



THE
SHAW
PRIZE
邵逸夫獎

Life Science & Medicine

Mathematical Sciences

Astronomy

THE SHAW PRIZE 2021
AWARD CEREMONY

The Shaw Prize

The Shaw Prize is an international award to honour individuals, regardless of race, nationality, gender and religious belief. 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.

Message from the Chief Executive

I would like to extend my warmest congratulations to the five Shaw Laureates this year on their breakthroughs in the areas of astronomy, life science and medicine, and mathematical sciences.

The lingering threat of the COVID-19 pandemic has not dampened the voracious ambition of our Shaw Laureates to venture into the uncharted waters of science. The revolutionary discoveries of these greatest minds have advanced the frontiers of our knowledge and contributed to the betterment of humanity. Their success will undoubtedly inspire and encourage other scientists to press ahead in their own research across the wide spectrum of scientific disciplines.

The Government of the Hong Kong Special Administrative Region shares the unswerving commitment of the Shaw Prize in promoting scientific research and nurturing talent. We will continue to support the research activities of higher education institutions with a view to strengthening Hong Kong's overall competitiveness in a world that is increasingly putting a premium on science and technology. We firmly believe that only by deepening our understanding of the laws of nature and devoting our minds and resources



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

to innovation can we create a brighter future for our next generation.

I would like to express my sincere gratitude to the Shaw Prize Foundation for its dedication to further progress and prosperity of society and civilisations. I also wish the Shaw Laureates of 2021 every success in their future scientific pursuits.

A handwritten signature in black ink that reads "Carrie Lam".

Mrs Carrie Lam

Chief Executive

Hong Kong Special Administrative Region

Message from the Chairman of the Board of Adjudicators

Welcome to the eighteenth 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 Shaw's entrepreneurship and philanthropy inspired the quest for new knowledge, highlighted outstanding achievements, and became a major force for progress in the world.



Travel restrictions during the pandemic again forced this year's Shaw Prize Presentations to be a virtual ceremony. The methods of remote assembly have now become familiar. We are proud to be able to continue the founding vision of Mr and Mrs Shaw in promoting scientific discoveries whose beacons of truth and long-term contributions to society only shine brighter in these difficult times.

This year, we honour five scientists in the three designated fields for their distinguished contributions. They are Professors Victoria Kaspi and Chryssa Kouveliotou in Astronomy, Professor Scott Emr in Life Science and Medicine, and Professors Jean-Michel Bismut and Jeff Cheeger in Mathematical Sciences.

A handwritten signature in black ink that reads "Frank H. Shu". The signature is written in a cursive, flowing style.

Frank H Shu
Chairman, Board of Adjudicators
Shaw Prize 2021

(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”.

PROGRAMME

(Virtual Ceremony – 28 October 2021)

Opening Video introducing The Shaw Prize

Speech by

Professor Frank H Shu

Member of the Council

Chairman of the Board of Adjudicators, The Shaw Prize

Speech by

The Honourable Mrs Carrie Lam Cheng Yuet-ngor

The Chief Executive of HKSAR

Speech by

Professor Reinhard Genzel

Member of the Board of Adjudicators

Chairman of the Selection Committee for
the Prize in Astronomy

Speech by

Professor Victoria M Kaspi

Laureate in Astronomy

Speech by

Professor Chryssa Kouveliotou

Laureate in Astronomy

Speech by

Professor Bonnie L Bassler

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

Speech by

Professor Scott D Emr

Laureate 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

Speech by

Professor Jean-Michel Bismut

Laureate in Mathematical Sciences

Speech by

Professor Jeff Cheeger

Laureate in Mathematical Sciences



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), Stern-Gerlach Medal (2003), Petrie Prize (2005), The Shaw Prize in Astronomy (2008), Jansky Prize (2010), Honorary Doctorate University of Leiden (2010), Karl Schwarzschild Medal (2011), Crafoord Prize in Astronomy (2012) and Tycho Brahe Prize (2012), Herschel Medal (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 (2014) and the Bavarian Maximilian Order for Science and Art (2021). In 2020, he received the Nobel Prize in Physics, jointly with Andrea Ghez, for the discovery of a supermassive compact object at the centre of our galaxy.

He is a Member of the European Academy of Sciences, the German Academy of Natural Sciences Leopoldina, the Bavarian Academy of Sciences, the Pontifical Academy of Sciences and the Order Pour Le Merite for Science and Arts of the Republic of Germany. 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.

The Prize in Astronomy 2021

Victoria M Kaspi

and

Chryssa Kouveliotou

for their contributions to our understanding of magnetars, a class of highly magnetized neutron stars that are linked to a wide range of spectacular, transient astrophysical phenomena. Through the development of new and precise observational techniques, they confirmed the existence of neutron stars with ultra-strong magnetic fields and characterized their physical properties. Their work has established magnetars as a new and important class of astrophysical objects.

An Essay on the Prize in Astronomy 2021

The 2021 Shaw Prize in Astronomy is awarded in equal parts to Victoria M Kaspi and Chryssa Kouveliotou for their contributions to the understanding of **magnetars**, a class of highly magnetized neutron stars that are linked to a wide range of spectacular, transient astrophysical phenomena. By developing new and precise observational techniques, they confirmed the existence of this new class of neutron stars with ultra-strong magnetic fields, and characterized their physical properties. Their work has established magnetars as a new and important class of astrophysical objects.

Neutron stars are ultra-compact remnants of explosions of massive stars, which have exhausted their “fuel” for generating energy through fusion, and then collapse under their own gravity. Most young neutron stars are rapidly rotating with periods of milliseconds to seconds, and many of them emit powerful beams of electromagnetic radiation (observed as pulsars). As such, they are accurate “cosmic clocks” that enable tests of fundamental physics in the presence of a gravitational field many billion times stronger than that on earth. The Nobel Prize in Physics was awarded twice for work on pulsars, in 1974 and in 1993.

Pulsars have strong magnetic fields, since the magnetic field lines of the progenitor star are “frozen” into the stellar remnant as it collapses to become a neutron star. These magnetic fields funnel jets of particles along the magnetic poles, but classic radio pulsars are powered mainly by rotational energy and slowly spin down over their lifetime.

The research of Kaspi and Kouveliotou was motivated by the theoretical prediction of Duncan and Thompson in 1992 that neutron stars with magnetic fields up to a thousand times stronger than those in regular pulsars could form if the so-called “dynamo mechanism” for generating magnetic fields were efficient during the first few seconds after gravitational collapse in the core of the progenitor star. Such objects (henceforth termed “magnetars”) would be powered by their large reservoirs of magnetic energy, not rotation, and were predicted to produce highly energetic bursts of γ -rays by generating highly energetic ionized particle pairs at their centres. Magnetars have magnetic field strengths of 10^{10} Tesla (or 10^{14} Gauss), one hundred million times stronger than any manufactured magnet, and among the strongest magnetic objects throughout the universe.

In 1998/99, Chryssa Kouveliotou and her colleagues discovered a class of variable X-ray/ γ -ray sources called “**soft gamma-ray repeaters**” (SGRs) and identified them as magnetars, thus providing a stunning confirmation of the Duncan–Thompson model. By developing new techniques for pulse timing at X-ray wavelengths and applying these to data from the Rossi X-ray Timing satellite (RXTE), Kouveliotou was able to detect X-ray pulses with a period of 7.5 seconds within the persistent X-ray emission of SGR 1806-20. She then measured a spin-down rate for the pulsar, and derived both the pulsar age and the magnetic field strength. The spin-down measurements were extremely challenging because of the faintness of the pulsed signal and the need to correct the rotation phase across multiple epochs.

In 2002, Victoria Kaspi showed that a second class of rare X-ray-emitting pulsars, the “**anomalous X-ray pulsars**” (AXPs), were also magnetars. Kaspi took the techniques used by radio astronomers to maintain phase coherence in pulsar timing, and adapted them to work in the much more challenging X-ray domain. This allowed her to make extremely accurate timing measurements of X-ray pulsars across intervals of months to years, and hence to measure spin-down rates far smaller than those seen in SGR 1806-20. Kaspi has also made fundamental contributions to the characterization of magnetars as a population by elucidating their physical properties and their relationship to classic radio pulsars. Her work has cemented the recognition of magnetars as a distinct source class. Today, magnetars are routinely invoked to explain the physics underlying a diverse range of astrophysical transients including γ -ray bursts, super-luminous supernovae, and nascent neutron stars.

In 2020, a so-called “fast radio burst” was found to likely be associated with a magnetar, possibly linking magnetars to another spectacular and mysterious observational phenomenon.

The Shaw Prize 2021 recognizes the seminal contributions of Vicky Kaspi and Chryssa Kouveliotou to the understanding of the enigmatic properties of magnetars and pulsars.

Victoria M Kaspi Laureate in Astronomy



I was born in Austin, Texas in 1967, to my Canadian mother Shirley and my Israeli father Joseph. Our family was in Austin as my father was working on his PhD in Hebrew Literature at the University of Texas. I was the youngest of 3 children: my brother Cyril (who unfortunately passed away in 1993) was 9 years my senior, and my sister Terry was 7 years older. We moved to Chicago, IL for 2 years after my father graduated, where he took on a college faculty position. But he missed his family in Israel, so we moved there in 1972. However, the combination of my mother's diagnosis with Multiple Sclerosis and the surprise attack of Israel in the Yom Kippur war made her long for Canada, and so we returned to her home city of Montreal in 1973, where I spent the rest of my formative years. I loved school, finding it a respite from my challenging family circumstances given my mother's debilitating illness. In particular, I loved math and science — though not to the exclusion of literature, music, and sports.

After high school I studied Pure & Applied Sciences at Marianopolis College, and then decided to pursue Physics at McGill University in Montreal. I received my BSc with Honours in Physics from McGill in 1989. During my McGill days, I did summer research in particle physics, and enjoyed a summer internship at CERN in Geneva, Switzerland. Subsequently I obtained a PhD in Physics specializing in astrophysics from Princeton University in 1993 where I worked under the supervision of Nobel Laureate Joseph Taylor, but was co-supervised by Richard Manchester of the Australia Telescope National Facility in Sydney, Australia, where I did an extended internship. My graduate work was on timing radio pulsars and its applications, primarily using the Green Bank, Parkes and Arecibo Observatories. Other notable mentors during my graduate days were Andrew Lyne and Dan Stinebring.

After graduating from Princeton, I was awarded a Hubble Postdoctoral Fellowship which I took to the California Institute of Technology and Jet Propulsion Laboratory from 1994 to 1996. There I worked primarily with Shri Kulkarni and Tom Prince on a variety of pulsar-related topics. While still continuing radio work, I had already begun transitioning to X-ray astronomy, as there were impressive new X-ray missions being launched.

In 1997, I moved to the Massachusetts Institute of Technology, where I joined the faculty. There I began monitoring magnetars, specifically Anomalous X-ray

Pulsars (AXPs), routinely using the Rossi X-ray Timing Explorer (RXTE), but also using the Chandra and the XMM-Newton Observatories, working with colleague Deepto Chakrabarty. While at MIT I also began to supervise my own graduate students and postdocs, an endeavour which, over my career, has been perhaps the most rewarding. I chose to join the faculty of McGill University, my alma mater, in 1999, returning to Montreal where I had grown up. At McGill, I continued my radio and X-ray observational program of pulsars and magnetars. It was through the continued monitoring program with RXTE that my research group discovered bursting behaviour in AXPs, which cemented their identification as magnetars. The next decade involved developing a detailed understanding of AXP bursting behaviour using RXTE and subsequently the Neil Gehrels Swift X-ray Observatory.

It was also upon my return to McGill that I started a family together with my husband David Langleben, a cardiologist at the McGill-affiliated Jewish General Hospital in Montreal. Our son Ian was born in 2000, and daughters Julia and Hayley in 2002 and 2004, respectively. Raising a family while leading a research group was fun but challenging, and I am grateful to David and my sister Terry and my extended family and friends for their support over the years.

From 2013–2015 I was Associate Dean for Research in the McGill Faculty of Science, which taught me about how major infrastructure is funded. Simultaneously, the phenomenon of Fast Radio Bursts (FRBs) was being recognized and my research team, as part of the PALFA collaboration using Arecibo, had just discovered an FRB. Simultaneously, senior cosmologist colleagues in Canada, notably Matt Dobbs, Mark Halpern, Gary Hinshaw, Ue-Li Pen and Keith Vanderlinde, were building the Canadian Hydrogen Intensity Mapping Experiment (CHIME), which had the potential to revolutionize the FRB field. I led a major grant proposal with them to extend CHIME's capabilities to FRB (and pulsar) detection, a project which has occupied most of my research time since 2015. Today, the CHIME/FRB project is making interesting discoveries, and we are building CHIME/FRB Outrigger telescopes for precision sky localization of our detections.

I am very grateful and proud to have been co-awarded the Shaw Prize with friend and colleague Chryssa Kouveliotou for work on magnetars. There is no greater honour than the respect of one's peers. However, I consider my greatest research accomplishment the training and development of my wonderful, hard-working students and postdocs without which so much in my career would not have been impossible. I dedicate this award to them.

Chryssa Kouveliotou

Laureate in Astronomy



I was born in Athens, Greece in May, 1953. I was the first child of two girls, born 1.5 years apart. Ours was a middle-class family, well-educated and with comfortable income. My father, Nicholas, was a mathematician born in a small village in Peloponnese. He was the first from his five siblings to leave the village for the capital. After he graduated from the University, he started a tutoring school in mathematics for high school students, at all levels. My mother, Theofano, was born in Athens in a middle-class family. She studied Economics and worked at the Finance Ministry; she was pretty independent and emancipated for the times. They both worked long hours, and that meant that the Athens grandparents took care of the children. As the first-born, I enjoyed full attention and care. Grandpa took it upon himself to teach me reading very early, three to four years old. He succeeded; I could read but I had no clue what it all meant.

I attended grammar school in my neighbourhood and six years later, I left with excellent memorizing ability and a strong affinity to natural sciences and rudimentary math. High school was female only, very conservative, and high performance oriented; our week had six working days until I graduated. My best classes were physics and math; the first because the teacher was the best I ever had in all my education years, and the second because there was no way I would fail as a mathematician's daughter... I finished high school at the top of the class and passed the university entrance exams for Physics, ranking among the top ten. A year later a military junta took over in Greece...and our student years changed dramatically. I graduated with a Physics Bachelor's degree in 1975, but my real goal was to study Astrophysics, and that meant going abroad.

I started with UK — I knew the language very well and loved the country, which I had visited as a student; I also applied to Germany as I had studied German. I got accepted by the University of Sussex for an MSc and the Max Planck Institute for Extraterrestrial Physics (MPE) for a PhD, with the Technical University of Munich as the degree-awarding institution. I decided to do both and my parents agreed to support me in the first year. I spent nine memorable months in Brighton in classes and working with Peter Wehinger on the Na lines from Io (Jupiter's moon). These

were very austere years, living on a very tight budget... and yet it was one of the best times in my life. My most cherished memory was during our two weeks at Herstmonceux, attending classes at the Royal Greenwich Observatory and hoping that the rain would stop, so that we could observe. It did not and I still remember the pub where we all spent our evenings waiting for the sky to clear.

Next stop, Munich. I joined the gamma-ray group and started studying Gamma Ray Bursts in preparation for my thesis project; my advisor was Klaus Pinkau. MPE sent me twice to NASA's GSFC to train on the GRB data analysis from the ISEE-3 mission; thus started my long-term love affair with NASA, which culminated amicably almost thirty-eight years later. MPE was a transformative period in my life. I owe my colleagues and friends there a lot of gratitude for taking me under their wings and letting me grow into a professional. I graduated in 1981 and returned to Greece as a lecturer at the University of Athens (UoA). During my twelve years at UoA, I spent all summers and sabbaticals in the USA. In 1991, I was invited by Jerry Fishman to spend my second sabbatical at NASA's MSFC working with data from Burst and Transient Source Experiment on Compton Gamma-Ray Observatory; after two years I retired from UoA. In 2002, I became a US citizen and was hired as a civil servant; I retired as a Senior Scientist for High-Energy Astrophysics on January 31, 2015. While at MSFC, I worked on GRBs, establishing their first phenomenological classification based on durations and spectra, and on Soft Gamma Repeaters, establishing their nature as magnetars with RXTE data. This was the most productive, stressful, and rewarding period in my life.

I joined George Washington University Physics Department in February 2015. Our Astrogrouper has by now enjoyed recognition with a steadily increasing number of graduate student applications. In 2020, I became the department chair for a three-year tenure.

During all these years, I worked in large international collaborations and with individual researchers. I worked with and mentored students, postdoctoral fellows and colleagues. My work was and is my life and joy and my colleagues are my extended family. The Shaw Prize arrived at the 40th year of my career and I cannot thank the Shaw Prize Foundation enough for this formidable award and their recognition of my life's work.



**Professor
Bonnie L Bassler**

*Member of the Board of
Adjudicators*

*Chairman of the Selection
Committee for the Prize in
Life Science and Medicine*

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.

The Prize in Life Science and Medicine 2021

Scott D Emr

**for the landmark discovery of the ESCRT
(Endosomal Sorting Complex Required for Transport)
pathway, which is essential in diverse processes involving
membrane biology, including cell division, cell-surface
receptor regulation, viral dissemination, and nerve
axon pruning. These processes are central to
life, health and disease.**

An Essay on the Prize in Life Science and Medicine 2021

The building block of living things is the cell, and every cell has specific compartments with dedicated functions, akin to the separate rooms in a house. Therefore, to construct a cell, its components, especially proteins and lipids that constitute the membrane barriers surrounding each compartment, must be accurately sorted to, and properly assembled at, the correct destination and at the right time. The landmark discoveries made by this year's Shaw Laureate in Life Science and Medicine, Scott D Emr, provided ground-breaking insights into the composition, dynamics, and assembly of a specialized subset of these membrane-enclosed compartments.

Among the compartments with discrete functions are organelles, like the lysosome in animal cells and its equivalent in yeast cells, the vacuole. One mechanism for transport of material to such a destination is through delivery via vesicles, small, fluid-filled and protein-containing sacs surrounded by a lipid membrane. In pioneering studies, Emr devised an elegant genetic strategy to identify genes in budding yeast, a model cell, that encode components required to build the vacuole. Emr fused the gene encoding the lysosomal protease carboxypeptidase Y (CPY) to the gene encoding invertase (INV), an enzyme normally secreted to permit growth of this yeast on the sugar sucrose. As anticipated, the CPY-INV fusion protein was transported efficiently into the vacuole and not secreted, indicating that the organelle-targeting information in CPY was dominant. Mutant cells unable to deliver CPY-INV properly, causing the fusion protein to be secreted, could be identified by their ability to grow on sucrose medium. Such *vps* mutants (defective in vacuolar protein sorting) secreted every other vacuolar component tested, indicating that *VPS* gene products had general roles in vacuole biogenesis. More than 40 *VPS* genes were identified and conserved counterparts found in human cells. Emr began the arduous, but immensely important, task of determining the biochemical functions of the *Vps* proteins. Indeed, understanding the role of each *Vps* protein would have a transformative impact on our knowledge about the molecular basis of intracellular vesicle-mediated protein trafficking.

A subset of *VPS* genes revealed a key role for phosphoinositide (PI) lipids as organelle "identity tags" that direct vesicle trafficking. The *VPS34* gene specifies a lipid kinase that phosphorylates PI to generate PI-3P on the surface of a pre-lysosomal compartment, the endosome. This key finding led the way for showing that other phosphoinositides act as "address codes" for other cellular membranes. Another large subset of *VPS* genes was found to encode components of an ordered

pathway that brings about dramatic membrane deformation and scission, which Emr named the ESCRT (Endosomal Sorting Complexes Required for Transport) machinery. In a series of truly path-finding discoveries, Emr and colleagues systematically characterized these components, defining five distinct stages in execution of the ESCRT pathway and identifying the proteins and protein complexes that function at each step: ESCRT-0, ESCRT-I, ESCRT-II, ESCRT-III, and the Vps4 complex (an AAA+ ATPase). The critical requirement for PI-3P was pinpointed by showing that ESCRT-0 and ESCRT-II are selectively recruited to the endosomal membrane by binding to this lipid. Moreover, ESCRT-0, ESCRT-I and ESCRT-II were shown to bind ubiquitin, a “tag” specifically attached to membrane proteins destined for packaging into ESCRT-generated vesicles. As a result, ESCRT-0, ESCRT-I, and ESCRT-II are recruited in succession and co-assemble on the endosome surface, where they nucleate co-recruitment of the ESCRT-III components (Vps20, Vps32, Vps24 and Vps2). The Emr group then made the remarkable discovery that the ESCRT-III components polymerize into a spiral of filaments that corral cargo captured by the other ESCRTs and, most dramatically, sculpt the membrane, bending it away from the cytoplasm into the endosome, thereby depositing the bound cargo into invaginations projecting into the endosome. The Vps4 ATPase catalyzes resolution of the process, driving scission of the membrane at the necks of the invaginations, culminating in release of vesicles into the endosomal lumen and in disassembly and recycling of the ESCRT machinery into the cytoplasm. These seminal discoveries about how a membrane can be bent away from the cytoplasm established a new paradigm in membrane topology and shattered the previous dogma, in which vesicles formed for secretory transport and for clathrin-mediated endocytosis bend toward the cytoplasm. Emr’s pioneering research showed that failure of the ESCRTs to sort cargo into endosomes results in persistence of proteins (e.g., cell-surface receptors) on the endosome surface and their inappropriate recycling back to the plasma membrane, thus revealing how mutations in ESCRT components can contribute to cancers by permitting sustained signaling by growth factor receptors. ESCRT-directed membrane bending is now recognized as a universal mechanism used by cells in other ways, such as repair of membrane damage, completion of cytokinesis, and pruning of neuronal axons during brain development, as well as exploited by viruses, such as HIV, to bud and escape from host cells. Thus, Emr’s remarkable contributions have uniquely illuminated processes that are central for life, from yeast to humans.

Scott D Emr

Laureate in Life Science and Medicine



I grew up in Fort Lee, New Jersey, close to the George Washington Bridge across from New York City. My dad worked in the city as a manager of a shirt button manufacturing company. My mother and father did not attend college but they both were very supportive and encouraged my interest in science. For Christmas each year, they generously would find a way to purchase the microscope, chemistry set, telescope, erector set, etc. that I requested each year.

My sister, two brothers and I attended Fort Lee public schools. At an early age, I realized that I most enjoyed mathematics and the sciences. After elementary school, I was placed in an honours programme with advanced classes in science and math. In high school, I was selected to attend a summer science curriculum at New York University.

During the late 1960s, the TV series “The Undersea World of Jacques Cousteau” highlighting the adventures of undersea exploration had a big impact on me. I decided to apply to universities with strong oceanography programmes. In 1972, I entered the University of Rhode Island (URI) majoring in biology. After having the opportunity to go out on a research vessel in the Atlantic Ocean, I quickly realized that much of the marine research being done at that time was not as exciting as portrayed in Cousteau’s TV series. I remained a biology major but was not sure what direction to follow for my future. In my junior year, a genetics class and a microbiology lab opened my eyes to the power of genetics and the advantages of simple model organisms like the bacterium *E. coli*.

The most memorable highlight of this period, however, was meeting my future wife, Michelle, who also was in her junior year at URI, majoring in music and early education. I was in love. We got married three years later after I started graduate school.

I applied to graduate programmes with an emphasis in genetics and microbiology. I accepted the offer from Harvard’s Department of Microbiology and Molecular Genetics. My four years of graduate school were among the most exciting years of my life. It was challenging and I spent long hours in the lab and in the library studying and reading journal articles (a time before the internet and personal computers). I was captivated by the research I was doing and by the exciting discoveries being made in the laboratories of Thomas Silhavy and Jonathan Beckwith where I was working. My PhD thesis focused on the genetics of protein secretion in *E. coli*.

In 1980, I applied for a postdoctoral position in Randy Schekman’s lab at the University of California, Berkeley. They were characterizing the first secretion defective mutants in yeast. This allowed me to extend my interests to a eukaryotic

genetic model, yeast. In 1981, my wife and I moved cross-country and set out on the next stage of our adventure together.

Initially, the projects I worked on in Schekman's lab did not succeed. However, rather than being discouraged, I doubled my efforts and returned to lessons learned as a graduate student. Within a few weeks, I had succeeded in developing several useful gene fusion approaches in yeast. After about a year in the Schekman lab, I received phone calls asking if I would consider sending in my resume and apply for open faculty positions. Randy encouraged me to apply and a few months later, I was deciding between several job offers. I accepted the offer from the Division of Biology at the California Institute of Technology. This was an ideal environment for me to build a research programme. I shared a floor with two senior faculties, Mel Simon and Jon Abelson. It was a highly collaborative and supportive environment. I quickly had several outstanding graduate students and postdoctoral research fellows working with me.

We devised a gene fusion-based genetic strategy to identify genes in yeast that encode the cellular machinery required to build the vacuole (lysosome). In just a few years, we were able to identify mutations in 33 genes, termed *VPS* for Vacuolar Protein Sorting. Independently, Tom Stevens' lab at the University of Oregon also isolated similar yeast mutants. Together, our labs identified more than 40 *VPS* genes, many more than we had ever expected. Although uncertain where the analysis of these genes would take us, we began the task of determining the biochemical functions for the protein products of the *VPS* genes. These studies have occupied my lab for almost 40 years and set the stage for our discovery of the highly conserved ESCRT machinery. I am truly indebted to and grateful for the exceptional students and postdocs who have worked with me during these years.

In 1991, I was recruited to the University of California, San Diego School of Medicine by George Palade, the father of modern cell biology. Roger Tsien, a brilliant chemical biologist, had his lab just across the hall from mine. At the time, he was developing the Green Fluorescent Protein, GFP, as a tool for live cell imaging. Roger shared his GFP constructs with my lab and GFP became an indispensable tool in our analysis of the *VPS* pathway.

In 2007, I moved to Cornell University where I am serving as the Founding Director of the Weill Institute for Cell and Molecular Biology. This has been a great opportunity for me to pay forward some of the knowledge and excitement I have experienced to the next generation of young faculty recruited into the Institute.

My wife and I are delighted to be living in beautiful Ithaca, NY with a wonderful community of colleagues and friends. We have two children who are grown and married now. Our daughter Bryanna is a Pediatric Surgeon in Pittsburgh, PA. Our son Kevin is an Anesthesiologist in Albany, NY. We have two wonderful grandchildren and a third on the way. I am very grateful for my family. They bring so much love and joy into my life.



Professor W Timothy Gowers

*Member of the Board of
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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 Béla Bollobás. 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 the Rouse Ball Professor of Mathematics. From 2009–2020 he was a Royal Society Research Professor, and since October 2020 he has been Professor of Combinatorics at the Collège de France. 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 Szemerédi'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 2021

Jean-Michel Bismut

and

Jeff Cheeger

**for their remarkable insights that have transformed,
and continue to transform, modern geometry.**

An Essay on the Prize in Mathematical Sciences 2021

Geometry is one of the oldest branches of mathematics, going back to the Greeks and beyond. A famous problem left open by the Greeks and not resolved until the 19th century was whether the parallel postulate, which states that given a line in the plane and a point not on that line, there is exactly one line through the point that does not meet the first line, could be deduced from Euclid's other axioms. It was shown by Gauss, Bolyai and Lobachevsky that the answer was no, and that there are different, mathematically consistent geometries in which the notions of Euclidean geometry such as points and lines have natural interpretations, and in these geometries the other axioms hold but the parallel postulate does not. This demonstrates that the parallel postulate cannot be a consequence of the other axioms. Moreover, these non-Euclidean geometries, far from being mere curiosities, are fundamental to modern mathematics.

From these ideas, thanks in particular to the work of Riemann, the concept of a manifold became central to geometry. A manifold can be thought of as a higher-dimensional generalization of the notion of a surface in three-dimensional space, though a manifold is often better thought of “intrinsically” rather than with reference to a larger space in which it lives. Manifolds are ubiquitous in mathematics and physics — for example, they are needed to make sense of the notion of curved spacetime, which is essential to Einstein's theory of general relativity — and their study has led to remarkable developments and many fascinating open problems.

One of these developments is the realization that global topological quantities of a manifold can often be computed using local tools. For example, a famous theorem of Gauss and Bonnet shows that the number of “holes” a surface has (where, for instance, a torus has one hole, the surface of a figure-of-8-shaped pretzel has two, and so on), can be obtained by integrating a local quantity, the curvature, over the surface. This idea has subsequently been vastly generalized, a particular highlight being the famous Atiyah–Singer index theorem from 1963. This theorem led to an entire subfield of mathematics devoted to index theory.

Bismut has played a central role in this subfield. In the early part of his career, he made profound contributions to probability theory that have had a major impact on the theory of mathematical finance. Later, he imported ideas from probability into index

theory, reproving all the main theorems and vastly extending them, which enabled him to link index theory to other parts of mathematics. This has led to many applications in areas as far afield as Arakelov geometry, which is used in number theory to study high-dimensional Diophantine equations, and physics, where the tools developed by Bismut have been used to compute the genus-1 Gromov–Witten invariant. In recent years, his work has been changing the way we think about the Selberg trace formula, a fundamental tool in representation theory and modern number theory. A common feature of all his works is that using index theory he is able to prove explicit formulas for quantities that people would previously never have dared to try to compute.

A major theme of modern geometry, to which Cheeger has made profound contributions, is to understand the impact of curvature conditions, such as assuming that the curvature is everywhere non-negative, on the structure of manifolds. His work in this area has had a huge impact — for example, Perelman made essential use of it in his solution of the Poincaré conjecture. Cheeger is also a household name in combinatorics and theoretical computer science, owing to his introduction of what we now call the Cheeger constant. This is the smallest area of a hypersurface that divides a manifold into two parts, which Cheeger related to the first non-trivial eigenvalue of the Laplace–Beltrami operator on that manifold. A discrete analogue of this result for graphs has played an extremely important role in the study of random walks on graphs, which in turn has led to the development of important algorithms for random sampling, integration in high dimensions, and many other applications.

Bismut and Cheeger have also worked together, and are particularly celebrated for their extension of a famous invariant, the so-called eta invariant, from manifolds to families of manifolds, which allowed them to compute explicitly the limit of the eta invariant along a collapsing sequence of spaces.

More generally, over the last few decades, including right up to the present day, Bismut and Cheeger, as well as solving long-standing open problems, have introduced important new ideas and built tools that have greatly extended the range of what is possible in modern geometry, and as a result have transformed the subject.

Jean-Michel Bismut

Laureate in Mathematical Sciences



I was born in Lisbon on February 26th 1948. My father had been assigned to teach in the French high school in Lisbon. Lisbon was a pleasant city, preserved from the war. In Lycée Charles-Lepierre, I received an extraordinary education, at the contact of several cultures, with mathematics, physics, biology and humanities playing an important role. My father did not leave me much choice on the field on which I should concentrate: mathematics was as important as

literature, Latin, ancient Greek and history. One uncle who was an engineer, and an aunt and her husband, both theoretical physicists, opened my eyes at an early age to what physics was accomplishing at the time.

At fifteen, I moved to Greece with my parents, stayed one year there, and spent my last year of high school at Lycée Louis-le-Grand, as well as the next two years to prepare for Grandes Écoles. In the fall of 1967, I was accepted at École Polytechnique. There came a real shock: the mathematics introductory course was given by Laurent Schwartz, a Fields medalist and the inventor of distributions. He gave a deep, witty, extraordinary dense course. Twice a week, he organized an evening seminar that started at 8 pm and lasted for two hours, whose scope was an introduction to mathematics.

In May 1968, while universities were closed, École Polytechnique was still functioning. With no teaching duties, university professors came to teach us. In mathematics, three times the usual number of courses were being given. No wonder so many mathematicians came out of École Polytechnique under these circumstances.

Under J-L Lions and J Neveu, I completed my PhD thesis at Université Paris VI in 1973. It contained a mixture of probability and the calculus of variations. Since I had been ranked first in a competitive environment, I had many choices. As I was concerned by the atmosphere in universities at the time, I decided to discover the real world, while teaching at École Polytechnique, and still practicing mathematics at night. Ultimately, I realized that mathematics was infinitely more interesting to me.

In my work, I have been concerned with connections between probability, the calculus of variations, and geometry. Into that study, I imported ideas

from classical mechanics, and stochastic differential equations. This way, I obtained Hamiltonian equations, unforeseen at the time, and which are still in use, in particular in mathematical economics. Links with geometry appeared progressively, first under the influence of Paul Malliavin, later because of the index theory of Dirac operators, and unforeseen connections with equivariant localization on loop spaces proposed by Michael Atiyah and Edward Witten. After working on local versions of the families index theorem for Dirac operators, in joint work with Henri Gillet, Christophe Soulé, and Gilles Lebeau, I turned to analytic questions motivated by Arakelov geometry, that led us to a detailed study of Quillen metrics. I discovered that probabilistic ideas combined with algebra could be relevant in questions not connected with probability. With collaborators that included Jeff Cheeger, I turned to refined version of index theory, that included eta invariants, real torsion, and their families version.

Later, I discovered an object whose potential is still not fully explored, the hypoelliptic Laplacian. Such an operator was known before in statistical physics as the Fokker-Planck operator. My own contribution was to show that it is part of a geometric deformation scheme, with unsuspected preserved quantities. With Gilles Lebeau, we showed that real torsion is one of those. Later, I showed that holomorphic torsion is also included. This interpolation process has two related aspects: an analytic aspect, connected with differential operators, and a probabilistic aspect connected with dynamics. Geometry and classical physics unify these two points of view. This construction creates nonclassical and even nonphysical links between classical objects, the origin of which lies in path integrals and index theory.

On symmetric spaces of non-compact type, more is true: no spectral information is lost in the deformation. This led to new geometric perspectives on classical objects in the harmonic analysis of real reductive groups: the orbital integrals. Using the hypoelliptic deformation in complex geometry also opened up new possibilities for getting rid of the restrictions of Kähler geometry.

In my mathematical life, I have been fortunate to work with many collaborators, who gave me considerable courage and the benefit of their friendship. I was also fortunate to have had many excellent students, who became extraordinary collaborators. I also owe my family so much kind support in difficult times.

Jeff Cheeger

Laureate in Mathematical Sciences



I was born on December 1, 1943, at the Brooklyn Jewish Hospital. I had a normal childhood, engaging in the usual games and sports. My father introduced me to mathematics at the level of elementary algebra when I was seven. Intermittently, he would teach me more. Soon I was hooked.

In the seventh grade, I made a great new friend, Mel Hochster, a fellow math enthusiast, later my college roommate, now, an eminent mathematician. I attended Erasmus Hall, a large public high school with many famous alumni. There were some very bright students and the honours classes were at a good level. Eventually, I became captain of the math team.

At Harvard, my teachers Shlomo Sternberg and Raul Bott were charismatic and encouraging. As a junior, with no practice, I tied for 21st in the country on the Putnam exam. This relatively modest accomplishment meant a lot to me. As a senior, I took a graduate course in PDE from a young Assistant Professor named Jim Simons.

In graduate school at Princeton, after deciding to study differential geometry, I consulted Jim, who was a specialist in that area. Coincidentally, he had just moved to Princeton and was working as a code breaker at the Institute for Defense Analyses. My advisor was the legendary Salomon Bochner, but my teacher was Jim. For a year, he told me what to read and patiently answered all my questions. Then he suggested a thesis problem. After I solved it, it morphed into something very different, a finiteness theorem for manifolds of a given dimension admitting a Riemannian metric with bounds on curvature and diameter and a lower bound on volume. This needed a corresponding lower bound for the injectivity radius, which I think of as my first real theorem. The finiteness theorem brought a certain change in perspective to Riemannian geometry, now subsumed under Cheeger–Gromov compactness.

The major part of my career has been spent at Stony Brook (1969–1989) and the Courant Institute (1989–). First, I spent an exciting year at Berkeley and another at Michigan. Significant stays in Brazil, Finland, IHES in France and IAS in Princeton were enormously fruitful. I have had exceptionally brilliant collaborators and some great students. Several collaborators are mentioned below. Unfortunately, space constraints forced the omission of many others.

When I started doing research, my viewpoint was geometric and topological. As I learned more analysis, my work evolved into a mixture of all three fields. Several times, I noticed things which were hiding in plain sight, but which proved to have far reaching consequences. In retrospect, a significant part of my work involved finding structure in contexts which might initially have seemed too naive or too rough. Occasionally, a specific problem led to new developments that went far beyond what was needed for the original application.

With strong mutual connections and the mention of a few highlights, my work could be summarized as follows. (1) Curvature and geometric analysis; see below. (2) A lower bound for the first nonzero eigenvalue of the Laplacian, which has had a vast, varied and seemingly endless number of descendants. (3) Analysis on singular spaces: The precursor was my proof of the Ray–Singer conjecture on the equality of Ray–Singer torsion, an analytic invariant and Reidemeister torsion, a topological invariant. Simultaneously, Werner Müller gave a different proof. Independently, I discovered Poincaré duality for singular spaces, in the guise of L_2 -cohomology. Later, I showed it was equivalent to the contemporaneously defined intersection homology theory of Goresky–MacPherson. I pioneered index theory and spectral theory on piecewise constant curvature pseudomanifolds. Applications included a local combinatorial formula for the signature. Adiabatic limits of η -invariants and local families index for manifolds with boundary were joint with Jean-Michel Bismut. (4) Metric measure spaces: I showed that properly formulated, all of first order differential calculus is valid for metric measure spaces whenever the measure is doubling and a Poincaré inequality holds in Heinonen-Koskela’s sense. Examples include non-selfsimilar fractals with dimension any real number. Related work with Bruce Kleiner and Assaf Naor had applications to theoretical computer science.

Curvature. My thesis (1967) and my first paper with Detlef Gromoll (1969) on the soul theorem for complete manifolds of nonnegative curvature were purely geometric. In 1971, we proved the fundamental splitting theorem for complete manifolds of nonnegative Ricci curvature. The statement was geometric but the proof involved partial differential equations (PDE). Both works with Detlef were early examples of rigidity theorems. Here is the principle. When geometric hypotheses are sufficiently in tension, they can mutually coexist only in highly non-generic situations where specific special structure is present. Similarly, Misha Gromov and I characterized collapse with bounded curvature in terms of generalized circular symmetry (1980–1992) in the end joining forces with Kenji Fukaya (1992). Work with Toby Colding (1995–2000) on Ricci curvature was a mixture of geometry and PDE. We proved quantitative versions of rigidity theorems which, together with scaling, vastly increased their range of applicability. Specifically, if the hypotheses of rigidity theorems fail to hold by only a sufficiently small amount, then the conclusions hold up to an arbitrarily small error. Quantitative rigidity theorems were the basis of our structure theory for weak geometric limits (Gromov–Hausdorff limits) of sequences of smooth Riemannian manifolds with Ricci bounded below. These geometric objects play the role that distributions play in analysis. In particular, limit spaces can have singularities living on lower dimensional subsets and we proved a sharp bound on their dimension. Aaron Naber and I gave the first quantitative theory of such singular sets (2011–2021). Beyond bounding their dimension, we bounded their size. Our flexible techniques were rapidly applied to numerous nonlinear elliptic and parabolic geometric PDE’s. In 2015, we proved a longstanding conjecture on noncollapsed Gromov–Hausdorff limits of sequences of n -dimensional Einstein manifolds: Singular sets have dimension at most $n - 4$.

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 Ma Lin (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)

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* Professor Kwok-Kan Tam (Member)

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* 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

The late Sir Michael Berridge (1938–2020)
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



SHAW PRIZE

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



SHAW PRIZE

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



SHAW PRIZE

The Shaw Prize 2019

From right to left

Professor Edward C Stone
Laureate in Astronomy

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

Professor Maria Jasin
Laureate in Life Science and Medicine

Dr Michel Talagrand
Laureate in Mathematical Sciences



The Shaw Prize 2020 (Virtual)

From right to left

Professor Roger D Blandford
Laureate in Astronomy

Professor Gero Miesenböck
Laureate in Life Science and Medicine

Professor Peter Hegemann
Laureate in Life Science and Medicine

Professor Georg Nagel
Laureate in Life Science and Medicine

Professor Alexander Beilinson
Laureate in Mathematical Sciences

Professor David Kazhdan
Laureate in Mathematical Sciences



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

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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 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. 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
Wai-Man Chan,
Raymond

Mr Raymond Chan joined the Shaw Group in January 1994 and in December 2017, assumed the role of Managing Director of the Shaw Group of Companies, totalling fifty-four and 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 Advisors 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 and Hong Kong Institute of Architects. He is also a registered architect under the Architect Registration Board in both UK and Hong Kong.

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 and the Honorary Chairman of Board of Directors of Nanjing Medical 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 Member of the Governing Committee of Tseung Kwan O Hospital. In June and October 2021, he was awarded Honorary Fellowships by The Chinese University of Hong Kong and The Hong Kong University of Science and Technology respectively.

Council Member



**Professor
Wai-Yee Chan**

Professor Wai-Yee Chan is Pro-Vice-Chancellor/Vice-President, Li Ka Shing Professor of Biomedical Sciences and Director of the Institute for Tissue Engineering and Regenerative Medicine, The Chinese University of Hong Kong (CUHK), Hong Kong. Professor Chan obtained his BSc (First Class Honours) in Chemistry from CUHK in 1974 and PhD in Biochemistry from the University of Florida, Gainesville, Florida, USA in 1977. Prior to joining CUHK in June of 2009, he was Professor of Pediatrics, Georgetown University Medical Center, Washington, DC, and Head and Principal Investigator, Section on Developmental Genomics, Eunice Kennedy Shriver National Institute of Child Health and Human Development, National Institutes of Health, Bethesda, Maryland, 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 boards 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 Research Professor of Electronic Engineering of The Chinese University of Hong Kong. He received his Bachelor in Engineering (First Class Honours) and PhD 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 (2000) and the Bronze Bauhinia Star (2010) and Silver Bauhinia Star (2017) of the HKSAR; he was admitted to the HKIE Hall of Fame (2010). 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, the Louis K Diamond Professor of Hematology at the University of California, San Francisco, USA, is a world-leading expert 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 to DNA diagnosis and his discovery of human DNA polymorphism 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 Cagliari, 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)

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*Professor Emeritus, Department of Mathematics,
College of Natural Sciences, The University of Texas at Austin, USA*

Selection Committee Member



**Professor
Sandra M Faber**

Astronomy Committee

Professor Sandra M Faber is University Professor Emerita at the University of California Santa Cruz and a staff member of the UCO/Lick Observatory. She is an observational astronomer with research interests in cosmology and galaxy formation. Discoveries include the first structural scaling law for galaxies, large-scale flow perturbations in the expansion of the Universe, super-massive black holes at the centres of galaxies, and the first detailed description of galaxy formation based on “cold dark matter.”

Professor Faber assembled the scientific case for the Keck 10 m telescopes, helped to diagnose the optical flaw in the Hubble Space Telescope, led the construction of the DEIMOS spectrograph on Keck, and co-led the CANDELS survey on Hubble, which extended our view of galaxy formation back nearly to the Big Bang.

Professor Faber received her BA degree in Physics from Swarthmore College and her PhD in Astronomy from Harvard. She is a Member of the US National Academy of Sciences, the American Academy of Arts and Sciences, and the American Philosophical Society. She serves on the boards of several organizations including the Carnegie Institution of Science, Annual Reviews, and (formerly) the Harvard Board of Overseers. She has received the Bruce Medal of the Astronomical Society of the Pacific, the Russell Prize of the American Astronomical Society, the Gruber Cosmology Prize, the Gold Medal of the Royal Astronomical Society, and the National Medal of Science from President Obama.

(Photo credit: Steve Kurtz)

Selection Committee Member



**Professor
Luis C Ho**

Astronomy Committee

Professor Luis C Ho studied physics and astronomy as an undergraduate at Harvard University and obtained his PhD in Astronomy from the University of California, Berkeley. He was Staff Astronomer for 15 years at the Observatories of the Carnegie Institution for Science, before moving to China to serve as the Director of the Kavli Institute for Astronomy and Astrophysics and University Chair Professor at Peking University. He serves on numerous national and international advisory committees, and has been actively involved in helping to develop astronomy throughout China and East Asia, including the planning of current and future large telescopes and instruments.

Professor Ho's research uses a range of observational techniques to investigate the physics of active galaxies, massive black holes, black hole-galaxy coevolution, galaxy structure, extragalactic star formation, and the interstellar medium.

Selection Committee Member



**Professor
Elaine M Sadler**

Astronomy Committee

Professor Elaine M Sadler received her PhD in Astronomy from the Australian National University and held postdoctoral positions in Germany and the USA before returning to Australia, where she currently holds a faculty position at the University of Sydney. From 2014–18 she was Director of the ARC Centre of Excellence for All-sky Astrophysics (CAASTRO), and since 2018 she has also held the role of Australia Telescope National Facility (ATNF) Chief Scientist at the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia’s national science agency.

Her research area is observational astronomy and astrophysics, with a particular focus on galaxy evolution, active galaxies, stellar populations and transient objects. Much of her research is based on the analysis of data from large-area optical and radio surveys, and she has designed and carried out several major radio surveys of the southern sky. She regularly serves on national and international advisory committees, and is actively involved in planning for next-generation telescopes and facilities.

Professor Sadler was elected to the Australian Academy of Science in 2010. She is currently the Academy’s Foreign Secretary (2018–2022), and a Member of the Academy’s governing Council.

Selection Committee Member



**Professor
Scott D Tremaine**

Astronomy Committee

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

At the University of Toronto he was the first Director of the Canadian Institute for Theoretical Astrophysics, from 1985 to 1996, and at Princeton University he chaired the Department of Astrophysical Sciences from 1998 to 2006. He was the Richard Black Professor at the Institute for Advanced Study in Princeton from 2007 to 2020. He is currently an Emeritus Professor at Princeton University and the Institute for Advanced Study and a Professor at the University of Toronto.

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, the Henry Norris Russell Lectureship of the American Astronomical Society, 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
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). From 2015 to 2019 he was Director of Research of the Princess Maxima Center for Pediatric Oncology.

Professor Clevers is a Member of the Royal Netherlands Academy of Arts and Sciences, of the US National Academy of Sciences, of the Royal Society of London and of the French Academie des Sciences. He received multiple awards including the Breakthrough Prize in Life Sciences. He is Chevalier de la Legion d'Honneur and Knight in the Order of the Netherlands Lion since 2012.

Selection Committee Member



**Professor
Michael N Hall**

*Life Science and
Medicine Committee*

Professor Michael N Hall received his PhD from Harvard University and was a postdoctoral fellow at the Pasteur Institute (France) and the University of California, San Francisco. He joined the Biozentrum of the University of Basel (Switzerland) in 1987 where he is currently Professor and former Chair of Biochemistry. Professor Hall is a pioneer in the fields of TOR signaling and cell growth control. In 1991, Professor Hall and colleagues discovered TOR (Target of Rapamycin) and subsequently elucidated its role as a central controller of cell growth and metabolism. The discovery of TOR led to a fundamental change in how one thinks of cell growth. It is not a spontaneous process that just happens when building blocks (nutrients) are available, but rather a highly regulated, plastic process controlled by TOR-dependent signaling pathways. As a central controller of cell growth and metabolism, TOR plays a key role in development, aging, and disease. Professor Hall is a Member of the US National Academy of Sciences and has received numerous awards, including the Breakthrough Prize in Life Sciences (2014) and the Albert Lasker Award for Basic Medical Research (2017).

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.

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
Marina V Rodnina**

*Life Science and
Medicine Committee*

Professor Marina V Rodnina is the head of the Department of Physical Biochemistry at the Max Planck Institute for Biophysical Chemistry in Goettingen, Germany. Her research focuses on the function of the ribosome as a macromolecular machine. Her group pioneered the use of kinetic and fluorescence methods in conjunction with quantitative biochemistry to solve the mechanisms of translation. Her current interests focus on the dynamics of the ribosome and translation factors, and the mechanisms of translational recoding and co-translational protein folding.

Professor Rodnina is a Member of the German Academy of Sciences Leopoldina, Academia Europaea, and the European Molecular Biology Organization. She received the Hans Neurath Award of the Protein Society in 2015, the Gottfried Wilhelm Leibniz Prize in 2016, the Otto Warburg Medal in 2019, and the Albrecht Kossel Prize in 2020. She is a holder of an ERC Advanced Investigator Grant 2018.

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.

Professor 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, Canada's Gairdner Prize and the Brain Prize.

Selection Committee Member



**Professor
Luigi Ambrosio**

*Mathematical Sciences
Committee*

Professor Luigi Ambrosio is presently Full Professor and Director of the Scuola Normale Superiore in Pisa, Italy. Born in 1963, he studied at the Scuola Normale and at the University of Pisa under the direction of Ennio De Giorgi. His research interests moved gradually from Calculus of Variations and Geometric Measure Theory, with basic contributions to the theory of BV functions and the theory of currents, to Optimal Transport and Probability. He is the author of more than 200 papers, many text and research books and the scientific advisor of many brilliant mathematicians worldwide. He has been sectional speaker at the ICM in Beijing and, more recently, plenary speaker at the ICM in Rio de Janeiro. He is currently Member of the Executive Committee of the IMU.

Selection Committee Member



**Professor
Nicolas Bergeron**

*Mathematical Sciences
Committee*

Professor Nicolas Bergeron is a French mathematician, currently a Professor at the Département de Mathématiques et Applications of École Normale Supérieure in Paris. He studied at the École Normale Supérieure de Lyon, got a PhD there and a Habilitation from Orsay University. After holding positions at CNRS in Orsay, he has been Professor of Mathematics at the Université Paris 6 (Jussieu) from 2006 to 2018.

Working at the interface of Geometry, Topology and Arithmetic he was an invited speaker at the ECM Berlin in 2016 and ICM Rio in 2018. He also received the bronze medal of the CNRS (2007), was a junior member of the Institut Universitaire de France (2010–2015) and was invited to give a Takagi Lectures in Kyoto in 2018 and held an Aisenstadt Chair in Montréal in 2020.

Selection Committee Member



**Professor
Toshiyuki Kobayashi**

*Mathematical Sciences
Committee*

Professor Toshiyuki Kobayashi is a Professor of the University of Tokyo, and also serves as a Principal Investigator of Kavli Institute for the Physics and Mathematics of the Universe (IPMU).

His research interests include analysis of symmetries, representation theory of Lie groups and discontinuous groups.

His academic honours include the Spring Prize (1999, Japan), JSPS Prize (2007), Humboldt Research Award (2008, Germany), and AMS Fellow (2017, USA).

Professor Kobayashi received Medal with Purple Ribbon in 2014.

Selection Committee Member



**Professor
Karen K Uhlenbeck**

*Mathematical Sciences
Committee*

Professor Karen K Uhlenbeck received her BS in Mathematics from the University of Michigan in 1964, and her PhD from Brandeis University in 1968 under the direction of R S Palais. She held post doctoral and faculty positions at MIT, the University of California, Berkeley, the University of Illinois in both Champaign-Urbana and in Chicago and the University of Chicago. Most of her career from 1987–2014 was spent at the University of Texas at Austin. After her retirement, she moved to the Institute for Advanced Study, and now holds a position as Distinguished Visiting Professor. Uhlenbeck’s mathematical work is in geometric analysis. Throughout her career she has been involved in many programmes which encourage women in mathematics. Her awards include a Sloan Fellowship, a MacArthur Fellowship, membership in the National Academy of Sciences, the National Medal of Science and honorary degrees from seven colleges and universities. In 2019, she was awarded the Abel Prize in Mathematics.

(Photo credit: Andrea Kane/Institute for Advanced Study, Princeton, NJ USA)

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 Amazing Filmphony”, a concert of his film music with Hong Kong Sinfonietta; “The Originals”, a concert celebrating 50 years of Hong Kong original musicals which he curated. 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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