director of the Oxford Centre for Nonlinear Partial Differential Equations in the Mathematical Institute. He previously spent over 20 years in the Department of Mathematics at Heriot-Watt University, Edinburgh.

His main research interests are in applications of nonlinear analysis to mechanics, specifically problems of materials science and liquid crystals, together with related problems of the calculus of variations and infinite-dimensional dynamical systems.

He has received various awards, including the John von Neumann lecture of SIAM, the Sylvester Medal of the Royal Society, the Royal Medal of the Royal Society of Edinburgh and the David Crighton Medal of the London Mathematical Society and IMA. He is a Fellow of the Royal Societies of London and Edinburgh, and a Foreign Member of the French Academy of Sciences, the Norwegian Academy of Science and Letters, and the Istituto Lombardo. He was President of the International Mathematical Union from 2003–2006.

Selection Committee Member

Professor Annalisa Buffa

Mathematical Sciences Committee

Professor Annalisa Buffa received her degree in Computer Science in 1996 and her PhD in Mathematics in 2000. She obtained a research position at the CNR Institute IMATI (Italy) in 2001. She became Research Director in 2004 and led the Institute from 2013 to 2016. In September 2016, she joined the Mathematics Department at EPFL (Switzerland) as Full Professor.

In 2008 she was granted an ERC StG, she received the ICIAM Collatz Prize in 2015 and was awarded an ERC AdG in 2016. She was invited/plenary speaker at a number of international conferences, section speaker as International Congress of Mathematicians (2014, Seoul, Korea), and plenary speaker at ICIAM (Beijing, China, 2015). She is a member of the Academia Europaea.

Her work is focused on the numerical analysis of partial differential equations and her contributions span from functional analysis to algorithmic aspects and parallel computing.

Selection Committee Member

Professor David Eisenbud

Mathematical Sciences Committee

Professor David Eisenbud received his PhD in Mathematics in 1970 at the University of Chicago, and was on the faculty at Brandeis University before joining University of California, Berkeley, where he became Professor of Mathematics in 1997. He has served as Director of MSRI from 1997–2007 and from 2013 to the present. From 2009 to 2011 he was Director for Mathematics and the Physical Sciences at the Simons Foundation, and is currently on the Board of Directors of the Foundation. Professor Eisenbud's mathematical interests range over commutative and non-commutative algebra, algebraic geometry, topology, and computer methods.

Professor Eisenbud was President of the American Mathematical Society from 2003 to 2005. He is a Director of Math for America, a foundation devoted to improving mathematics teaching. He has been a member of the Board of Mathematical Sciences and their Applications of the National Research Council, and of the US National Committee of the International Mathematical Union. In 2006, Eisenbud was elected a Fellow of the American Academy of Arts and Sciences.

Selection Committee Member

**Professor
Dusa McDuff**

*Mathematical Sciences
Committee*

Professor Dusa McDuff, born in 1945, is the Helen Lyttle Kimmel '41 Professor of Mathematics at Barnard College, Columbia University. After completing an Undergraduate degree in Edinburgh, she received her PhD in 1971 from the University of Cambridge. After studying in Moscow and Cambridge, she served as a faculty member first at the Universities of York and Warwick in the UK, and then, from 1978 to 2007, at Stony Brook University, USA.

Dusa McDuff has been awarded numerous honors including the Ruth Lyttle Satter Prize of the American Mathematical Society in 1991, and honorary doctorates from the Universities of Edinburgh, York, St. Andrews, Strasbourg and the Pierre and Marie Curie campus of the Sorbonne, Paris.

She is a Fellow of the Royal Society of London, and of the American Academy of Arts and Sciences, as well as a member of the US National Academy of Sciences and of the American Philosophical Society.

Presenter

**Ms
Do Do Cheng**

*Award-winning Actress
Versatile TV Performer
Programme Host*

Award-winning actress, versatile TV performer and programme host Ms Do Do Cheng has starred in many TVB classic dramas and won film awards, local and international. Her hosting of the Hong Kong version of "The Weakest Link" and starring in Television Broadcasts Limited's (TVB) sit-com "War of the Genders" became talk-of-the-town. Ms Cheng's success in hosting the TVB game show on legal knowledge "Justice for All" brought her career to a new height. In addition to the 2008 Beijing Olympics for TVB, she has also been hosting many yearly events of the Company namely TVB Anniversary Gala, TV Award Presentation and Miss Hong Kong Pageant. She has also been a popular talk show host at Hong Kong Commercial Broadcasting Corporation Ltd since September 2011. From its inception in 2004, Ms Cheng has been one of the presenters for the Shaw Prize Award Presentation Ceremony.

Presenter

**Mr
Leon Ko**

Composer

Mr Leon Ko received a Richard Rodgers Development Award in the US for his musical "Heading East". His musical "Takeaway" in 2011 was the first major British Chinese musical to premiere in London. His music for the movie "Perhaps Love" won him a Golden Horse Award and a Hong Kong Film Award. He won Best Original Film Song for the movie "The Last Tycoon" at the 32nd Hong Kong Film Awards, and received another Best Song nomination for the movie "Insanity" in 2015. For the stage, he won six Best Score awards for his musicals in Hong Kong. Mr Ko was the musical director of Jacky Cheung's 2004 world tour of "Snow, Wolf, Lake". He wrote new music for the recent Cantonese opera "Shade of Butterfly and Red Pear Blossom" presented by Yam Kim Fai & Pak Suet Sin Charitable Foundation. Besides music, Mr Ko launched "Time In A Bottle", the first-ever perfume bottle exhibition in Hong Kong in 2010, showcasing the artistry of vintage bottles in the context of theatre.

Mr Ko is currently a council member of the Hong Kong Academy for Performing Arts.

In 2017, he received a Medal of Honour from the government of the Hong Kong Special Administrative Region.

Special Acknowledgement
(Airlines in alphabetical order)

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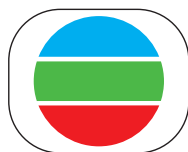

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