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
(1907 – 2014)

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 influence, and with the unfailing support of his wife Mrs Mona Shaw, established 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 am delighted to congratulate the 2019 Shaw Prize recipients for their remarkable contributions to science, to advancing our understanding of ourselves, our world and the universe we inhabit.

Since its inauguration in 2002, by Hong Kong innovator and philanthropist Run Run Shaw, the Shaw Prize has become one of the world's most distinguished honours. The annual award recognises the highest achievements in scientific and academic research, as well as its applications, in three fields: astronomy, life science and medicine, and mathematical sciences. Equally important, the Shaw Prize creates illustrious role models for others — in Hong Kong and in the global scientific and research communities — to emulate.

The Government of the Hong Kong Special Administrative Region is equally committed to promoting scientific research and innovation and technology, to expanding these sectors in our economy and our community, and to inspiring our youth to pursue rewarding careers in them. Our policy plans in science and technology are multifaceted

The Honourable Mrs Carrie Lam Cheng Yuet-ngor

and long-term. They include doubling research funding in our higher education sector to help drive R&D excellence in Hong Kong.

My thanks to the Shaw Prize Foundation for its singular generosity and its far-reaching vision. I wish this year's Shaw Laureates continuing achievement. Their inspiration expands our possibilities, and, in doing so, helps shape our future and the boundless promise it offers us all.

Carrie Lam

Mrs Carrie Lam
Chief Executive
Hong Kong Special Administrative Region

Message from the Chairman of the Board of Adjudicators

Welcome to the sixteenth annual Shaw Prize Award Presentation Ceremony. In 2002 Mr Run Run Shaw and Mrs Mona Shaw established the Shaw Prize to honour scientists in the fields of Astronomy, Life Science and Medicine, and Mathematical Sciences. The inaugural Award Ceremony took place in 2004. In the ensuing years, the Shaws' entrepreneurship and philanthropy inspired the quest for knowledge, highlighted outstanding achievements, and became a major force for progress in the world.

Despite the passing of Mr Shaw in 2014 and Mrs Shaw in 2017, the memory of their dedicated purpose and energy continues to inspire Council Members to carry on the founding vision of Mr and Mrs Shaw. Under the direction of the Shaw Prize Foundation, future generations will continue to broaden the Shaw family's programme of advancing knowledge through scientific discoveries, thus strengthening and enhancing the aims of the Shaw Prize.

Tonight, we honour three scientists in the designated fields for their distinguished contributions. They are Professor Edward Stone in Astronomy; Professor Maria Jasin in Life Science and Medicine; and Dr Michel Talagrand in Mathematical Sciences.

Frank H Shu
Chairman, Board of Adjudicators
Shaw Prize 2019

(Photo of Prof Frank H Shu©Stony Brook University)

The Shaw Prize Medal

The front of the medal displays a portrait of Mr 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 and year, the name of the laureate, and in the upper right corner, an imprint of a saying due to Xun Zi (313 – 238 BCE), a thinker in the Warring States period of Chinese history: "制天命而用之", meaning "Grasp the law of nature and make use of it".

AGENDA

Arrival of Officiating Guest and Laureates

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Welcome Speech by Professor Frank H Shu
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
25 September 2019

AWARD PRESENTATION

(Category listed in alphabetical order)

Astronomy

Professor Edward C Stone

Life Science and Medicine

Professor Maria Jasin

Mathematical Sciences

Dr Michel Talagrand

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, and 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 2019

Edward C Stone

for his leadership in the Voyager project,
which has, over the past four decades,
transformed our understanding of the four giant planets
and the outer solar system,
and has now begun to explore interstellar space.

An Essay on the Prize in Astronomy 2019

One of the longstanding dreams of humanity has been to explore our Solar System by space travel. In his 1865 novel *De la terre à la lune*, Jules Verne told the story of members of a "Baltimore Gun Club" building a huge cannon to shoot a projectile with three of the Club's members on board, for a trip to and landing on the Moon. About one century later, the USA–Soviet space race of the 1960s turned this dream into reality by developing the necessary technology and providing the resources for such ambitious endeavours. After several failures, the US Mariner 2 mission succeeded in 1962 in the first flyby of Venus, followed by the 1964 Mariner 4 flyby of Mars. Between 1966 and 1967 the Soviet missions Luna 9–13 and Venera 4 pioneered the first lunar landing and investigation of Venus's atmosphere, followed by the 1969 culmination of the Apollo 11 manned lunar landing.

In 1972/1973 the Pioneer spacecraft 10 and 11 flew by Jupiter and Saturn. The next major NASA programme, Voyager, consisted of two spacecraft launched in August/September 1977 to undertake a "grand tour" of the outer solar system. Both spacecraft flew past Jupiter and Saturn in the period 1979–1981. Voyager 2 visited Uranus in 1986, and Neptune in 1989. The Voyager data were far superior to those obtained by Pioneer. The two Voyagers' high-resolution images of the outer solar system planets and their moons fascinated all of humanity, experts and laypersons alike. These unique data are also particularly important for the study of extra-solar planets, since Uranus and Neptune now appear to be more representative of the bulk of the exoplanet population than the other solar-system planets.

The Voyager probes sent back to Earth unique information of fascinating and often strange worlds, including

- the discovery that Jupiter's satellite Io has many volcanoes, powered by tidal heating of its interior;
- the first images of the rings of Jupiter, Uranus, and Neptune, and the discovery of complex structure in Saturn's rings including gaps, narrow ringlets, waves and transient "spokes";
- the discovery that Uranus and Neptune have magnetic fields, but surprisingly with a magnetic symmetry axis that is both strongly tilted and offset relative to the planetary spin axis. Voyager also provided the first measurements of the magnetospheres of these planets, including size, density, composition, and plasma waves;
- the first detailed measurements of the atmospheres of Saturn's enigmatic satellite Titan and Neptune's satellite Triton;
- the discovery that Neptune radiates about 2.5 times as much energy as it receives from the Sun. The nature of this energy source is not yet understood;

- measurements of the composition, winds, temperature and pressure profiles of the planetary atmospheres. Neptune's atmosphere has winds of up to 2,000 km/h and a vast storm system called the Great Dark Spot;

- dramatic improvements of our knowledge of the masses, sizes, shapes, and gravitational fields of all the giant planets and many of their satellites.

Voyager 1 is now 145 times as far from us as the Sun, and has become the most distant human artefact. Many of the instruments continue to send back valuable data, more than forty years after the launch date. The Shaw Prize Astronomy Committee is convinced that *now* is the time to recognize these achievements. The most natural definition of the "boundary" of the solar system is the *heliopause*. It marks the outer boundary of the solar system, where the interstellar gas halts the solar wind. Inside the heliopause, space is filled by low-density material from the Sun, while outside it contains material from other stars. The Voyager spacecraft crossed the heliopause in 2012 and 2018, and returned data on the physical properties of the ambient plasma as the spacecraft crossed into interstellar space. This was the final milestone of the Voyager mission.

One of the explicit aims of the Shaw Prize is to recognize advances that have "*enriched humanity's spiritual civilization*". Arguably more than most other scientific endeavours, Voyager has achieved this goal through its spectacular images of unfamiliar worlds. Each spacecraft carried a "*golden record*" containing sounds and images selected to portray the diversity of life and culture on Earth and intended for a possible encounter with an advanced civilization. In 1990 Voyager 1 looked back to take a famous "*family portrait*" of the solar system planets including the image of Earth known as the "*pale blue dot*", which became a symbol for how small we are in the larger Universe. The mission is unparalleled in its duration and the unique science it has returned. The story of the researchers who devoted their entire careers to Voyager resonates strongly with a wide audience.

The dominant figure in the Voyager mission is Edward C Stone, Professor of Physics at the California Institute of Technology. He has served as Project Scientist from 1972 to the present — over 45 years — and is Principal Investigator on one of the spacecraft's 11 instruments. During the planetary encounters he became internationally known as the public spokesperson for Voyager and explained Voyager's scientific discoveries to the public with lucidity and scientific authority. His far-ranging contributions to and leadership of this epochal space mission make **Professor Edward C Stone** an excellent recipient of the 2019 Shaw Prize in Astronomy.

Edward C Stone
Laureate in Astronomy

In 1957, as I drove to the University of Chicago for the Fall term of physics classes, I remember seeing a newspaper headline announcing that Russia had launched a spacecraft into earth orbit. Sputnik 1 transmitted a radio signal as it circled Earth, marking the beginning of the Space Age and a new realm of human activity.

That journey began in my hometown of Burlington, Iowa, on the banks of the Mississippi River. I was the older of two sons in a family of four. Our father was a construction superintendent who enjoyed learning new things and explaining how they worked. As a homemaker, our mother created a warm, welcoming, and nurturing space for our family. Both parents had a strong work ethic, and later our mother served as the business manager for the Overhead Door franchise our father had acquired.

They encouraged my pursuit of scientific and technical activities such as building radios and other electronics. My physics teacher further advanced my scientific and laboratory experience and it was due to his urging that I enrolled at the University of Chicago in October of 1956, one year before the surprising launch of Sputnik 1 by the Soviet Union.

I was fortunate to have had Professor John A Simpson as an advisor. In the summer of 1958, I began working in his group, and in December 1961, my thesis experiment, a cosmic ray telescope, was launched into a polar orbit on Explorer 36. Though the data were limited, this was my first step in measuring cosmic rays from supernova explosions and solar energetic particles produced by solar eruptions.

After completing my thesis in 1964, I joined Professor Rochus Vogt, a former fellow Chicago graduate student, in establishing a space physics programme at Caltech in Pasadena, California. Since then I have had a leading role in developing instruments for determining the composition of cosmic rays and solar particles and have been the principal investigator or co-investigator on fifteen NASA spacecraft, five of which are still operating.

In 1965, the fledgling field of space exploration expanded to the outer solar system and beyond. A student at the Jet Propulsion Laboratory, managed by Caltech for NASA, discovered that a spacecraft launched in 1977 could swing by Jupiter, Saturn, Uranus, and Neptune. This “Grand Tour” alignment occurs only every 176

years, so NASA took the bold step of developing two identical spacecraft, called Voyager 1 and 2, to undertake the journey.

As the Voyager Project Scientist, I coordinated eleven teams of scientists selected by NASA to study the planets, their satellites, rings, and magnetic fields. Only five of the teams continued beyond Neptune as the focus for the two spacecraft shifted to the much longer journey to interstellar space.

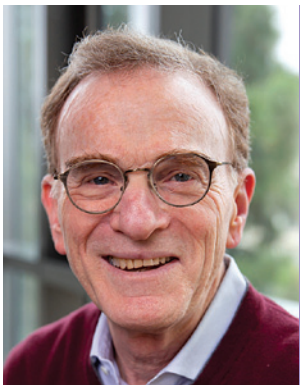
During these years, I have also had opportunities to contribute to other observatories. In 1983, two years after the Voyager 2 encounter with Saturn, I became chair of the Division of Physics, Mathematics, and Astronomy at Caltech, and oversaw the construction of the W M Keck Observatory that has two telescopes with ten-meter mirrors that peer deep into space from atop Mauna Kea on Hawaii Island.

Not all observatories have telescopes designed for observing light waves, and in 1987, I oversaw the establishment of LIGO, the Laser Interferometer Gravitational-Wave Observatory. Nearly three decades later, its laser system detected the first gravitational waves from the merger of two black holes.

Two years after Voyager's flyby of Neptune in 1989, I became JPL Director, serving from 1991 to 2001. JPL celebrated a number of memorable missions during this time, including: a plucky little Mars rover; the Galileo spacecraft that orbited giant Jupiter for eight years; Cassini, a spacecraft that dropped a probe into the atmosphere of Saturn's moon Titan and orbited the planet itself for thirteen years; and the Wide Field/Planetary Camera, constructed at JPL, for NASA's Hubble Space Telescope.

After retiring as JPL director, the development of the Thirty Meter Telescope (TMT), beckoned. With a mirror thirty meters across, TMT will collect enough light from the distant universe to study the first generation of stars and to search for evidence of life on planets orbiting nearby stars. As the founding executive director of the TMT International Observatory, I oversee a consortium of scientists and engineers from Canada, China, India, Japan, Caltech, and the University of California, that looks forward to first light from the top of Mauna in 2030.

The journey that began in Burlington, Iowa, reached two major milestones in 2012. My wife, Alice, and I celebrated our 50th wedding anniversary with family and friends in Burlington just as Voyager 1 became the first human-made object to enter interstellar space. Joined last year by Voyager 2, the two spacecraft will be Earth's ambassadors to the stars, orbiting the Milky Way for billions of years.



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. During 2011–2019, he served as founding Editor-in-Chief of the open access journal, "eLife", sponsored by the HHMI, The Wellcome Trust/ UK and the Max Planck Society. Beginning in 2017, Schekman was appointed director of a programme to identify and support basic research on Parkinson's Disease (https://parkinsonsroadmap.org).

The Prize in Life Science and Medicine 2019

Maria Jasin

for her work showing that
localized double strand breaks in DNA
stimulate recombination in mammalian cells.
This seminal work was essential for and led
directly to the tools enabling editing at
specific sites in mammalian genomes.

An Essay on the Prize in
Life Science and Medicine 2019

Human chromosomes often undergo breakage due to agents that damage the DNA. It is critical to repair such breaks, to maintain genome integrity and to prevent mutations that can give rise to cancer. All organisms have the capacity to repair such breaks by a process called homologous recombination, which restores the continuity of the genome without introducing mutations. A non-homologous recombination process, called end-joining, often introduces mutations and thus is only used by a cell when homologous recombination is not possible. Maria Jasin pioneered genetic and physical assays for recombination in human cells and she was the first scientist to directly demonstrate the importance of both homologous recombination and non-homologous end-joining for repair of chromosomal breaks. Her discovery has important implications for both normal cellular function, embryonic development, fertility, and for the etiology of diseases such as cancer. In the course of this work, Jasin demonstrated that breaks in chromosomes greatly increase the frequency of recombination at the site of the break. This important discovery laid the groundwork for efficient modification of mammalian genomes by site-specific nucleases, an approach that is currently being widely exploited for gene therapy and basic research.

Jasin developed her interest in gene modification as a graduate student in Paul Schimmel's lab at MIT, working in bacterial systems. She began pursuing ideas about double-strand break (DSB)–provoked recombination in mammalian cells as a postdoctoral fellow with Walter Schaffner in Zurich. From her work there, she published a paper on recombination between endogenous and incoming copies of SV40 viral genomes. However, in order to focus more specifically on genome modification and recombination, Jasin moved to Paul Berg's lab at Stanford where she showed that recombination was greatly stimulated by a DSB on the transfected DNA within a region of homology to the chromosomal target. Like her work with Schaffner, this study used targeting of SV40 sequences in monkey kidney cells. She then followed this up by targeting an endogenous human gene, the CD4 locus.

On the basis of this important work, Jasin then started her own lab at Memorial Sloan Kettering Cancer Center in New York in 1990. In Jasin's groundbreaking 1994 work, her laboratory devised an ingenious method to create a DSB in the mouse genome to provoke recombination. To do this, she used a specialized nuclease enzyme from yeast that had a well-characterized, 18 nucleotide long DNA recognition sequence so as to break a unique site in even complex genomes. The gene encoding the yeast enzyme was introduced into mouse cells after the companion recognition sequence, not normally present in any mouse chromosome, was genetically engineered into a gene that could be scored for its function in the cells. When the recognition sequence is cut by the yeast enzyme, Jasin found how the mouse cells patch it up by the normal cellular process of repair.

Using this strategy, Jasin performed the first gene editing. Importantly, she showed that introduction of a site-specific DSB into the genome of mammalian cells produced a 1000-fold increase in the targeting of a homologous fragment of

DNA to that site. This groundbreaking work laid the foundation for all subsequent gene-editing studies, because now it was clear that a DSB in the genome is the critical step.

Of course, none of us work in a vacuum. The intellectual backdrop of the time included the then-recent pioneering work of Terry Orr-Weaver, Jack Szostak, and Rodney Rothstein on gene targeting in yeast, leading to their influential model (with Frank Stahl) for repair of plasmid DSBs by homologous recombination. Other important foundational work in yeast was the characterization of mating locus type switching triggered by a mating-specific endonuclease (HO)-mediated DSB (work of Jim Haber, Jeff Strathern, and others), and the engineering of the yeast endonuclease that Jasin used (I-SceI) by Bernard Dujon's laboratory. And in work contemporaneous to Jasin's, Dujon also analyzed effects of a chromosomal DSB on recombination with other chromosomal templates, not as Jasin did using a transfected donor template for the recombination reaction. Importantly, Jasin's work was the first to demonstrate that a chromosomal DSB could recombine with a transfected piece of homologous DNA, or alternatively, undergo non-homologous repair. This particular arrangement in her 1994 papers presages the precision genome editing of the modern era.

Jasin's discovery forms the basis for subsequent work on highly specific but flexible nucleases — zinc fingers nucleases, TALENs, and CRISPR — that are currently being used for genome modification. All of these methods describe new and increasingly refined ways to introduce enzymes and DSBs into DNA. Nonetheless, they all rely fundamentally on Jasin's discovery of the stimulation of recombination by a double strand DNA break and the strategy to introduce a DNA cleaving enzyme to make the precise break. In her visionary 1994 paper, Jasin modestly concluded: "This could facilitate the creation of subtle genetic alterations at targeted loci."

Using the methods developed in her lab and now applied worldwide, Jasin also discovered that the two major familial breast/ovarian tumor suppressor genes, BRCA1 and BRCA2, are required for homologous recombination, a finding that explained how the loss of either of these two genes increases the frequency of potentially carcinogenic genetic alterations (note the 2018 Shaw Prize in Life Science and Medicine to Mary-Claire King for the discovery of the BRCA1 and 2 genes in breast cancer). The importance of these results cannot be overstated, and they are being exploited in novel therapies for the treatment of breast, ovarian, and other cancers with BRCA1 and BRCA2 mutations, and potentially cancers with mutations in other homologous recombination genes.

Maria Jasin's research has contributed to the textbook view of how cells survive breaks in their chromosomes, which is critical for the life of all cells. Equally important, her insights paved the way for today's current revolution in genome editing.

Maria Jasin
Laureate in Life Science and Medicine

I was born in deep winter in 1956 in Detroit, Michigan, to immigrant parents from markedly different parts of the world. My father emigrated after World War II from what was at the time Czechoslovakia, now the Slovak Republic, from the small village of Štefanovce in the far east of the country. Decades before his initial arrival at Ellis Island in New York, my mother's family left the small town of Tel Keppe, near Mosul in Nineveh province, in present-day Iraq. After relocating to Canada, long enough for my mother to be born in Thunder Bay, Ontario, her family settled in Michigan. My parents met in Detroit, a city teeming at the time with immigrant groups from both Eastern Europe and the Middle East. After the untimely death of my mother, my father moved our small family—my older sister, with whom I am very close, and me—to south Florida, which flourished with job opportunities for him in a more appealing climate. Although he lacked higher education himself, it was clear that my father placed a high priority on our education. My sister and I grew up with a great deal of freedom to pursue interests in diverse academic subjects, as well as in tennis and, in my case, the piano. We both earned undergraduate degrees at a nearby state university, Florida Atlantic University, where my sister now teaches in the English Department.

My exposure to science during my youth, outside of extracurricular reading, came primarily from the US space programme, particularly the Apollo programme with its ultimate goal of a moon landing. The keen interest that the Apollo missions generated in me was certainly shared nationwide and was reinforced with broadcasts of the rocket launches from Cape Canaveral, Florida, as well as the space walks, moon landings, and splashdowns. Even the Sears telescope my father gave us, its lens trained on the moon, brought us a tiny bit closer to developments in the Apollo programme. The fiftieth anniversary this year of the first moonwalk has helped me realize anew the impact of the Apollo missions on my developing interest in science, the sheer excitement for astronomy, mathematics, physics, and engineering it sparked in me. Later, though, as an undergraduate learning for the first time about the new and quantitative discipline of molecular biology, I was drawn to biology as my field of study and, ultimately, my life's work.

The Massachusetts Institute of Technology provided a deeply stimulating environment for graduate studies, and I was extremely fortunate to have been admitted into its PhD programme. MIT also provided an opportunity to establish lifelong friendships and relationships with colleagues. For my thesis research in

the laboratory of Paul Schimmel, I performed one of the first structure-function analyses of a protein using site-directed mutagenesis of the gene. Importantly, this project required me to perform targeted mutagenesis of the bacterial chromosome to have a "clean" genetic background, which allowed me to determine the protein activity encoded by gene fragments I created. Following approaches used in yeast, I was able to create a conditional null mutation of the gene I was studying through homologous recombination of the genome with genetically engineered DNA. These studies underscored the critical importance of targeted mutagenesis of genomes for understanding gene function, and I aspired to develop similar powerful approaches for mammalian genomes.

My first studies in this area were in Walter Schaffner's laboratory at the University of Zürich on the ETH Hönggerberg campus. Walter's observation of homologous recombination between plasmid and chromosomally-integrated SV40 viral genomes made it evident to me that recombination could occur at detectable frequencies in mammalian cells. Following the yeast paradigm, I determined that a double-strand break in the plasmid was highly recombinogenic. I continued these studies at Stanford University in the laboratory of Paul Berg and made a related set of observations more pertinent to genome modification: a double-strand break in the plasmid could also enhance its integration into the genome, although these events were not frequent in the total cell population.

Given that the DNA entity with the break is the recipient of genetic information, I reasoned that for efficient homologous recombination, the break needed to be introduced into the genome rather than the plasmid. To that end, my own laboratory at Memorial Sloan Kettering Cancer Center performed the first gene editing experiment, which was published in 1994, by expressing a rare-cutting endonuclease. By providing a homologous DNA fragment, we established a crucial role for homologous recombination in double-strand break repair, at odds with the paradigm current at the time. Thus, for the first time, a specific change could be efficiently introduced into a mammalian genome. These experiments also uncovered frequent nonhomologous repair, which often introduces small deletions, leading to current methods to make gene mutations.

The approach of introducing a double-strand break into the genome to direct its modification, together with the development of programmable nucleases by a number of labs, has led to a revolution in biology and medicine. This revolution brings the clear promise of disease cure/amelioration and allows gene editing of organisms across the phylogenetic tree, which is transforming our understanding of biological processes on this earth.

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 2019

Michel Talagrand

for his work on
concentration inequalities,
on suprema of stochastic processes and
on rigorous results for spin glasses.

An Essay on the Prize in
Mathematical Sciences 2019

Michel Talagrand works in the areas of probability and high-dimensional geometry. While these areas may sound quite different, they are in fact intimately connected: indeed, a sequence of random variables, each of which takes a numerical value, can be thought of as the coordinates of a single random variable that takes values in a high-dimensional space. And a major theme in modern statistics is the difficulty of extracting useful information from data that depend on many variables, which is naturally modelled as a problem about identifying structure in high-dimensional sets.

Talagrand has made profound contributions to the two areas, at least three of which could be described as revolutionary.

A first major theme of his research is the study of suprema of stochastic processes. A stochastic process is a collection of interacting random variables. When one is given a large such collection, it is often of crucial importance to obtain information about how its maximum value is distributed. Starting with the case of Gaussian processes (here each random variable has a Gaussian distribution, given by the famous "bell curve", and can be correlated in a certain way) and then looking at more general cases, Talagrand has developed tools, such as majorizing measures or generic chaining, that provide powerful and widely used bounds for how these maximum values behave.

The second group of contributions concern a phenomenon known as concentration of measure. Broadly speaking, this says that many functions that depend on a large number of reasonably independent random variables are extremely likely to take values close to their average. A particularly simple example, where the random variables are fully independent, occurs when one tosses a coin a thousand times. The expected number of heads is 500, and it turns out to be extremely unlikely that the actual number of heads will be a long way from this expectation: for example, the probability that the number of heads will be between 450 and 550 is roughly 99.7 percent, and the probability that it will be more than 600 is approximately two millionths of one percent. In such a situation, we say that the number of heads is concentrated about its average. This phenomenon, often associated with the name of the mathematician Vitali Milman, is remarkably general and has a multitude of applications in areas as diverse as the geometry of convex bodies, graph theory, and theoretical computer science.

One of Talagrand's great achievements has been to examine this phenomenon in detail and hugely improve our understanding of it. In particular, he proved famous inequalities, using completely new techniques, that give new concentration results that are, once again, widely used in many different important settings.

A third family of results for which he is famous concern objects known as spin glasses, which provide a mathematical model of a physical phenomenon involving very disordered systems. Unlike many models from statistical physics, spin glasses have a double layer of randomness. First, the way in which different random variables (the spins in the spin glass language) will interact is chosen at random, which creates a very complex energy landscape, and then the random variables themselves are sampled randomly. One would now like to understand this large family of randomly interacting random variables and describe its typical features. Spin glasses have a short and simple definition, but they are notoriously hard to analyze. A significant advance was made by the theoretical physicist, Giorgio Parisi, who proposed a formula for the free energy of a spin glass, which is an important quantity that encapsulates information about this random energy landscape. However, turning predictions of statistical physicists into mathematically rigorous arguments is often extremely hard, and a rich source of fascinating mathematical problems. Finding a complete rigorous proof in this case seemed to be way beyond what was realistic to hope for, despite remarkable insights and progress by Francesco Guerra, but Talagrand managed to do it, thereby providing for the first time a complete mathematical underpinning for this extremely important physical theory.

One notable feature of Talagrand's career that marks him out from many other mathematicians is that when he solves a problem, he does not just leave it and move on. Rather, he continues to work on it, improving his understanding and reworking his arguments until he has a well-developed theory that can be more easily used by other mathematicians. He has written monumental and highly influential textbooks on all the three topics just mentioned, and these have played a very significant part in the spread of his ideas, which are now central to the work of large numbers of other mathematicians. Talagrand is a true one-off, nearly always working on his own, and obtaining extraordinary and highly unexpected results that have changed the mathematical landscape.

Michel Talagrand
Laureate in Mathematical Sciences

My four grandparents were born very poor into large peasant families. Against all odds they managed to give my parents access to higher education. My father became a mathematics professor and it was he who sparked my interest in science.

I was born with congenital defective retinas and lost one eye at age five. When I was fifteen, I suffered from several consecutive retinal detachments in the remaining eye, causing me to miss school for half a year. Fearing that I would shortly become blind, I focused my energy on studying. I learned that this focus and hard work could make me competent in mathematics and physics. I did not attend an elite university, but the local university in Lyon close to where my parents lived. My university years were very happy and I built a solid foundation in mathematics.

My great luck is that the National Centre for Scientific Research offered me, in 1974, a research position, even though I had not yet done any research. This was uncommon, and the last year that such positions were offered. I have treasured this position all my life as it allowed me to work without any constraint on the topics of my liking.

I started doing research in the Functional Analysis group of Professor Choquet in Paris, where I completed my PhD. Professor Choquet's mathematics were supremely elegant and seemed effortless. Unfortunately, this is not the style I was born for, but several of my later contributions would not have been possible if I had not been inspired by his vision of mathematics. My interests shifted over the years but I belonged to this group for my entire career. Paris is a fantastic place to be a mathematician. Many mathematical stars work there and there are so many prominent visitors. I benefitted immensely from interaction with these visitors, and with my colleagues, at the numerous conferences I attended, but overall, I had few collaborators.

Thanks to mathematics, I met a wonderful woman who highly valued academic achievement. She has supported my work in every conceivable way, as well as bringing me so much personal happiness.

I developed an early interest in measure theory. While in the seventies this theory was well past its prime, it helped me learn to look at things in an abstract way,

which served me well later in my career. It also triggered my interest in Banach Spaces, although it was clear that I could not have the same impact as the leaders in the field. The arrival of Gilles Pisier in our group, in 1983, was a turning point for me. Gilles shared his private notes on Probability in Banach Spaces, an area that I could then learn and where I eventually became successful. He also directed me to the problem of characterizing the continuity of Gaussian processes, on which X Fernique had made determining advances, and which I was able to solve in 1985. This started my work on upper and lower bounds of stochastic processes. Pisier's influence changed the very nature of my work, which became far more quantitative.

I was also greatly influenced by Vitali Milman, who was most energetically expounding the concept of concentration of measure. I did not understand the depth of this concept at first, but it directed me to the discovery of several "concentration inequalities" that have since proved useful. The most important of these required taking a convex hull, and certainly this was easier to discover having been a student of Gustave Choquet.

I started mathematics with the modest goal of making a living out of it and began by working on small problems in somewhat exotic areas. My interests later shifted towards more central areas of mathematics, but I always worked on the problems I enjoyed the most, following my own preference. The path of discovery in mathematics can be very tortuous. The discovery of new classes of concentration inequalities stemmed from considering a problem of seemingly secondary interest. Many times, what I had learned by writing a paper of trifling importance proved a key step in a far more substantial theorem.

Rather late in life, I attacked a well-established problem in theoretical physics. The physicists were studying purely mathematical objects (called spin glasses) using methods which do not belong to mathematics. It was an all-consuming eight-year effort to prove that mathematics could bring a far more solid solution to this problem.

In later years, I have tried to write textbooks to communicate the experience of a lifetime in probability theory and have not shied away from reworking them over and over.

The Shaw Prize Foundation recognition is an honour I could never have dreamed of. It will allow me to set up a far more modest mathematical prize recognizing the achievements of young researchers in the areas to which I have devoted my life.

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;

* The late Professor Lin Ma (Promoter) (1924– 2017)
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;

* The late Mrs Mona Shaw (Member) (1934– 2017)
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

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

The late Professor Jean Bourgain (1954–2018)
Laureate in Mathematical Sciences

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

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

Mr Donald Tsang
The then Chief Executive of HKSAR

Professor Bruce A Beutler
Laureate in Life Science and Medicine

Professor Demetrios Christodoulou
Laureate in Mathematical Sciences

Professor Richard S Hamilton
Laureate in Mathematical Sciences

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 C Y Leung
The then Chief Executive of HKSAR

Professor David C Jewitt
Laureate in Astronomy

Professor Jane Luu
Laureate in Astronomy

Professor Maxim Kontsevich
Laureate in Mathematical Sciences

The Shaw Prize 2013

From right to left

Professor Michael W Young
Laureate in Life Science and Medicine

Professor Michael Rosbash
Laureate in Life Science and Medicine

Professor Jeffery C Hall
Laureate in Life Science and Medicine

Mr C Y Leung
The then Chief Executive of HKSAR

Professor David L Donoho
Laureate in Mathematical Sciences

Professor Steven A Balbus
Laureate in Astronomy

Professor John F Hawley
Laureate in Astronomy

The Shaw Prize 2014

From right to left

Professor Daniel Eisenstein
Laureate in Astronomy

Professor Shaun Cole
Laureate in Astronomy

Professor John A Peacock
Laureate in Astronomy

Mr C Y 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 C Y 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 C Y 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

The Shaw Prize 2017

From right to left

Professor Simon D M White
Laureate in Astronomy

Professor Ronald D Vale
Laureate in Life Science and Medicine

The Hon Mrs Carrie Lam Cheng Yuet-ngor
Chief Executive of HKSAR

Professor János Kollár
Laureate in Mathematical Sciences

Professor Claire Voisin
Laureate in Mathematical Sciences

Remarks: The late Professor Ian R Gibbons (1931–2018), Laureate in Life Science and Medicine, was unable to participate in the ceremony

The Shaw Prize 2018

From right to left

Dr Jean-Loup Puget
Laureate in Astronomy

The Hon Mrs Carrie Lam Cheng Yuet-ngor
Chief Executive of HKSAR

Professor Mary-Claire King
Laureate in Life Science and Medicine

Professor Luis A Caffarelli
Laureate in Mathematical Sciences

The Shaw Prize 2018 Award Presentation Dinner

The Shaw Prize Council

Founding Members

Mrs Mona Shaw

Professor Ma Lin

Professor Chen-Ning Yang

Founding Member

Mrs Mona Shaw
(1934 – 2017)

Mrs Mona Shaw uplifted her husband's idea of creating an award to honour and highlight international scientific achievements and together with Mr Run Run Shaw and esteemed academics, brought the concept to fruition with the founding of the Shaw Prize. Advancing the Shaw focus on education, and in the firm belief that the sharing of knowledge is key to discovery, the Prize aims to inform the world's budding scientists of major breakthroughs in diverse scientific fields, and through widely disseminated Shaw Laureate lectures, inspire them to be future trailblazers. Herself a highly respected leader in business, advancing the arts and philanthropy, Mrs Mona Shaw orchestrated the format of the annual Awards Ceremony and her remembered presence is warmly cherished.

Founding Member

Professor Ma Lin
(1924 – 2017)

A founding member of the Shaw Prize, Professor Ma's ideals have indelibly marked the Prize, and together with his legacy of love for the creation and application of knowledge, continue to fuel its advancement. An internationally acclaimed biochemist and gifted leader, on his watch the Chinese University of Hong Kong established the Department of Biochemistry, the Faculty of Medicine, and later the founding of Shaw College. As a scientist and educator his expertise melded well with Mr Run Run Shaw's quest to inspire scientific research and expand discovery. The founding of the Shaw Prize embodied their shared vision of societal progress through the advancement of knowledge.

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.

The Shaw Prize Council

Council Members

Professor Kenneth Young (Chairman)

Mr Wai Man Chan, Raymond

Professor Wai-Yee Chan

Professor Pak-Chung Ching

Professor Yuet-Wai Kan

Professor Frank H Shu

Council Member (Chairman)

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 positions 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. He is a Director of the Council of the Hong Kong Laureate Forum. 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

Mr
Raymond Wai-Man Chan

Mr Raymond Chan joined the Shaw Group in January 1994 and in December 2017, he assumed the role of Managing Director of the Shaw Group of Companies, totalling fifty-four, situated locally and overseas. He was at the same time appointed Chairman of the Shaw Foundation and the Shaw Prize Foundation. Since 2012, he has been a Member on the Board of Advisers of Sir Run Run Shaw Charitable Trust.

Born and educated in Hong Kong, he continued his studies in the United Kingdom gaining BA (Hons) and B Arch (Hons) and became a Member of the Royal Institute of British Architects, the Architects Registration Board and the Hong Kong Institute of Architects.

He is a Member of the Board of Trustees of Shaw College, The Chinese University of Hong Kong and an Honorary Trustee of Peking University, People's Republic of China. Mr Chan is also a Director of the Council of the Hong Kong Laureate Forum. From 2003 to 2016 he served as a Committee Member on the Hospital Governing Committee (Tseung Kwan O).

Council Member

Professor
Wai-Yee Chan

Professor Wai-Yee Chan is Pro-Vice-Chancellor, Master of CW Chu College, Professor of Biomedical Sciences and Acting 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.

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, IET, HKIE and HKAES. He is Chairman of the Veterinary Surgeons Board of Hong Kong and Chairman of the Board of Directors of the Nano and Advanced Materials Institute. Professor Ching was awarded the IEEE Third Millennium Award in 2000, the HKIE Hall of Fame in 2010, as well as the Bronze Bauhinia Star and Silver Bauhinia Star by the Government of HKSAR in 2010 and 2017 respectively. 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 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
Frank H Shu

Professor Frank H Shu is a Shaw Laureate for his work in theoretical astrophysics. He was born in Kunming, China and emigrated to the United States at the age of six. He is a member of the US National Academy of Sciences, the American Philosophical Society, a Fellow of the American Academy of Arts and Sciences, and a Senior Fellow in the Institute for Advanced Study at City University of Hong Kong. While at Berkeley, in 1998 he was appointed as University Professor, an honour bestowed on only 35 faculty members in the UC system since its founding. From 2002 to 2006 he served as President of National Tsing Hua University in Taiwan. He then joined the Physics Department at the University of California at San Diego. In 2009 he retired from UCSD to work on climate change at Academia Sinica and to spin out a private company, Astron Solutions Corporation.

(Photo of Prof Frank H Shu©Stony Brook University)

Board of Adjudicators

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Professor Frank H Shu
Professor Emeritus
Department of Physics
University of California, San Diego
USA

Vice Chairman

Professor Kenneth Young
Emeritus Professor of Physics
The Chinese University of Hong Kong
Hong Kong

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Max Planck Institute of Extraterrestrial Physics
Germany

Professor Randy W Schekman
Chairman of the Selection Committee in Life Science and Medicine
HHMI Investigator and
Professor of Cell and Developmental Biology
Department of Molecular and Cell Biology
University of California, Berkeley
USA

Professor W Timothy Gowers
Chairman of the Selection Committee in Mathematical Sciences
Royal Society Research Professor and
Rouse Ball Chair in Mathematics
Department of Pure Mathematics and Mathematical Statistics
University of Cambridge
UK

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Professor Chryssa Kouveliotou
Professor and Director of the Astronomy, Physics, Statistics Institute of Science (APSIS), Department of Physics, Columbian College of Arts & Sciences, George Washington University, USA

Professor John A Peacock
Professor of Cosmology, Institute for Astronomy, University of Edinburgh, UK

Professor Scott Tremaine
Richard Black Professor of Astrophysics, School of Natural Sciences, Institute for Advanced Study, Princeton, USA

Professor Ewine van Dishoeck
Professor of Molecular Astrophysics, Leiden University, The Netherlands

Life Science and Medicine

Professor Bonnie L Bassler
HHMI Investigator and Squibb Professor and Chair, Department of Molecular Biology, Princeton University, USA

Professor Hans Clevers
Professor in Molecular Genetics, Hubrecht Institute, The Netherlands

Professor Carol Greider
Daniel Nathans Professor and Director, Department of Molecular Biology and Genetics, Johns Hopkins University School of Medicine, USA

Professor Richard Lifton
President and Head of Laboratory of Human Genetics and Genomics, The Rockefeller University, USA

Professor Xiaodong Wang
Director and Investigator, National Institute of Biological Sciences, Beijing, PRC

Professor Huda Y Zoghbi
HHMI Investigator, Ralph D Feigin Professor of Pediatrics and Professor of Molecular and Human Genetics, Neurology and Neuroscience, Baylor College of Medicine, USA

Mathematical Sciences

Professor Hélène Esnault
Einstein Professor of Mathematics, Mathematisches Institut, Freie Universität Berlin, Germany

Professor Felix Otto
Director, Max Planck Institute for Mathematics in the Sciences, Germany

Professor Paul Seidel
Norman Levinson Professor of Mathematics, Department of Mathematics, Massachusetts Institute of Technology, USA

Professor Wendelin Werner
Professor of Mathematics, Department of Mathematics, ETH Zürich, Switzerland

Selection Committee Member

Professor
Chryssa Kouveliotou

Astronomy Committee

Professor Chryssa Kouveliotou is a Professor of Physics at George Washington University and Director of the GWU/ Astronomy, Physics, and Statistics Institute of Sciences. She studied Physics at the University of Athens, Greece and completed an MA at the University of Sussex (1977) and a PhD in Astrophysics at the Technical University of Munich (1981).

Her expertise is in observational High-Energy Astrophysics, more specifically X- & Gamma-Ray Transients, Gamma Ray Bursts (GRBs), Magnetars, X-ray Binaries. She has contributed transformative discoveries in the study of GRBs and she established the existence of magnetars, neutron stars with extreme magnetic fields.

Professor Kouveliotou has received the Descartes Prize (2002), the Rossi Prize (2003), the NASA Space Act Award and Exceptional Service Medal (2005, 2012), and the Heineman Prize (2012). She holds two honorary PhDs (Universities of Sussex and Amsterdam) and she is decorated by the Greek Government as a Commander of the Order of the Honour (2015). She was elected to the US National Academy of Sciences, the American Academy of Arts and Sciences, the Royal Dutch Academy, and the Academy of Athens, Greece.

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 of the International Astronomical Union, former member of the ALMA Board and Co-PI of the JWST-MIRI instrument.

She has received many prizes, including the 2018 Kavli Prize for Astrophysics, the 2018 James Craig Watson Medal of the US National Academy, the 2015 Albert Einstein World Award of Science, the 2014 Lodewijk Woltjer EAS Prize Lecture and the 2014 Lise Meitner Goteborg Award in Physics, as well as 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
Bonnie L Bassler

Life Science and Medicine Committee

Professor Bonnie L Bassler is a member of the US National Academy of Sciences, the National Academy of Medicine, and the American Academy of Arts and Sciences. She is a Howard Hughes Medical Institute Investigator and the Squibb Professor and Chair of the Department of Molecular Biology at Princeton University. Her research focuses on the molecular mechanisms bacteria use for intercellular communication. This process is called quorum sensing. Professor Bassler's discoveries are paving the way to the development of novel therapies for combating bacteria by disrupting quorum-sensing-mediated communication. She received the Shaw Prize in Life Sciences and Medicine in 2015. Professor Bassler is a member of the Royal Society and the American Philosophical Society. She served on the National Science Board from 2010–2016 and was nominated to that position by President Barack Obama. The Board oversees the NSF and prioritizes the nation's research and educational activities in science, math and engineering.

Selection Committee Member

Professor Hans Clevers

Life Science and Medicine Committee

Professor Hans Clevers obtained his MD degree in 1984 and his PhD degree in 1985 from the University Utrecht, the Netherlands. His postdoctoral work (1986–1989) was done with Cox Terhorst at the Dana–Farber Cancer Institute of Harvard University, Boston, USA. From 1991–2002 Professor Hans Clevers was Professor in Immunology at Utrecht University and, since 2002, Professor in Molecular Genetics. From 2002–2012 he was director of the Hubrecht Institute in Utrecht. From 2012–2015 he was President of the Royal Netherlands Academy of Arts and Sciences (KNAW). Since June 1, 2015 he is Director of Research of the Princess Maxima Center for Pediatric Oncology.

Professor Hans Clevers has been a member of the Royal Netherlands Academy of Arts and Sciences since 2000, a member of the American Academy of Arts and Sciences since 2012 and a member of the US National Academy of Sciences since 2014. He obtained two ERC Advanced Investigator grants (2008 and 2016). He is Chevalier de la Legion d'Honneur since 2005 and Knight in the Order of the Netherlands Lion since 2012.

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 Richard Lifton

Life Science and Medicine Committee

Professor Richard Lifton is President of The Rockefeller University where he is also Head of the Laboratory of Human Genetics and Genomics. He previously was Sterling Professor and Chair of Genetics at Yale University. Professor Lifton has used human genetics and genomics to identify mutations that identify key genes and pathways underlying a wide range of human diseases including hypertension, osteoporosis, cancer, and congenital malformations. Recently, he has pioneered the development of exome sequencing for disease gene discovery and clinical diagnosis.

Professor Lifton is a member of the US National Academy of Sciences, National Academy of Medicine and the American Academy of Arts and Sciences. He has received the highest scientific awards of the American Heart Association, the American and International Societies of Nephrology, the American and International Societies of Hypertension, and the New York Academy of Medicine. He received the 2008 Wiley Prize for Biomedical Sciences and the 2014 Breakthrough Prize in Life Sciences.

Selection Committee Member

Professor Xiaodong Wang

Life Science and Medicine Committee

Professor Xiaodong Wang was born in Wuhan, China in 1963. He received his BS in Biology from Beijing Normal University in July, 1984 and his PhD in Biochemistry from the University of Texas Southwestern Medical Center in May, 1991.

Prof Wang has served as the Director and Investigator of the National Institute of Biological Sciences, Beijing, since 2010. Previously, he was a Howard Hughes Medical Institute Investigator from 1997 to 2010 and held the position of the George L MacGregor Distinguished Chair Professor in Biomedical Sciences at the University of Texas Southwestern Medical Center in Dallas, Texas from 2001 to 2010. He has been a member of the US National Academy of Sciences since 2004 and a foreign associate of the Chinese Academy of Sciences since 2013.

Selection Committee Member

Professor
Huda Y Zoghbi

Life Science and Medicine Committee

Professor Huda Y Zoghbi is the Ralph D Feigin Professor of Pediatrics at Baylor College of Medicine, where she is also Professor of Molecular and Human Genetics, Neurology and Neuroscience. She has been an Investigator with the Howard Hughes Medical Institute since 1996. She is also the founding Director of the Jan and Dan Duncan Neurological Research Institute at Texas Children's Hospital.

Professor Zoghbi's interest is in understanding healthy brain development as well as what goes awry in specific neurological conditions. She has published seminal work on the cause and pathogenesis of Rett syndrome and late-onset neurodegenerative diseases, and has trained many scientists and physician-scientists. In 2000 she was elected to the Institute of Medicine, and in 2004 she was elected to the US National Academy of Sciences. Among Professor Zoghbi's recent honours are the Shaw Prize, the Breakthrough Prize and Canada's Gairdner prize.

Selection Committee Member

Professor Hélène Esnault

Mathematical Sciences Committee

Professor Hélène Esnault is a French and German mathematician working in Algebraic-Arithmetic Geometry. She studied at the École Normale Supérieure, got a PhD and a Doctorat d'État from the University Paris VII, and a Habilitation from the University of Bonn. She held a Chair at the University of Essen 1990–2012, then became an Einstein Professor at the Freie Universität Berlin, Germany.

She received the Paul Doisteau-Emile Blutet Prize of the Academy of Sciences in Paris (2001), the Leibniz Prize of the German Research Council DFG (2003), the Cantor Medal (2019), an ERC Advanced Grant (2009), a Chaire d'Excellence de la Fondation Mathématique de Paris (2011), honorary Doctorate degrees of the Vietnam Academy of Sciences and Technology (2009) and of the University of Rennes (2013). She was an invited speaker at the ICM Beijing 2002 and the ECM Krakow 2012. She was a Chern Professor at MSRI (Berkeley) 2019.

She is a member of the Academies of North Rhine-Westphalia since 2005, of the German National Academy (Leopoldina) since 2008, of Berlin–Brandenburg since 2010, of the European Academy (Academia Europaea) since 2014.

Selection Committee Member

Professor
Felix Otto

Mathematical Sciences Committee

Professor Felix Otto is Director at the Max Planck Institute for Mathematics in the Sciences in Leipzig (Germany) since 2010. He received his PhD in Mathematics at the University of Bonn in 1993. He was Postdoc at the Courant Institute and the Carnegie-Mellon University. In 1997 he became assistant and in 1998 Full Professor at the University of California at Santa Barbara. In 1999 he became Full Professor at the Department of Applied Mathematics at the University of Bonn where he was the Managing Director of the Hausdorff Center for Mathematics from 2006–2009.

His main expertise is in the applied analysis of partial differential equations and in the calculus of variations. He has worked on gradient flows, on micromagnetics, and on stochastic homogenization.

He has received various awards, including the Max Planck Research Prize, the Leibniz Prize of the German Science Foundation and the Collatz Prize of CICIAM. He is a member of the German Academy of Sciences Leopoldina, the Berlin-Brandenburg Academy of Sciences and Humanities and the Academia Europaea.

Selection Committee Member

Professor
Paul Seidel

Mathematical Sciences Committee

Professor Paul Seidel was educated in Italy, Germany, and the UK. He received his DPhil from Oxford University in 1998, with a thesis written under the supervision of Sir Simon Donaldson. He has held permanent positions at CNRS, Imperial College, and the University of Chicago; visiting faculty appointments at the Radcliffe Institute, the Institute for Advanced Study, Columbia University, and Princeton University; and is currently the Norman Levinson Professor of Mathematics at MIT. His areas of research are symplectic topology and mirror symmetry. He is a recipient of the Veblen Prize of the American Mathematical Society. He is a Fellow of the American Academy of Arts and Sciences, as well as of the American Mathematical Society.

Selection Committee Member

Professor Wendelin Werner

Mathematical Sciences Committee

Professor Wendelin Werner is a French mathematician, currently professor at the ETH Zürich in Switzerland. He studied at the École Normale Supérieure in Paris and was awarded his PhD in 1993 by the University of Pierre and Marie Curie. After holding positions at CNRS in Paris and a post-doctoral stay at the University of Cambridge, he has been Professor of Mathematics at the Université Paris-Sud in Orsay from 1997 to 2013.

For his works in probability, at the interface between stochastics, analysis and mathematical physics, Professor Werner was awarded a number of awards including the Fermat Prize, the Loève Prize, and the Fields Medal in 2006. He is a member of the French, Berlin-Brandenburg, Leopoldina and Brazilian Academies of Sciences.

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

Theatre and Film 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. In Hong Kong, he has won eight awards for his stage musicals such as "The Passage Beyond" and "Sing Out". His movie works include "Perhaps Love" (Golden Horse Award and Hong Kong Film Award), "The Last Tycoon" (Best Original Film Song), "That Demon Within", "Insanity" and "Monster Hunt". Mr Ko was the musical director of Jacky Cheung's 2004 world tour of "Snow, Wolf, Lake". Recent works include the stage musical "The Great Pretender", "The Amazing Filmphony", a concert of his film music with Hong Kong Sinfonietta, and new music for the Cantonese opera "Shade of Butterfly and Red Pear Blossom" in Hong Kong and Macau. 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.

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CATHAY PACIFIC
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Hong Kong Convention and Exhibition Centre

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