

THE
SHAW
PRIZE
邵逸夫獎

Astronomy

Life Science & Medicine

Mathematical Sciences

THE SHAW PRIZE 2020
AWARD CEREMONY

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.

Message from the Chief Executive

I am delighted to congratulate the Laureates of the Shaw Prize 2020 on their outstanding achievements in science and research, in furthering our understanding of humanity, the planet we share and the universe beyond.

Our world has been reeling, this past year, from the COVID-19 pandemic and the overwhelming distress it has wrought. If the unprecedented global crisis is a potent reminder of just how fragile our lives are, it is also an inspiring testament to the power of research, the remarkable ability of the world's scientists to rise to the daunting challenge, developing effective vaccines accessible to all.

The online presentation of the 2020 Shaw Prize is yet another vivid example of innovation in the face of the pandemic. And the six Laureates selected this past year, in the categories of Astronomy, Life Science and Medicine, and Mathematical Sciences, brilliantly encapsulate what can be achieved in pursuit of excellence through science and its myriad applications.

This past year's Laureates, like those honoured each year since the Shaw Prize began in 2002, come from all over the world. They add value to our lives, enrich our societies and communities and serve as towering role models for



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

tomorrow's scientists, researchers and academics. They reaffirm my Government's commitment to supporting scientific research and nurturing talent in science, technology and innovation.

I am grateful to the Shaw Prize Foundation for its far-reaching vision. And I look forward to the continuing progress, and triumphs, of this year's distinguished Shaw Prize Laureates.

A handwritten signature in black ink that reads "Carrielam". The signature is fluid and cursive, with the first letter "C" being particularly large and stylized.

Mrs Carrie Lam

Chief Executive

Hong Kong Special Administrative Region

Message from the Chairman of the Board of Adjudicators

Welcome to the seventeenth annual Shaw Prize Award Presentation Ceremony. In 2002 Sir 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 have inspired the quest for new knowledge, highlighted outstanding achievements, and have become a major force for progress in the world.

The pandemic forced this year's Shaw Prize Presentations to be a virtual ceremony, which the Shaw Prize Foundation with its background in the film and communications industry could undertake with confidence. Through modern methods of remote assembly, 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 utility only shine brighter in times of medical crises, social division, and public doubt.

This year, we honour six scientists in the three designated fields for their distinguished contributions. They are Professor Roger Blandford in Astronomy; Professors Gero Miesenböck, Peter Hegemann, and Georg Nagel in Life Science and Medicine; and Professors Alexander Beilinson and David Kazhdan in Mathematical Sciences.

A handwritten signature in black ink that reads "Frank H. Shu".

Frank H Shu

Chairman, Board of Adjudicators
Shaw Prize 2020

(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 – 20 May 2021)

Opening Address by

Mr Wai-Man Chan, Raymond

Chairman of the Shaw Prize Foundation

Member of the Council

Speech by

The Honourable Mrs Carrie Lam Cheng Yuet-ngor

The Chief Executive of HKSAR

Speech by

Professor Frank H Shu

Member of the Council

Chairman of the Board of Adjudicators, The Shaw Prize

Speech by

Professor Reinhard Genzel

Member of the Board of Adjudicators

Chairman of the Selection Committee for

the Prize in Astronomy

Speech by

Professor Roger D Blandford

Laureate in Astronomy

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 Gero Miesenböck

Laureate in Life Science and Medicine

Speech by

Professor Peter Hegemann

Laureate in Life Science and Medicine

Speech by

Professor Georg Nagel

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 Alexander Beilinson

Laureate in Mathematical Sciences

Speech by

Professor David Kazhdan

Laureate in Mathematical Sciences

Closing Remarks by

Professor Kenneth Young

Chairman of the Council

Vice Chairman of the Board of Adjudicators, The Shaw Prize



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) 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 2020

Roger D Blandford

**for his foundational contributions to
theoretical astrophysics, especially concerning the
fundamental understanding of active galactic nuclei,
the formation and collimation of relativistic jets,
the energy extraction mechanism from black holes,
and the acceleration of particles in shocks and
their relevant radiation mechanisms.**

An Essay on the Prize in Astronomy 2020

In 1918, the American astronomer Heber Curtis used the Crossley Reflector at Lick Observatory in California to take optical photographs of nearby galaxies. When observing M87, the central elliptical galaxy in the Virgo galaxy cluster 53 million light years from the Sun, Curtis noted the lack of a spiral structure and observed a “curious straight ray ... apparently connected with the nucleus by a thin line of matter”. This measurement heralded the discovery of radio jets, the ejection of highly collimated, relativistic plasma streams or “blobs”, from a central energy source. Forty years later radio astronomers in the UK and Australia discovered a new class of “radio stars” not obviously connected with bright optical nebulae. Caltech astronomer Maarten Schmidt then used the large 5 m Hale telescope on Palomar to identify a faint, compact optical nebula associated with one of these radio stars, 3C273. Schmidt interpreted the substantial (16%) redshift of all spectral lines in the optical spectrum as being caused by the expansion of the Universe. If so, 3C273 must be 2.4 billion light years from us, 45 times further away than M87, and the optical luminosity of the faint compact speck would have to be about one thousand times greater than the 100 billion stars of our Milky Way. Thus began the subject of *quasars*, quasi-stellar radio sources. Many quasars and other somewhat less spectacular “active galactic nuclei” (AGN) exhibit powerful radio jets.

Detailed observational and theoretical research since these discoveries have led to a widely accepted standard model in which most galactic nuclei contain spinning charged massive black holes, with huge masses ranging from 1 million to 10 billion times that of the Sun. When matter in the form of gas or stars is gravitationally attracted by these black holes, a rapidly rotating, hot plasma accretion disk or torus forms around the hole just outside its event horizon, probably pervaded by strong magnetic fields. The interaction of the spinning black hole, the magnetic field lines anchored in the black hole and the inner accretion disk, and the accretion disk plasma, drive matter rapidly out along the rotation axis of hole and disk. The 2020 Shaw Laureate in Astronomy, Professor Roger Blandford, has been one of the most important architects and drivers in constructing the theoretical framework of this *active galactic nuclei + jet* paradigm. These same processes are also relevant to γ -ray bursts and stellar-mass black holes.

Blandford originated key ideas leading to the spectacular multi-scale acceleration and collimation of relativistic jets, involving complex fluid-dynamical and electro-dynamical processes (with Königl, Begelman, Ostriker, Rees). Perhaps his most prescient contribution was his recognition (with Znajek) that magnetic torques

could extract energy from a spinning (Kerr–Newman) black hole, and thus efficiently drive jets. This paper as well as others on the creation of fast winds from accretion disks around massive black holes (with Payne, Begelman and others) have in recent years become even more relevant and widely cited than when they were originally written. This is because high resolution radio and infrared interferometric observations are just now beginning to directly probe and reveal the innermost accretion and jet formation zones around massive black holes, which Blandford analysed in his prescient theoretical work. The disk winds are also relevant for outflows from protostars. His theoretical work impresses by its focus on key physical aspects, such as energy transport and shock-based mechanisms for cosmic ray acceleration in highly complex, magnetised plasmas.

Another paper that is now more cited than ever deals with the fate of binary black holes, which arise as the outcome of mergers between galaxies (with Begelman & Rees). With McKee he showed how time-variable line and continuum emission can be used to explore the spatial structure of broad-line regions around AGN, a now standard technique used by many observers.

Blandford has made major contributions to an extremely broad range of astrophysical problems, arguably placing him among the rare group of “universal” scientists. He has been one of the leaders in the modelling and interpretation of gravitational lensing. He has contributed to the interpretation of γ -ray data from the Fermi spacecraft and to the study of gravitational waves. Blandford’s contributions began and often are rooted in analytic work, but in recent papers he and his collaborators have exploited increasingly sophisticated numerical techniques to capture realistically the complex physics in the strong gravity environment of spinning and accreting black holes (with McKinney, Tchekovskoy, Anantua and many others).

In addition to his research, Roger Blandford stands out because of his tireless participation in community service, culminating in the leadership of the 2010 US decadal survey in astrophysics.

Blandford’s many profound contributions to theoretical astrophysics and his continuing originality and towering presence make him a worthy recipient of the 2020 Shaw Prize in Astronomy.

Roger D Blandford

Laureate in Astronomy



I was born in 1949 in Grantham in eastern England. In 1954, my parents, Jack and Janet, my younger sister, Janette, and I moved to Birmingham, where my parents had both grown up and my father worked in the meat market, as had many of his relatives. I attended the local primary school where I was well taught and, quite unusually for the time, saw my first science experiments which left a big impression. The local public library had a children's section with books about science, including several on astronomy which I read avidly. At the age of eleven, I was fortunate to start at King Edward's School in Birmingham which has an outstanding academic tradition. At that time, it was customary to specialize early and, although I was originally most interested in mathematics, I also studied chemistry and physics. It was a time of social change from the conservatism of post-war England to a more youthful and vibrant global culture.

Before starting at Cambridge University in 1967, I spent four months teaching mathematics in a new high school in the north of Scotland. This was an amazing opportunity and I, at least, learned a lot and was able to climb many mountains. I started specializing in chemistry at Cambridge but converted to physics after reading Feynman's lectures while employed at a boating pool in the pouring rain — one of many vacation jobs. At Cambridge we were taught by some outstanding scientists who broke many of the rules of modern pedagogy, leaving us to devise our own versions of what they understood so well. I am very grateful for this and still get fresh insights from their lectures.

I intended to start as a research student in elementary particle theory. However, 1970 was a time of stasis in the field. In contrast, astronomy was bubbling with discovery and a half-hour meeting with my future supervisor, Martin Rees, rekindled my childhood interest and I joined the new Institute of Theoretical Astronomy in Cambridge. Of course, the next five years were golden in particle physics, but for me, it was the right choice. In order to learn some astronomy, I spent an idyllic summer on a course at the Royal Greenwich Observatory, where I met my wonderful wife, Liz.

Life as a research student was very busy as we were only supported for three years. I had to take classes, teach undergraduates where, again, I learned so much, and write a thesis. Under Martin Rees' visionary and sure-footed guidance and with generous prodding by Peter Scheuer, I worked mainly on double radio sources

and particle acceleration and tried to learn plasma physics, which I saw as my best opportunity for future employment in the then growing fusion programme. Instead, I was elected to a research fellowship in St John's College and started to think more seriously about general relativity and neutron stars. Liz and I spent a wonderful year at Princeton and Berkeley, exploring the US and Canada. I was fortunate in my collaborators during those years, including Chris McKee, Ted Scharlemann, Larry Smarr, Saul Teukolsky and Roman Znajek.

I was offered a junior faculty position at Caltech and we moved to Pasadena with our one-month-old son, Jonathan, in 1976. It was an exciting time and, while being mentored in very different ways by Marshall Cohen, Peter Goldreich, Gerry Neugebauer, Wal Sargent and Kip Thorne, I also enjoyed friendship and shared scientific interests with my peers, especially Jeremy Mould, Tom Prince, Tony Readhead and Tom Soifer. Visitors to Caltech and family visits to Cambridge, now with a second son, Edward, led to further collaborations with Jon Arons, Mitch Begelman, Jerry Ostriker and many others. At Caltech, I was privileged to work with excellent students and postdocs, too many to list, most of whom have gone on to impressive, independent careers and with whom I am proud to have been associated. I also started working with the agencies on strategic planning, which culminated in my chairing the 2010 NRC decadal survey in astronomy and astrophysics.

In 2003 I was given the opportunity to establish the first new Kavli Institute at Stanford University with Steve Kahn. It was hard to leave Caltech, but I am glad to have seized the opportunity and delighted with what KIPAC has become after seventeen years, especially under my successors, Tom Abel and Risa Wechsler. Scientifically, I became much more involved in cosmology and gamma-ray astronomy through the wonderful Fermi telescope, led by Peter Michelson.

As I look back on a lifetime in scientific research, education and administration, I feel privileged to have seen so much durable and ongoing discovery; some of this from inspired individual insights, even more from large collaborations. I have been blessed with wonderful teachers, colleagues and students who have taught me so much. While I am personally honoured and humbled by the award of the Shaw Prize, it is to this much larger community that I must pay tribute.



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 2020

**Gero Miesenböck,
Peter Hegemann
and
Georg Nagel**

**for the development of optogenetics,
a technology that has
revolutionized neuroscience.**

An Essay on the Prize in Life Science and Medicine 2020

Understanding the brain is a daunting challenge. Each of the many billions of nerve cells in the human brain may make thousands of contacts with other neurons, resulting in an astronomical number of synaptic connections. The tools that allow us to trace and regulate neural networks in experimental animals have emerged in recent years thanks to the discoveries of our Shaw Life Science Awardees for 2020: Gero Miesenböck of Oxford University, Peter Hegemann of Humboldt University, Berlin, and Georg Nagel of the University of Würzburg.

Neuroscientists had long sought methods to control the activity of individual nerve cells in order to understand the networks in which they communicate and define the processes they control. Direct activation of nerve cells by physical or chemical means had been used for over two centuries, but the dream had been to modify nerve cells genetically so that electrical signals could be induced or suppressed remotely, allowing a less invasive and more precise means of controlling the function of neural networks in an intact organism. The first key breakthrough came in 2002 with the development of an optogenetic tool devised by Gero Miesenböck. Using a naturally light-responsive protein, rhodopsin, which serves as the pigment on which we rely for vision, his team inserted the *Drosophila* (fruitfly) genes necessary to express the light-responsive rhodopsin into a vertebrate nerve cell culture. As a result, cells in the culture showed patterns of neuronal activity elicited by light. Building on this initial finding, Miesenböck was the first to show that this approach could be applied to an intact animal, and that by optically activating particular circuits one could alter specific behaviours of the animal. His subsequent studies of sexually dimorphic behaviour, the neural basis of reinforcement, and the regulation and function of sleep demonstrated the full potential of optogenetics beyond the proof-of-principle stage. In his first report Miesenböck concluded that “Since sensitivity to light is built into each target neuron, advance knowledge of its spatial coordinates is unnecessary. Large numbers of neurons can be addressed simultaneously and precisely, without undesirable cross-talk to neighbouring cells that are functionally distinct”. Miesenböck’s approach represented the first chapter in the new era of optogenetics.

In the application of this approach to animals, the fruitfly rhodopsin had certain technical disadvantages in terms of speed of response to light and genetic simplicity. Fortunately, soon after Miesenböck’s work a simpler photo-responsive channel protein emerged from studies on the detection of light by

an alga, *Chlamydomonas*. Rhodopsins had been discovered in certain archaeal microorganisms, but the speedy phototactic and photoelectrical response of the algal rhodopsin suggested that a single receptor protein may be sufficient to elicit a change in membrane current. In early work published in 1991, Peter Hegemann discovered the rhodopsin-based photocurrent in *Chlamydomonas*. After years of further work on this light response, Hegemann teamed up with Georg Nagel, who had since 1995 characterized microbial rhodopsins in heterologous expression systems and measured the first photocurrents of bacteriorhodopsin, a light-activated proton pump, in vertebrate cells. In two papers published in 2002 and 2003, they demonstrated by expression in oocytes that the two discovered *Chlamydomonas* rhodopsins are light-responsive channel proteins that unify light sensing and channel functions. They named these proteins Channelrhodopsins, ChR1 and ChR2. Crucially, Nagel discovered that ChR2 elicits an extremely fast, light-induced change in membrane current when expressed in oocytes or cultured human cells. These discoveries represented the second major step in the development of optogenetics. Hegemann and Nagel characterized ChRs in molecular detail by a wide range of biophysical techniques. The many mutants they and their colleagues generated led to the deciphering of the channel mechanism, including gating and ion selection.

The discovery of ChRs by Hegemann and Nagel has enabled various functional applications in a variety of cells and tissues. In 2005/2006, five teams independently showed the power of ChR2 for light activation of neurons: Deisseroth, Boyden, and Nagel and, a few months later, Herlitze, Landmesser, and Hegemann as well as Ishizuka and Yawo. In parallel, Nagel and Gottschalk demonstrated the optical modulation of *C. elegans* behaviour, and the team of Huo-Zhuo Pan restored vision in blind mice.

As a result of these foundational, basic science discoveries, we now have the tools needed to precisely control specific neural networks in the brain. These discoveries presage a golden age of exploration of the mysteries of cognition and emotion, with potential applications in psychiatry disorders that are only now being defined at the level of genes and cells.

Gero Miesenböck

Laureate in Life Science and Medicine



Each new issue of the *Annual Review of Biochemistry* was like a sorbet course during medical school: a palate cleanser between the stodgy mains of the curriculum. The dark blue books now fill three shelves in my study, beginning with volume 52 of 1983, the year I entered the University of Innsbruck.

I was a reluctant medical student, having bowed to paternal pressure. My father had grown up in the Soviet-occupied part of post-war Austria and, with financial support from his parish, been sent to a boarding school that specialized in the production of Catholic priests. At the age of 18 he struggled free of this destiny (which would have made my future existence precarious but not impossible, as some of his ordained classmates subsequently proved), but a continuing lack of funds put his wish to train as a physician out of reach. He became a half-hearted classicist instead, and the fulfilment of his medical dream fell to me. And so, when my time came to choose a course of study, my father, in what I suspect was a ploy to bend my nascent interests to his plan, arranged a visit with a colleague at the Technical University of Vienna. Seated in a dusty office, the professor of biochemistry reached for two aspirin tablets before explaining the cause of his headache: too many students; endless hours of tedious instruction; no time for research; and therefore no discoveries of significance by anyone at his institute, ever, with the possible exception of Hromatka's procedure for making vinegar — "but that was probably an accident. Don't come here; study medicine instead." This performance sealed my fate until I, too, found the courage to shed an ill-fitting career, just as my father himself had done four decades earlier.

Among my favourite pieces in the *Annual Review* were the autobiographical chapters that open each volume. I remember reading that matchbook covers, not butterflies, were the dominant species in the Brooklyn streets of Arthur Kornberg's childhood; that natural history and science were unfamiliar pursuits. Kornberg's remark resonated because science was also outside the sphere of music, literature, and art inhabited by my parents; they appreciated science not as a source of beauty, pleasure or transcendence but as a base for practical advances. Only as a teenager, after a lengthy flirtation with writing fiction, did it dawn on me that science offered similar opportunities for creative expression: there was a possible world to be imagined. The need to check imagination against reality had given rise to an art form: the elegant experiment which arrived in a minimum of steps at a sharply stated inference. It was

the mastery of this art that would later draw me to James Rothman.

Before then, however, I had to finish my degree — an increasingly unpleasant prospect as the course shifted to the clinic, just as I first tasted laboratory life with its refreshing mix of intellectual and manual work, of camaraderie and solitude. I eventually graduated but continued for years to freeze when the dean's office called in the midst of an experiment, threatening to expel me if I didn't pass dermatology at once, before realizing I had woken from a dream.

In his memoir for the *Annual Review*, Gottfried Schatz summed up university in 1950s Austria under the heading "Desert". Little had changed a generation later. Scanning the arid plain of contented mediocrity for possible thesis advisors, I spotted a shimmering oasis (or was it a mirage?): Josef Patsch, recently repatriated from Baylor College of Medicine. My apprenticeship with him, studying lipid metabolism, gave me the first thrill of discovery, enough practice with a pen to accept Nabokov's decree that writing requires "the precision of a poet and the imagination of a scientist", and an idealized view of US academia as unlike anything I knew: international, risk-taking, and informal. Yet our bond — which bordered on friendship despite never losing the starch of "Herr Professor" — dissolved with my exodus to this Promised Land.

It was there, under Rothman's influence, that my goals crystallized, albeit into an unexpected shape. Biochemistry had cast its spell on me with the rigour and inventiveness of its game, the audacity of breaking life into parts and understanding it by way of reassembly. Other branches of biology, especially neuroscience, were full of mesmerizing problems but lacked muscle by comparison. What would it take to apply the force of functional reconstitution to them? Could a neuroscientist isolate the electrical activity patterns that embody our experience like a biochemist purifies an enzyme, by fractionating them according to their power to evoke perception, action, emotion, or thought when added to a brain? But how could something like this ever be done — seizing control of many neurons while solving the needle-in-the-haystack problem of finding the right ones? One Saturday in June 1999, after my little daughter and I had crisscrossed New York Harbor on the Staten Island Ferry, as we sometimes did on weekends, an idea docked in my mind: visual photoreceptors, transplanted from their natural context, might be used for this purpose, as genetically encoded receivers of optical commands.

Peter Hegemann

Laureate in Life Science and Medicine



I grew up in Aachen in a family coming from Westphalia with a large number of medical doctors, including both parents, both grandfathers, brother, and a number of cousins and uncles. My youth was extremely traditional. I was sent to a humanistic gymnasium with many years of Latin and Greek and I hated to translate boring reports about Roman and Greek wars. I disliked this school with the exception of the small topics Chemistry, Physics, Biology, Art and Music, most of them quite unimportant for that ancient school type. But playing flute in the orchestra and fooling around on motorcycles was great fun outside school.

In parallel, I became fascinated with the great maritime explorers including da Gama, Columbus, Vaspuchi, Magellan, Cook, Joshua Slokum and many others. Later, near the end of school, I focused on arctic expeditions with my greatest heroes Nansen and Amundsen. I learned from them what you need to explore new territories: courage, very accurate preparation, a huge amount of patience, and certainly self-confident, knowledgeable and reliable co-workers you can trust in difficult situations. However, when I finished school I realized that there is no territory left on this planet that remains undiscovered, with the possible exception of deep-sea areas. Thereafter, I became interested in astronomy but I was convinced that my mathematical skills were underdeveloped. But, discovery seemed not to be the only route to satisfaction. To create something new that never existed before appeared to me a challenging alternative and as a consequence, I began to study chemistry in Münster where I was born. After two years I moved to Munich to focus on biochemistry.

As a student at the Ludwig Maximilian University I was fascinated by Feodor Lynen, a great enzymologist and unconventional character. Shortly after my last exam he died and I started my masters work in the lab of one of Lynen's most successful students, Dieter Osterhelt, at that time a young Director at the Max Planck Institute for Biochemistry. Dieter had discovered the function of bacteriorhodopsin as a light-driven proton pump, which was the birth of the microbial rhodopsin research. The years in this institute were the most stimulating time for me. I characterized the just identified light-driven proton pump Halorhodopsin. Dieter, until today, remains my only real academic teacher. We also had a lot of fun skiing and mountaineering in the Alps, and in the summer, sailing and occasionally racing on the many lakes.

After my PhD I tried to do my research independently as soon as possible and decided to work on the photoreceptors in green alga *Chlamydomonas*. After a one-year visit to the physics department in Syracuse, NY, to focus on quantitative photobiology with Ken Foster (a late Max Delbrück graduate student) I started

my own group again at the MPI for Biochemistry to identify the phototaxis photoreceptor. The biochemical work failed despite my intense experience with microbial rhodopsins. The reason was that *Chlamydomonas* contains > 20 sensory photoreceptors and at least eight of them rhodopsins. But, in parallel I started electrophysiology on *Chlamydomonas* with my 2nd graduate student Hartman Harz supported by Hans-Dieter Lux, a director at the MPI for Psychiatry in the next-door building. We characterized photocurrents in *Chlamydomonas* and proposed that they are carried by rhodopsin and due to the very fast current rise that the rhodopsin and the channel form a single protein complex. A few years later we extended the proposal by saying that the rhodopsin and the channel are one protein. Also, from my private perspective, I had a great time in Munich where I met my wife, we had three children together and we all are loving and fighting each other to this day — now with two grandchildren supporting us in both directions.

Chlamydomonas research was neither the most cited nor the best funded research but I got a position at the University Regensburg where a number of new colleagues worked on eukaryotic model organisms and *Chlamydomonas* was appreciated. We made slow progress with our electrophysiological studies but after many biochemical failures Suneel Keteriya identified two large rhodopsin cDNAs in the Katzusa *Chlamydomonas* cDNA data base. Our interest was to verify our proposal and we proved the function of both new rhodopsins in a collaboration with Georg Nagel. He was the one who proved in *Xenopus* oocytes that both proteins are indeed light-activated ion channels that we named Channelrhodopsin-1 and -2 (ChR1 and ChR2). We already found that ChR2 is better expressed than ChR1 with 10x larger photocurrents and the key experiments on the way into neuroscience was the demonstration that ChR2 expresses well and is fully functional in human kidney cells (HEK).

Not as a big surprise, mostly young researchers have undertaken the adventure to go with ChR2 into application which should also be considered as optogenetic pioneers. They expressed ChRs in a number of cells, tissues and animals, namely Zhuo-Hua Pan in the retina of mice, Karl Deisseroth in hippocampal neurons, Stefan Herlitze in chicken embryos, Alexander Gottschalk in *C. elegans*, and Hiromu Yawo in mouse brain slices. After their key publications in 2005/6 the field exploded and many superb scientists applied and improved optogenetic systems worldwide and my lab contributed with photoreceptor characterization and molecular improvements over the past 15 years in Berlin where I am working since 2005. Berlin somehow suits us, chaotic and stimulating with its everyday struggles. I am grateful to all the wonderful companions who have travelled with me on more or less bumpy roads during the past 35 years.

Georg Nagel

Laureate in Life Science and Medicine



Born in Weingarten, southern Germany, as the first of five children, I became seriously ill at the age of five. When my brother and sisters went skiing in nearby Austria, I built a steam engine or a radio from the science education kit which my parents gave me for Christmas every year. My summer school vacations were often spent undergoing surgery at the University hospital of Wuerzburg, a pretty city in northern Bavaria. In school I loved math, physics, and biology and decided on studying biology at the newly founded

University of Konstanz, near the Swiss mountains and a beautiful big lake.

I liked the strong focus on biochemistry and the structured curriculum of the biology course. Ernst Bamberg, my first lecturer in biophysics, gave me the chance to assist with exciting experiments in his lab for which I even got paid. He measured the opening and closing of a single ion channel (gramicidin) in an artificial membrane. After the diploma — with a thesis on dimerized gramicidin in a lipid monolayer — I did not feel ready to continue for a PhD. Instead, I worked as a teacher at a Swiss private high school and started, with others, “Café Chaos” in downtown Konstanz. Then I again had surgery in Wuerzburg and finally the inflammation in my bones could be stopped. I continued for some time as a teacher, even started hang-gliding in my free time, but when Ernst Bamberg invited me to move with him to Frankfurt, I readily took this chance.

Bamberg led a new research group at the Max Planck Institute (MPI) of Biophysics. At the MPI, I felt fortunate to learn and practice the “patch clamp technique”. There I met for the first time Peter Hegemann who, as a PhD student from MPI Munich, did many of his experiments in Bamberg’s lab in Frankfurt. For my thesis I also applied another new technique, the electrophysiological characterization of the sodium pump (Na/K-ATPase) by the UV light-induced concentration jump of ATP from “caged ATP”. After my PhD studies I spent two years as a postdoc with Clifford Slayman, Yale University, USA. This was a great place to “grow up” in science and to meet many eminent scientists. At Yale, Biff Forbush, the first to use caged ATP for elegant experiments on the sodium pump, impressed and helped me a lot.

In 1990 I continued at Rockefeller University, NY, in the lab of David Gadsby, a very gentle Englishman, known for his pioneering experiments on the sodium pump. Much to my regret he passed away prematurely in 2019. David’s lab was

very inspiring, with members from around the world. David sent me to Don Hilgemann in Dallas for two months where I learnt the “giant patch” technique. With that I could show that a cAMP-dependent anion channel in guinea pig heart cells is activated by protein kinase A and ATP and is equal to the recently cloned human cystic fibrosis transmembrane conductance regulator (CFTR). In New York I also found the love of my life, Anna, a guest professor at Columbia University from Napoli, Italy. Together we enjoyed New York even more and she — as a molecular biologist — helped me to widen my biophysical approach to science. The departure from NY to Germany (and Anna’s to Italy) was hard but fortunately, Anna then came to EMBL in Heidelberg, not too far from Frankfurt where I got a group leader position in Bamberg’s department at the MPI.

With Bamberg I started expression of the light-activated proton pump bacteriorhodopsin (BR) in oocytes of *Xenopus laevis*. This approach turned out to be quite successful and could have been the beginning of optogenetics in 1995. But the time was not yet ripe. We then characterized more microbial rhodopsins with the oocyte-, and later also mammalian cell-, expression approach. The year 1996 was a special year, as Anna and I married in Denmark and Nina was born. Our daughter presented a new sense to life and a balance to some of the hardships and failures in the lab.

In 1995 Peter Hegemann published chlamyopsin, a gene sequence from the green alga *Chlamydomonas reinhardtii*, as a hypothetical rhodopsin and possible light-gated ion channel. However, chlamyopsin turned out not to be an ion channel and five years later Peter contacted me when he found *Chlamydomonas* DNA sequences that showed similarity to BR. Even though expression of the first candidate in oocytes was extremely low, I could show a light-sensitive H^+ conductance, so I called the protein channelrhodopsin-1 (2002). With channelrhodopsin-2 (2003) our lab showed a light-induced permeability for mono- and divalent cations, and strong light effects on membrane potential. Obviously, we had discovered a new tool which five labs then independently introduced to neuroscience in 2005/2006. Soon after the discovery of channelrhodopsin-2 we were also the first to show the application of a newly discovered photoactivated adenylyl cyclase for cellular signaling research. In 2004, called to Wuerzburg as professor for Molecular Plant Physiology, I have since learned to know and love the city of my “hospital youth”. In 2019, thanks to the generous hospitality of the chairman of the Neurophysiology Department, Manfred Heckmann, we moved to the Institute of Physiology in the heart of the city, where I feel even more at home.



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 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 2020

**Alexander Beilinson
and
David Kazhdan**

**for their huge influence on and profound
contributions to representation theory, as well as
many other areas of mathematics.**

An Essay on the Prize in Mathematical Sciences 2020

Alexander Beilinson and David Kazhdan have made profound contributions to the branch of mathematics known as representation theory, and are also famous for the fundamental influence they have had on many other areas, such as arithmetic geometry, K-theory, conformal field theory, number theory, algebraic and complex geometry, group theory, and algebra more generally. As well as proving remarkable theorems themselves, they have created conceptual tools that have been essential to many breakthroughs of other mathematicians. Thanks to their work and its exceptionally broad reach, large areas of mathematics are significantly more advanced than would otherwise have been possible.

Group theory is intimately related to the notion of symmetry and one can think of a representation of a group as a “description” of it as a group of transformations, or symmetries, of some mathematical object, usually linear transformations of a vector space. Representations of groups reduce many group-theoretic problems in linear algebra, which is well understood. They are also important in physics because, for example, they describe how the symmetry group of a physical system affects the solutions of equations describing that system. In loose terms, representation theory is the study of the basic symmetries of mathematics and physics. Many different kinds of groups occur naturally as symmetry groups. An obvious example is finite groups, but there are also more “continuous” groups known as Lie groups that are hugely important in physics, as well as algebraic groups, which are groups defined using polynomial equations, and several other classes of groups. This partly explains how Beilinson and Kazhdan have been able to contribute to so many different fields.

One of Kazhdan’s most influential ideas has been the introduction of a property of groups that is known as Kazhdan’s property (T). Among the representations of a group there is always the not very interesting “trivial representation” where we associate with each group element the “transformation” that does nothing at all to the object. While the trivial representation is not interesting on its own, much more interesting is the question of how close another representation can be to the trivial one. Property (T) gives a precise quantitative meaning to this question. Kazhdan used Property (T) to solve two outstanding questions about discrete subgroups of Lie groups. Since then it has had important applications to group representation theory, lattices in algebraic groups over local fields, ergodic theory, geometric group theory, expanders, operator algebras and the theory of networks, and has been recognised as a truly fundamental concept in representation theory.

After this first breakthrough Kazhdan solved several other outstanding problems about lattices in Lie groups and representation theory such as the

Selberg conjecture about non-uniform lattices, and the Springer conjecture on the classification of affine Hecke algebras.

While working with George Lusztig on this last problem, he introduced an important family of polynomials, as well as formulating a very influential pair of (equivalent) conjectures concerning them. One of Alexander Beilinson's achievements was to prove these conjectures with Joseph Bernstein. (These conjectures were also proved independently by Jean-Luc Brylinski and Masaki Kashiwara.) The methods introduced in this proof led to the area known as geometric representation theory, an area that Kazhdan also played an important part in developing, which aims to understand the deeper geometric and categorical structures that often underlie group representations. The resulting insights have been used to solve several open problems.

Another famous concept, this one established by Beilinson, Bernstein and Pierre Deligne, is that of a perverse sheaf. It is not feasible to give a non-technical explanation of what a perverse sheaf is — one well-known account begins by helpfully stating that it is neither perverse nor a sheaf — but it is another concept that can be described as a true discovery, in that it has a far from obvious definition, but it is now seen to be “one of the most natural and fundamental objects in topology” (to quote from the same account). One of the central goals of mathematics, the Langlands programme, has been deeply influenced by this concept. For example, the whole work of Ngô on the “fundamental lemma” and the contributions of Laurent and Vincent Lafforgue (all three of them major prizewinners for this work) would have been unthinkable without it. Kazhdan too is bringing extraordinary mathematical insight into this circle of ideas. Indeed in a first attempt to prove the fundamental lemma, Goresky, Kottwitz and MacPherson were missing a way to organize certain algebraic objects in families. Kazhdan recently came up with the insight that this can be achieved by switching to formal algebraic geometry in infinite dimensions. This is the source of promising current work. Beilinson is also famous for formulating deep conjectures relating L -functions and motivic theory, which have completely changed the understanding of both topics and led to an explosion of related work.

Beilinson and Kazhdan are at the heart of many of the most exciting developments in mathematics over the last few decades, developments that continue to this day. It is for this that they are awarded the 2020 Shaw Prize in Mathematical Sciences.

Alexander Beilinson

Laureate in Mathematical Sciences



I was born in 1957 in Moscow. The city was much smaller then and still retained some rural character: small wooden houses with gardens, an occasional horse-driven cart. After the joy of early childhood, going to school was a setback. After 7th grade I went to mathematical school no. 2. It was a true change: lectures and seminars on advanced mathematical topics taught by professors and students from the University, the shining classes on literature and on history. I got to know A Parshin, and in 1972 he took me to I Gelfand's seminar; this was the start of mathematical life. After school I entered Pedagogical Institute, and in 1977 moved to the University to be Y Manin's student. Attendance was not enforced; skipping all classes of no interest (an officer informed me I was the champion of playing truant) gave much time for walking in the woods and for doing math. I graduated in 1980, and V Alexeev took me to his computer lab at the Cardiological Centre. Sadly, he died soon after. By the word of Gelfand, I became an engineer with no responsibilities at the biological division of the Centre and gained the same freedom as in my student years.

To those who wished to see things with one's own eyes, and valued free time to think — not focusing on their career — the Moscow of my time was a very nice place to be. Since Khrushchev announced that his predecessor had been a criminal, much of the public relegated all things related to the powers that be to the domain of the ridiculous. People were connected by the flow of books; poetry was learned by heart. A unique art, light and free, came to life: to get a taste, one can watch Yu Norstein's animated movies "Hedgehog in the Fog" and "Tale of Tales", and read Yuri Koval (it's a pity the best of Koval's books — the finest Russian prose of the time — are not translated into English). Mathematics was largely a part of that culture.

Doing math is akin to unfolding a melody; its first sounds are usually a gift from someone else. My first paper was written in the footsteps of the ADHM

classification of instantons. I caught the idea of higher regulators while preparing a talk on S Bloch's work; this led to conjectures on the values of L -functions (still widely open) and to speculations about mixed motives (largely realized by V Voevodsky and A Suslin). Conversations with R MacPherson and P Deligne brought forth our work with J Bernstein on the Kazhdan–Lusztig conjecture; we played happily with D -modules and perverse sheaves until Bernstein left Russia at the beginning of 1981. In the mid-80s, A Belavin taught me the basics of string theory and conformal field theory; his work with A Polyakov and A Zamolodchikov came to be a source of the idea of factorization geometry developed later together with V Drinfeld.

At the end of the 80s “perestroika” brought into Moscow streets immense crowds calling for changes. These arrived: the country was split and pillaged by the robber barons, the life losses on par with those in the Civil War 74 years earlier. In 1989 I went to the Landau Institute and, for two months in the Fall, I was at MIT. Around 1993 I began to work with Drinfeld on his approach to geometric Langlands theory via the quantization of Hitchin's fibration, and on factorization geometry. In 1998 we moved to Chicago. Drinfeld joined us within a year. Since then, we have run “geometric Langlands” seminar at U of C, which resembles the Gelfand seminar of yore.

In America there are still some woods; the trees are magnificent, the animals full of grace and wisdom. Life is very kind to me. But one can't help seeing everywhere the madman's effort to build in his own image a fake world by destroying the real one, together with its live magic we are all part of. In his Dachau diaries E Kupfer-Koberwitz wrote that the worst of what humans do to themselves is a direct consequence of what they do to animals. Perhaps the death spiral cannot be stopped unless a phase transition in our attitude to ourselves and to Nature happens, and we realize that animal lives matter no less than human ones.

David Kazhdan

Laureate in Mathematical Sciences



I was born in Moscow immediately after World War II, the only son of young academic parents. During the fifth grade of my local elementary school, I became interested in mathematics, and together with my grandfather, who had no high school education, I spent that year making my way quickly through algebra, geometry and trigonometry. I do not recall how much time, if any, was spent in regular classes that year, but that first experience showed me, and I still believe, that many mathematical subjects relegated to high school can be learned much earlier. The young mind can absorb mathematical concepts, like chess skills, at an early age.

By the beginning of the following year, I joined a math club organized by two students from Moscow University. This was a great experience. It opened my eyes — and my heart — to the beauty of mathematics, the field that ties together ostensibly unrelated concepts.

At that time, I often shopped for mathematical texts in used bookstores and frequently met Naum Vilenkin on my wanderings. He was an excellent mathematician who attended the seminar led by Israel Gelfand. Gelfand, by then a 45-year-old outstanding scientist in many areas of mathematics (and later of biology), had begun instructing his son, Sergei, who hoped to follow in his father's mathematical footsteps. They were looking for a partner and I surmise that Vilenkin told Gelfand about meeting me on those shopping expeditions. In any case, Vilenkin gave me Gelfand's phone number and I eagerly called my future mentor. After a cursory interview, Gelfand invited me to his home and for many years thereafter I would go to his house on a weekly basis. Those meetings opened the world of mathematics to me. The fundamental lesson Gelfand imparted was the feeling that mathematics constitutes a unity, that even if in the apparent diversity of subjects falling within the discipline, such divisions should not be taken too seriously.

I enjoyed participating in various math circles throughout my school years, and later at Moscow University I met a number of excellent mathematicians — young, committed, and focused partners. We often became friends and shared mutual feelings about the beauty of mathematics. We went together to numerous seminars, living and breathing mathematics, and constantly discussing our ideas and sharing our findings and quandaries. For our group, the Moscow International Congress of 1966 provided the unique opportunity of meeting world-famous mathematicians: Michael Atiyah, a British-Lebanese mathematician specializing in geometry; Harish-Chandra, an Indian mathematician and physicist who did fundamental work in representation theory; and a little later, Pierre Deligne, a Belgian colleague of similar age who began to visit Moscow frequently. Despite the hermetically closed borders of the communist state, for young Soviet students such interactions offered access to cutting edge developments in the various realms of mathematics on an international scale.

In 1968, I married Helena Slobodkin, a fellow mathematics student — and later computer programmer. Our first three children — Eli, Dina and Misha — were born over the next five years in Moscow. Daniel, the youngest, was born in Boston in the early 1980s after our immigration in 1975. Helena and I took advantage of the brief *détente* in the mid-1970s between Moscow and Washington. As a young, religious Jewish family, the rigidity of the Soviet Union, and specifically the restrictions against any forms of organized religion, did not offer much hope of raising our family as we wished.

Upon arrival in the United States, I was offered a position in the Harvard Mathematics Department where I had the privilege of spending the next 27 years. Harvard was a remarkably friendly and stimulating place. The Department integrated many different mathematical minds and offered a unique platform for interactions and collaborations between the faculty and the graduate student community. And more broadly, the world of Boston academia provided an auspicious environment for my work. I collaborated with various colleagues at Harvard and was exceptionally lucky to become a friend and collaborator of Romanian-born George Lusztig. And beyond the academic satisfactions of my tenure at Harvard, my family quickly made Boston our “home”. Relationships were built and long-lasting friendships forged.

In 2002, Helena and I moved to Jerusalem where I joined the Department of Mathematics at The Hebrew University and where I found a number of excellent mathematicians with whom I worked. Two of our four children were already living in Israel and our first grandchild had recently been born there. Although our family had previously spent two sabbaticals in Jerusalem, moving, yet again, to a new country and burdened with a new language (this time at the age of 55) was not trivial. And yet, I found the environment, the city, and especially my colleagues to be most welcoming. The Department allowed me to structure my teaching with allowances for my less than fluent Hebrew language skills and recognizing my strengths and weaknesses. They created the atmosphere that ensured my productivity by supporting me each step of the way and facilitating interactions with people in a variety of unfamiliar areas. Even now, after my retirement, I enjoy leading three to four seminars each semester.

Throughout my career, in all three countries where I have lived, I have been extremely fortunate — and continue to be fortunate — to have worked with many highly talented people. The inherently pure beauty that we see in mathematics is the glue that continues to bring us together. Even if it is via ZOOM conferences in the time of COVID, the world of mathematics, perhaps even more than in other domains of science, allows for professional relationships and cooperation between people in different parts of the globe, who have no shared language, come from diverse backgrounds, and live by dissimilar political orientations. This global community is what makes mathematics special — at least for me.



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)

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



SHAW PRIZE

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



SHAW PRIZE

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



SHAW PRIZE

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 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 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.

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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, 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 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.

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 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 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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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
Chryssa Kouveliotou**
Astronomy Committee

Professor Chryssa Kouveliotou is a Professor of Physics, the Physics Department Chair 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 MSc 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 2021, he holds 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 D Tremaine**

Astronomy Committee

Professor Scott D 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 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
Ewine van Dishoeck**

Astronomy Committee

Professor Ewine 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 2020 Jules Janssen Prize of the French Astronomical Society, 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). From 2015 to 2019 he was Director of Research of the Princess Maxima Center for Pediatric Oncology.

Professor Hans 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
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 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 Marina 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 and Canada's Gairdner Prize.

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
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), an ERC Advanced Grant (2009), a Chaire d'Excellence de la Fondation Mathématique de Paris (2011), the Cantor Medal (2019), 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, an invited Professor at the Institute for Advanced Studies (IAS, Princeton) 2019/20.

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
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
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.

Presenter



**Mr
Leon Ko**

Theatre and Film Composer

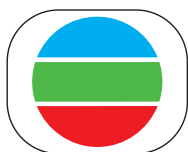
Mr Leon Ko received a Richard Rodgers Development Award in the US for his musical “Heading East”. His musical “Takeaway” in 2011 was the first major British Chinese musical to premiere in London. In Hong Kong, he has won eight awards for his stage musicals such as “The Passage Beyond” and “Sing Out”. 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.

Special Acknowledgement

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