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 culture and the arts, 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 work is recently achieved and who are currently active in their respective fields.

Founder's Biographical Note

The Shaw Prize was established under the auspices of Mr Run Run Shaw. Mr Shaw, born in China in 1907, is 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 (Hong Kong) Limited in Hong Kong. He was one of the founding members of Television Broadcasts Limited launched in Hong Kong in 1967. Mr Shaw has also founded two charities, The Sir Run Run Shaw Charitable Trust and The Shaw Foundation Hong Kong, both dedicated to the promotion of education, scientific and technological research, medical and welfare services, and culture and the arts.

Message from the Chief Executive

My sincere congratulations to the five recipients of this year's Shaw Prize. Through their work, the Shaw Laureates 2012 have extended the boundaries of knowledge in astronomy, life science and medicine, and mathematical sciences. Their achievements in our age of rapid scientific progress have had a profound and lasting impact on humankind and inspired new and wonderful discoveries and applications.

Now in its ninth year, the prestigious Shaw Prize continues to recognize our most distinguished scientists not only for their scholarly achievements, but also their abiding passion for knowledge and relentless efforts in challenging conventional thinking.

The Shaw Prize also demonstrates the far-sighted and generous philanthropic commitment of its founder Mr Run Run Shaw who, through his vision and wide-ranging contributions, has helped to stimulate the scientific and creative advancement of our community.

I wish the Shaw Laureates 2012 every success in their future scientific pursuits.

C Y Leung
Chief Executive
Hong Kong Special Administrative Region

THE SHAW PRIZE
邵逸夫獎

Message from the Founder

Year upon year, our lives are greatly enhanced by inspired individuals who, through their discoveries, enlighten us on the mysteries of our universe. Ideas relentlessly pursued to successful resolution weave the web of advancement, laying firm foundations for striking breakthroughs by future generations and thereby constantly renewing the quest for knowledge. The Shaw Prize draws attention to such breakthroughs and acknowledges these rare individuals who leave their mark on history.

Run Run Shaw

Message from Chairman of the Board of Adjudicators

The first Shaw Prize ceremony took place in 2004. In the eight years up to tonight, twenty-five Prizes have been awarded to forty-three scientists in three different fields: Astronomy, Life Science and Medicine, and Mathematical Sciences. These three fields represent active, productive and extremely exciting research areas that have tremendous potential for discoveries beneficial to mankind in the 21st Century and beyond, as I outlined briefly at last year's ceremony.

Tonight, the Shaw Prize is proud to present the Shaw Prizes of 2012 to five scientists in these three fields. With this presentation we are happy to have among our distinguished group of forty-eight Laureates the first female Shaw Prize winner.

Chen-Ning Yang

The Shaw Prize Medal

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

AGENDA

Arrival of Officiating Guest and Laureates

****

Welcome Speech by Professor Chen-Ning Yang

Member of the Council

Chairman of the Board of Adjudicators, The Shaw Prize

****

Speech by Professor Peter Goldreich

Member of the Board of Adjudicators

Chairman of the Selection Committee for the Prize in Astronomy

****

Speech by Professor Yuet-Wai Kan

Member of the Board of Adjudicators

Chairman of the Selection Committee for

the Prize in Life Science and Medicine

****

Speech by Professor Peter C Sarnak

Member of the Board of Adjudicators

Chairman of the Selection Committee for

the Prize in Mathematical Sciences

****

Award Presentation

Grand Hall

Hong Kong Convention and Exhibition Centre

17 September 2012

AWARD PRESENTATION
(Category listed in alphabetical order)

Astronomy

Professor David C Jewitt

and

Professor Jane Luu

Life Science and Medicine

Professor Franz-Ulrich Hartl

and

Professor Arthur L Horwich

Mathematical Sciences

Professor Maxim Kontsevich

Professor Peter Goldreich

Member of the Board of Adjudicators

Chairman of the Selection Committee for the Prize in Astronomy

Professor Peter Goldreich is the Lee A DuBridge Professor of Astrophysics & Planetary Physics Emeritus at the California Institute of Technology in Pasadena California.

He received a PhD from Cornell University in 1963. After spending one year as a postdoc at Cambridge University and two as an Assistant Professor at the University of California, Los Angeles, he joined the Caltech faculty as an Associate Professor in 1966. He was promoted to Full Professor in 1969 and remained at Caltech until he retired in 2002. Subsequently, he was appointed Professor in the School of Natural Sciences at the Institute for Advanced Study in Princeton from which he retired in 2009. Professor Goldreich is a Member of the US National Academy of Sciences and a Foreign Member of the Royal Society of London. His awards include the Henry Norris Russell Lectureship of the American Astronomical Society, the US National Medal of Science, the Gold Medal of the Royal Astronomical Society, the Grande Medaille of the French Academy of Sciences, and the Shaw Prize. Professor Goldreich's research involves the application of physics to the understanding of natural phenomena, in particular those revealed by astronomical observations.

The Prize in Astronomy 2012

David C Jewitt

and

Jane Luu

for their discovery and characterization of trans-Neptunian bodies, an archeological treasure dating back to the formation of the solar system and the long-sought source of short period comets.

An Essay on the Prize in Astronomy 2012

Astronomy is arguably the oldest science. Observations of the motion of heavenly bodies date back more than 2,500 years. Nevertheless, as recently as 1992, immediately prior to the detection of the first Kuiper belt objects (KBOs) by Jewitt and Luu,[1] little was known about the contents of the solar system beyond 30 AU.[2] Distant bodies are dim because they reflect little sunlight back to Earth and our most powerful telescopes can only image small angular regions at a single pointing. Thus searches for widely-spaced, faint images are tedious and resource intensive. Before Jewitt and Luu's discovery, Pluto and its large satellite Charon were the only directly detected bodies orbiting beyond Neptune.

Comets provide indirect information about reservoirs of bodies beyond 30 AU. Although comets are directly detected only when they come within a few AU, their orbits can be traced back to show where they came from. By 1950 it had been established that most long-period comets were visitors from distances in excess of 10,000 AU and that their orbits were randomly oriented with respect to the mean orbit plane of the solar system. These facts led Jan Oort to hypothesize that comets are stored in an enormous spherical cloud beyond 10,000 AU and that gravitational deflections by nearby stars are responsible for injecting those we detect into the inner solar system. Oort's model is widely accepted and the hypothetical comet cloud carries his name. However, his assumption that short-period comets are descendants of long-period ones did not fare as well.

Short-period comets are rare in comparison to long-period comets. Their orbits are mostly prograde and of low-inclination. Oort proposed that gravitational scattering by planets transforms a small fraction of long-period comets into short-period comets. However, during the 1980s, dynamical studies aided by numerical simulations demonstrated that Oort's proposal for the origin of short-period comets was untenable. Instead, they showed that an origin in a disk just outside the orbit of Neptune provides an excellent fit to the orbital characteristics of short-period comets. Independently, Jewitt and Luu began to search for KBOs during the time when these theoretical advances were being made. Success did not come quickly. It took them five years to find their first KBO.

After their initial discovery, Jewitt and Luu continue to lead efforts to characterize the spatial distribution and size spectrum of KBOs for more than a decade. As other astronomers joined the hunt, progress accelerated. During the past 20 years, more than 1,400 KBOs have been discovered. It has been established that the region between 30 and 50 AU is populated by a vast array of icy bodies with tens of thousands having diameters in excess of 100 kilometers. There are even a few whose diameters exceed 1,000 kilometers and one of comparable size to Pluto (diameter 2,000 kilometers) discovered by a team working with Mike Brown. This finding led to Pluto's demotion from its high status as the ninth planet to merely a charter member of a new class of dwarf planets.

A significant fraction of KBOs are trapped in orbital resonances with Neptune. That is, their orbit periods are related to Neptune's by the ratio of two small integers. Pluto is in a 3:2 resonance so Neptune circles the Sun three times while Pluto goes around it twice. As a result of this resonance, Pluto is protected from close approaches to Neptune even though its eccentric orbit crosses Neptune's circular one. By sheer coincidence, a paper by Renu Malhotra proposing that Neptune's outward migration was responsible for the resonant trapping of Pluto's orbit was published in 1993 in Nature, the same year and the same journal in which Jewitt and Luu's seminal article appeared. Similar dynamics apply to all orbital resonances, so Malhotra's proposal has been widely embraced as the explanation for the large fraction of resonant KBOs. Other resonances known to have substantial populations include the 5:2, 7:4, and 5:1. Trapping of KBOs in these resonances implies that Neptune's currently circular orbit maintained a substantial eccentricity during the time the planet was migrating.

Jewitt and Luu discovered a new component of the solar system and the source of the short-period comets. KBOs grew by the accretion of solids during the early stages of planet formation until some undetermined process, probably involving perturbations by Neptune while its orbit evolved, increased their relative velocities to the extent that further accretion could not take place. Owing to their great separations, large KBOs have suffered little collisional evolution since. Thus they offer us a frozen record of the early stages of planet formation. As impressive as progress has been, much unexplored territory remains. Almost nothing is known about the content of the solar system from 100 to 10,000 AU. These and other challenges remain for the future.

---

1 Gerard Kuiper was a Dutch-American astronomer.

2 Distances quoted here are relative to the Sun. An astronomical unit (AU) is the mean radius of the Earth's orbit about the Sun. Neptune's orbital radius is 30 AU and the nearest stars are at a distance of about 150,000 AU.

David C Jewitt
Laureate in Astronomy

I was born in London in 1958. My father worked on a factory assembly line producing industrial steel cutters, my mother was a telephone operator. My first memories are of a winter with very heavy snow, of having appendicitis and of the birth of my sister, Jenny, all in 1962. I first noticed the sky three years later when, one evening, several bright meteors flashed overhead within a short interval. My mother said they were "shooting stars", which confused me and left me wondering what I had seen. I began to look upwards at night more carefully and to think about space in the daytime and when it was cloudy (which, in England, was most of the time). Later, my grandparents bought me a tiny refractor as a birthday gift. Through it I saw the Moon, the stars and the planets, all against the sodium glare of the big city. I was astonished. A few years later, my uncle built me a bigger telescope: the planets looked even better. But I was also fascinated by trees, writing, machines, animals, music, rocks and fossils.

Later, I met "physics", then a new word for me. I found that it included many of the topics I most loved. A teacher told me that physics was the most difficult of subjects: I decided immediately to try to become good at it. Others told me that human knowledge was so vast that I could never hope to get to the edge of it. For years I believed them, but through my telescopes I sometimes saw things that I was pretty sure nobody else could have seen. The thought of being close to the edge made me very happy.

I was the first from my family to go to university. My time at University College London was free (tax-payer supported) and gave me an unsurpassable grounding in physics, mathematics and astronomy for which I remain extremely grateful. While at UCL, I won my first prize. The $500 Viking Prize from NASA was by far the largest sum of money I had ever seen. Crucially, it solved the problem of how to pay for my airfare to California, where I had been admitted as a graduate student at Caltech in 1979.

There, I worked closely with Ed Danielson, Gerry Neugebauer and his "infrared army" and I learned the importance of simplification from Peter Goldreich. I moved to MIT in 1983 as an assistant professor. Although not then equipped with good telescopes, MIT was where I first wondered "why is the outer solar system so empty compared to the inner solar system?". This naive question was the key that later unlocked the door to the Kuiper belt. In 1988 I moved to the University of Hawaii, a place having unparalleled access to the world's best telescopes and where, starting in 1992, we discovered and mapped the Kuiper belt.

I liked Hawaii and stayed for 21 years. The decade of the 1990s was especially full of surprises, both personal and scientific. While observing on Mauna Kea I met Jing Li, a Chinese graduate student in solar physics visiting from the University of Paris. We were married in 1993. Our daughter, Suu Suu, was born in 2000. Scientifically, Jane Luu and I found that the Kuiper belt is thick, more like a doughnut than a sheet of paper, evidence of an unexpectedly violent past. We also found that the Kuiper belt is dynamically divided into regions. The Classical belt contains the most primordial bodies and has a still-unexplained sharp outer edge. We found many resonant objects (whose periods are related simply to Neptune's), later shown by Renu Malhotra to be best explained if Neptune had migrated outwards, thus opening the door to wild new models of solar system evolution. Some resonant objects had Pluto-like orbits; we called them "plutinos" and concluded that Pluto was just another Kuiper belt object, albeit the brightest one. The Scattered belt, discovered in 1997, is the nursery of the comets. Joined by graduate student Chad Trujillo, we measured the mass of the belt and found too little material for the observed objects to grow – the current belt is probably a remnant of an original structure that was hundreds of times more massive. Few of our observational results were predicted by dynamicists. Instead, increasingly elaborate models continue to emerge to account for what we have seen.

I still like to be on the edge. At UCLA since 2009, I work on comets from the Kuiper belt and on a newly-found class of bodies that are half asteroid, half comet. I suspect that similar objects once supplied water to the Earth's oceans, as well as organic molecules that were the precursors to life.

Jane Luu
Laureate in Astronomy

Born in July 1963 in South Vietnam, I am the second child in a family of four children (one older sister, two younger brothers). We were part of a much larger family: my father had fourteen siblings, my mother five. Both my parents had emigrated to South Vietnam from North Vietnam in 1955. My father taught me French as a child, initiating a fondness for languages. In April 1975, when the South Vietnamese government collapsed, my family emigrated to the United States. We spent the next several months in a series of refugee camps, rented rooms and motel rooms before settling in Paducah, Kentucky, living with an aunt and her family. My father remained in Southern California to learn a trade and find employment, believing it easier to do this without supporting a family at the same time. Our year in Kentucky was a happy one, as my siblings and I were warmly welcomed by our teachers and fellow students. In the summer of 1976, we relocated to Ventura, California, to join my father, who by that time had become a bookkeeper. My family still remains in Southern California, where we have been joined by many cousins, aunts and uncles. Other relatives are spread out across the United States and beyond (Canada, France and Hong Kong).

The high school years in Ventura went well and I enrolled at Stanford University in 1980 as a freshman. I obtained a bachelor's degree in Physics from Stanford in 1984. A subsequent short stint at the Jet Propulsion Laboratory introduced me to planetary astronomy: the remarkable images returned by the Voyager spacecraft, opened my eyes to the prospect of studying such exotic objects as a profession. After a summer in Nepal and Tibet in 1986, I enrolled as a graduate student in the Department of Earth, Atmospheric, and Planetary Science at the Massachusetts Institute of Technology (MIT). There, I started working with David Jewitt, who was my advisor at the time; this was the start of our longtime collaboration.

I had the most wonderful time in graduate school (1986 – 1990): I was free to pursue any subject that struck my interest, essentially without any other concern. David and I collaborated on many projects focusing on physical properties of the small primitive bodies of the solar system: comets, asteroids, satellites of the outer planets. In 1987, we started our survey of the outer solar system, wishing to confirm that the outer solar system was truly as empty as it seemed. This work was to occupy us for the next twenty years, although my doctoral thesis was on the relationship between comets and asteroids. David left MIT in 1988 to take a professorship at the University of Hawaii in Manoa; I also moved to Hawaii in order to continue working with David, while remaining a graduate student at MIT. I received my PhD in 1990.

In the fall of 1990, I left Hawaii to be a Harvard-Smithsonian Postdoctoral Fellow at the Center for Astrophysics in Cambridge, Massachusetts. On 30 August 1992, using the University of Hawaii's 2.2-meter telescope on Mauna Kea, David and I discovered the object 1992 QB1, the first acknowledged representative of the Kuiper Belt, a large band of primitive bodies beyond Neptune. Before it received its official title (15760) 1992 QB1, we nicknamed our newly found object "Smiley" after the shrewdly intelligent British spymaster George Smiley in John Le Carre's spy novels (I think Smiley would approve). The 1992 – 1993 academic year was spent at UC Berkeley as a Hubble Fellow, followed by a year at Stanford. In the fall of 1994, I joined the faculty at Harvard University as a professor in the Astronomy Department. This was followed by a faculty position at the University of Leiden in the Netherlands from 1998 to 2001.

Upon returning to the United States in the fall of 2001, I started working on instrumentation as Technical Staff at the MIT Lincoln Laboratory in Lexington, Massachusetts. This change of direction from traditional science was prompted by a desire to learn how to build instruments: I had always felt that my education was lacking in this area, and I very much wanted to learn how to make things work. At Lincoln Laboratory, I developed an interest in the coherent properties of light and how to make use of them.

Besides my research activities, I have served on several scientific committees, including NASA's Origin of the Solar System Committee, various telescope time allocation committees, and most recently, the National Academy of Sciences' Planetary Science Decadal Survey for 2013 – 2022.

In my personal life, I am married to Ronnie Hoogerwerf, whom I met at Leiden. We live with our six-year-old daughter Eliot, and Mango, a Newfoundland dog, in Lexington, Massachusetts, where we are kept busy by a vegetable garden and a very popular bird feeder.

Professor Yuet-Wai Kan

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

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

The Prize in Life Science and Medicine 2012

Franz-Ulrich Hartl

and

Arthur L Horwich

for their contributions to the understanding of the molecular mechanism of protein folding. Proper protein folding is essential for many cellular functions.

An Essay on the Prize in
Life Science and Medicine 2012

Protein molecules are long, complex strings of amino acids that have many possible ways of folding into a compact shape, yet they somehow fold beautifully in the crowded interior environment of a cell. Folding is guided by the sequence of amino acids in a protein but sometimes this process goes bad when proteins are changed because of mutation or when surfaces that are incompatible with the water environment of the cell cytoplasm become exposed during the folding process. Cells have evolved molecular chaperones, such as GroEL, to help shield such surfaces and to provide a protected environment in which to complete the folding process. The surfaces of this remarkable machinery are very forgiving. They actually utilize metabolic energy (i.e., ATP hydrolysis) to alternate their physical chemistry between hydrophobic states and hydrophilic states, which restarts the folding when it stalls and expels the protein when folding is completed. In the case of GroEL, a molecular chaperone shaped like a test tube, access to the cavity is highly selective and limited to only newly-made proteins or those purposely unfolded to repair damage or mistakes.

The 2012 Shaw Prize in Life Science and Medicine is awarded to Ulrich Hartl, Director, Max Planck Institute of Biochemistry in Martisried, Germany and Arthur Horwich, Professor of Genetics and Investigator of the Howard Hughes Medical Institute, Yale University School of Medicine. Together, these two investigators identified the chaperones and their mechanism of action in the cell powerhouse, the mitochondrion, and in the cell sap, the cytoplasm.

The experiments of Hartl and Horwich from 1987 to 1997 created a coherent picture of the physiologic and biophysical processes that cells use to fold proteins. In an extraordinary body of work between 1991 and 1994, Hartl defined, resolved, and reconstituted the complete pathway by which molecular chaperones cooperate to fold proteins.

Electron microscopy images of GroEL, taken by Hartl and Wolfgang Baumeister, offered the first indication that folding occurs within the GroEL cavity, a hypothesis that was proposed in 1993 by Horwich. Hartl proposed that the chain folds in the internal microenvironment provided by the cavity of GroEL and its lid-shaped cofactor GroES. In essence, a series of ATP-driven conformational steps change the shape of the wall of the chamber to accept an unfolded domain and then closes the chamber to reinforce the folding event.

In 1994, together with the late Paul Sigler, Horwich solved the atomic structure of GroEL, which was one of the largest protein complexes whose structure was solved at the time. An elegant analysis using mutant GroEL proteins then confirmed, on a structural basis, that an unfolded protein binds in the centre of the hollow cylindrical GroEL complex by hydrophobic binding regions on the GroEL domains facing the central cavity.

More details followed in 1997, when Horwich and Sigler solved the atomic structure of the GroEL-GroES complex. The structure confirmed that the inner cavity of GroEL undergoes a massive conformational change upon GroES binding. This change results in the burial of the hydrophobic regions and formation of a large hydrophilic chamber in which proteins up to about 60,000 daltons in size are free to fold. This structure also identified the mechanism of ATP hydrolysis, allowing the Horwich laboratory to work out the reaction cycle.

Folding chaperones are essential to normal life. Elimination of chaperones from the cell causes irreversible and lethal damage because fully 10% of all the cell's proteins require GroEL for proper folding. Now that we know what chaperones do and can reproduce the process in the test tube, it has become possible to examine the role of the chaperones in guiding the folding of mutant proteins or in disease states. The next frontier will be to apply our knowledge of protein folding in the cell to control the process when it goes bad in diseases.

A new field of "proteostasis" seeks to understand the balance of protein folding, misfolding, and protein degradation that govern normal and abnormal cell physiology. Drugs that target the folding process and that stabilize a proper folded state for misfolded proteins, such as mutant forms of CFTR (Cystic Fibrosis Transmembrane Conductance) in cystic fibrosis, show promise in the treatment of a variety of genetic diseases. Similarly, the misfolded amyloid peptide that characterizes Alzheimer's Disease could be a target of drug therapy to prevent amyloid peptide aggregation. If we are able to harness our understanding of protein chaperones in the treatment of diseases of protein folding, it will be because of the pioneering efforts of Hartl, Horwich, and others who elevated the field to its current level of molecular precision.

Franz-Ulrich Hartl
Laureate in Life Science and Medicine

I was born on March 10th, 1957 in Essen, Germany. My father was an electrical engineer and my mother was trained as a domestic science teacher. When I was four years old, the family moved to the northern part of the Black Forest where I grew up in a small village. I had a wonderful childhood, roaming the fields and woods with the neighbours' children, collecting frogs and salamanders and building dams in the little brook near our house. When I was five, I learned to read musical notes and to play the recorder, later the flute and piano. After attending the small village school, I went to gymnasium (high school) in the district town of Pforzheim, where I developed two major interests, music and biology. The latter was spawned by my grandfather, a competent hobby microscopist, and by a family friend who was a biology teacher. He took me on field trips and taught me how to identify and collect insects. I was fascinated by the variety and beauty of butterflies and moths, and accumulated a substantial collection which I still keep in my office today. During the final years at high school I became very excited about biochemistry, the field that would become my vocation.

I joined Medical School at Heidelberg University at the age of 19. While attending mandatory classes in my 'spare time', I worked on my doctoral thesis in the Biochemistry Department. I discovered that a class of liver cell organelles, the peroxisomes, could be metabolically activated and induced to proliferate by thyroid hormone. My thesis was sent to the renowned biochemist Walter Neupert at Munich University for grading, who then invited me to join his laboratory as a postdoc – an amazing opportunity that I did not let pass. Although I completed my MD degree, I never practiced medicine but instead devoted myself to research.

The move to Munich turned out to be crucial, both for my professional and personal future – the latter because in 1986 Walter Neupert allowed me to attend a molecular biology summer school on a Greek island where I met my future wife Manajit. Walter's group studied the process by which mitochondria, another class of cell organelles, import newly-synthesized proteins. Evidence was mounting that so-called heat-shock proteins, such as Hsp70, had to stabilize these proteins in an unfolded state for translocation across the mitochondrial membranes. But how did the proteins fold into their functionally active forms once inside the organelle? Clearly, this was a fundamental question in biology and the mitochondrial system provided the opportunity to study it. In pursuing this problem I was fortunate that Walter introduced me to Art Horwich, a young geneticist from Yale. Using a combination of genetics and biochemistry, we discovered that the mitochondrial protein Hsp60, a molecular chaperone, mediated protein folding in an energy-dependent process. This discovery, published in two collaborative Nature papers in 1989, marked the radical deviation from the then prevailing view that proteins folded spontaneously, without any help by cellular machinery or an energy source.

To gain experience abroad, I interrupted my time at Munich University and spent almost a year with Bill Wickner in Los Angeles to work on bacterial protein export. While in Bill's lab I had the opportunity to explore various professional opportunities and eventually I accepted an offer from Memorial Sloan-Kettering Cancer Center to join the newly-founded Department of James Rothman as an Associate Professor. In 1991 my wife and I moved to New York, and this marked the beginning of our long-term collaboration. The following years were intense and full of exciting discoveries. My colleagues and I dissected and reconstituted the evolutionary conserved pathway of protein folding in which the Hsp70 and Hsp60 chaperone systems cooperate sequentially. We discovered that Hsp60, exemplified by bacterial GroEL, functions as a cage for single protein molecules to fold unimpaired by aggregation, and we demonstrated the significance of co-translational folding for the biogenesis of large multi-domain proteins. In 1993 I was tenured and promoted to Full Professor and in 1994 became an investigator of the Howard Hughes Medical Institute.

In 1997, I accepted the offer to become one of the Directors at the Max Planck Institute of Biochemistry in Martinsried near Munich. Over the past 15 years we have investigated the Hsp70 and GroEL mechanisms in more depth using structural and other biophysical approaches. We have conducted a systematic analysis, by quantitative proteomics, to understand how the cellular proteome utilizes the chaperone network for folding and conformational maintenance. We have also discovered that activating the chaperone system can prevent the formation of protein aggregates that cause neurodegenerative diseases, such as Huntington's or Parkinson's disease, and have provided evidence that such activation can be achieved with an experimental small molecule drug. In current research we wish to understand why cellular chaperone capacity declines during aging and how the system can be re-set to a more youthful state. Much work still lies ahead!

For many years I have had the privilege of collaborating closely with my wife Manajit, a first-class biochemist who has contributed to many aspects of our research. I have worked with a long list of highly gifted students and postdocs. They deserve most of the credit for the achievements of my laboratory and it gives me great joy to observe that many of them have advanced to successful independent careers in science.

Arthur L Horwich
Laureate in Life Science and Medicine

I was born in 1951 and grew up in suburban Chicago, exposed to mathematics and science at an early age by my parents. My Dad seemed to vicariously enjoy my interest in science as his career as an engineer had been derailed by World War II. I became a ham radio operator at age ten and spent considerable time building radio equipment and chatting on-the-air. I focused on science and mathematics at Oak Park High School, then matriculated at Brown University in 1969, entering a six-year medical program. There I worked with Michael Czech and John Fain on the mechanism of thermogenesis by brown adipose tissue, enjoying discussion of models and experimentation. I then pursued paediatric medical training at Yale, enjoying application of clinical science to the health of children. During this time, however, I became fascinated with the model of cell transformation by single genes encoded by tumour viruses and, upon completion of residency, went to the Salk Institute in 1978, where I worked on polyoma virus T antigens with Walter Eckhart and Tony Hunter. They taught me molecular biology and biochemistry, and I watched Tony discover tyrosine phosphorylation. At the end of three years in La Jolla, I returned to Yale to receive Medical Genetics and further scientific training with Leon Rosenberg and, during this time, working with the Rosenberg group, was able to clone cDNA encoding the subunit of the hepatic urea cycle enzyme OTC (ornithine transcarbamylase), whose X-linked inherited deficiency leads to lethal ammonia intoxication in affected newborn males. This allowed development of prenatal DNA-based diagnosis. We also pursued OTC biogenesis. OTC is translated in the cytosol, and then enters mitochondria. The cloned cDNA allowed us to observe the sequence of an N-terminal mitochondrial targeting peptide that contained sufficient information to target a protein to mitochondria.

I became an independent investigator in the Genetics Department at Yale in 1984. Here I set out to identify components of the yeast mitochondrion that are required for import of proteins, using human OTC as a model, and this led to our discovery of Hsp60 inside the mitochondrial matrix as a component that mediates de novo folding of imported proteins. That led to work of the next eighteen years, spent analyzing the mechanism by which this double ring component and its homologues in bacteria and elsewhere, the chaperonins, mediate de novo polypeptide chain folding.

In 1990, I became an Investigator of the Howard Hughes Medical Institute, enabling an unlimited degree of experimental freedom in seeking to understand chaperonin mechanism, using biochemical reconstitution with Ulrich Hartl; X-ray crystallography with the late Paul Sigler at Yale to solve structures of the folding machine; EM with Helen Saibil at Birkbeck College, London, to examine structures of the machine, including bound polypeptide; and NMR with Kurt Wüthrich to inspect disordered parts of the system. The early interactions with Ulrich were electric, the two of us crossing the Atlantic to spend time together discussing how this and other chaperone systems might work. As my wife describes, we would sit in our kitchen carrying on "Gro-speak" (discussion of GroEL mechanism) until 3 AM on a nightly basis. Likewise, interactions with Paul Sigler were exhilarating – we shared a love of jazz, the Chicago Bears, the Chicago Bulls and Michael Jordan (Paul had been a faculty member at the University of Chicago before coming to Yale), and of medicine as a landscape in which biological problems present themselves. Paul, as our lab neighbour next door in the Boyer Center, taught us crystallography, step-by-step. I also spent countless wonderful hours dining, discussing, and working in lab with Helen and Kurt. Members of my group were also inspirational over these years, including, to name a few, Ming Cheng, my graduate student, a young physician who unearthed the Hsp60 mutant, Kerstin Braig who unearthed the first decently diffracting crystal of GroEL, Jonathan Weissman, who helped dissect the topology and reaction pathway , Hays Rye, who watched the components dance once they were fluorescently labeled, and Wayne Fenton, George Farr, and Krystyna Furtak, who were the bedrock senior people in my lab who carried through much of the work that underpinned our experiments.

Not least in enabling my life in science and tolerating the large time investment are my kids, Mike, who just completed an MD/PhD program at the University of Massachusetts, Worcester, studying Argonaute proteins with Phil Zamore; Annie, an artist and now a designer with Banana Republic in New York; and Dave, who is entering college this Fall. All of us share a love of tennis and have had wonderful moments together out on the courts. Mike, Dave, and I are all pretty avid about fly fishing, and probably our most memorable jaunt was to Jackson Hole to catch truly large trout (all safely returned to the Snake River). Mike and his wife Hilary have just made me a proud grandfather, and we can see a twinkle in Anabel's eye as the next solid athlete in the family. Last but not least, my wife Martina is a paediatric cardiologist and basic scientist working on left-right handed asymmetry at Yale, who shares a love of sports, but prefers the "slippery" ones, ice skating and skiing, the latter of which all of us excel in except me – they go down double black diamond slopes while I meander down blue slopes. But we all share the same enjoyment of good food and drink at the end of a good day outside!

Professor Peter C Sarnak

Member of the Board of Adjudicators

Chairman of the Selection Committee for the Prize in Mathematical Sciences

Professor Peter C Sarnak is currently the Eugene Higgins Professor of Mathematics at Princeton University and Professor of the Institute for Advanced Study.

He has made major contributions to number theory, and to questions in analysis motivated by number theory. His interest in mathematics is wide-ranging, and his research focuses on the theory of zeta functions and automorphic forms with applications to number theory, combinatorics, and mathematical physics.

Professor Sarnak received his PhD from Stanford University in 1980. In the same year, he became Assistant Professor of Courant Institute of Mathematical Sciences of New York University and an Associate Professor in 1983. In 1987 he moved to Stanford University. He joined Princeton University as Professor in 1991, became the Henry Burchard Fine Professor of Mathematics in 1995 and the Chair of the Department of Mathematics from 1996 to 1999. From 2001 to 2005, he was Professor of Courant Institute of Mathematical Sciences of New York University.

He has received many awards, including the Frank Nelson Cole Prize, American Mathematical Society (2005) and Levi L Conant Prize, AMS (2003). He was elected as a Member of the US National Academy of Sciences and Fellow of the Royal Society of London in 2002.

The Prize in Mathematical Sciences 2012

Maxim Kontsevich

for his pioneering works in algebra, geometry and mathematical physics and in particular deformation quantization, motivic integration and mirror symmetry.

THE SHAW PRIZE 邵逸夫獎

An Essay on the Prize in Mathematical Sciences 2012

Traditionally the interaction between mathematics and theoretical physics has been concerned with topics ranging from dynamical systems and partial differential equations to differential geometry to probability theory. For the last two decades, modern algebra and algebraic geometry (which is the study of the solutions of systems of polynomial equations in several variables via algebraic methods) have taken a central position in this interaction. Physical insights and intuition, especially from string theory, have led to a number of unexpected and striking predictions in both classical and modern algebraic geometry. Thanks to the efforts of many mathematicians new techniques and theories have been developed and some of these conjectures have been proven.

Maxim Kontsevich has led the way in a number of these developments. Among his many achievements is his early work on Witten's conjecture concerning the topology and geometry of the moduli (that is parameter) spaces of all algebraic curves of a given genus, his solution of the problem of deformation quantization, his work in mirror symmetry and in a different direction the theory of motivic integration.

Quantization is the process of passing from classical to quantum mechanics and it has been realized by different mathematical theories. One of these is the algebraic theory of deformation quantization. This takes place on a Poisson manifold (that is a manifold with a Poisson bracket on functions) for which there are two natural algebras, the classical observables which are the functions under point-wise multiplication and the Poisson algebra where the multiplication comes from the Poisson structure. The problem is to give a formal deformation in powers of a parameter h, in which the zeroth order term is the classical algebra of observables and the next order term is the given Poisson algebra. The construction of such a deformation was carried out in special cases (Weyl, Moyal, Fedosov...) but the general case proved formidable. It was resolved brilliantly by Kontsevich using ideas from quantum field theory.

The discovery by physicists of mirror pairs of Calabi–Yau manifolds has led to a rich and evolving mathematical theory of mirror symmetry. The physics predicts that there is a relation between the symplectic geometry (that is a geometry coming from classical mechanics) on such a manifold and the algebraic/complex geometry of the mirror manifold. When carried out in certain examples for which explicit computations can be made, this led to some remarkable predictions in classical enumerative geometry, concerning the counting of curves in higher dimensional spaces. Some of these predictions have since been proven. Kontsevich introduced homological mirror symmetry which predicts that further refined objects associated with the symplectic geometry of the manifold are related to ones associated with the complex geometry of its mirror. These conjectures and their generalizations have been proven in significant special cases. From the beginning Kontsevich has played a leading role in the development of the mathematical theory of mirror symmetry. He continues to revisit the original formulation and to provide clearer conceptual answers to the mathematical question: “What is mirror symmetry?”

Motivic integration is another invention of Kontsevich. It is an integration theory which applies in the setting of algebraic geometry. Unlike the usual integral from calculus whose value is a number, the motivic integral has its values in a large ring which is built out of the collection of all varieties (the zero sets of polynomial equations). It satisfies many properties similar to the usual integral and while appearing to be quite abstract, when computed and compared in different settings it yields some far reaching information about algebraic varieties as well as their singularities. It has been used to resolve some basic questions about invariants of Calabi–Yau varieties and it is also central to many recent developments concerning the uniform structure of counting points on varieties over finite fields and rings.

Through his technical brilliance in resolving central problems, his conceptual insights and very original ideas, Kontsevich has played a substantial role in shaping modern algebra, algebraic geometry and mathematical physics and especially the connections between them.

Maxim Kontsevich
Laureate in Mathematical Sciences

I was born in 1964 in a suburb of Moscow, close to a big forest. My father is a well-known specialist in Korean language and history, my mother was an engineer (she is retired now), and my elder brother is a specialist in computer vision. The apartment where I grew up was very small and full of books – about half of them in Korean or Chinese.

I became interested in mathematics at age 10 – 11, mainly because of the influence of my brother. Several books at popular level were very inspiring. Also, my brother was subscribed to the famous monthly "Kvant" magazine containing many wonderful articles on mathematics and physics addressed to high-school kids, sometimes explaining even new results or unresolved problems. Also, I used to take part in Olympiads at various levels and was very successful.

In the Soviet Union, some schools had special classes for gifted children, with an additional four hours per week devoted to extra-curricular education (usually in mathematics or physics) taught by university students who had passed through the same system themselves. At age 13 – 15 I was attending such a school in Moscow, and from 1980 till 1985 was studying mathematics at Moscow State University. Because of my previous training in High School, I never attended regular courses, but instead went to several graduate and research-level seminars where I learned a huge amount of material. My tutor was Israel Gelfand, one of the greatest mathematicians of the 20th Century. His weekly seminar, on Mondays, was completely unpredictable, and covered the whole spectrum of mathematics. Outstanding mathematicians, both Soviet and visitors from abroad, gave lectures. In a sense, I grew up in these seminars, and also had the great luck to witness the birth of conformal field theory and string theory in the mid-80s. The interaction with theoretical physics remains vitally important for me even now. After graduating from university, I became a researcher at the Institute for Information Transmission Problems. Simultaneously, I began to learn to play the cello and for several years enjoyed the good company of my musician friends with whom I played some obscure pieces of baroque and renaissance music.

In 1988, I went abroad for the first time, to Poland and France. Also in 1988, I wrote a short article concerning two different approaches to string theory, and maybe because of this result, was invited to visit the Max Planck Institute for Mathematics in Bonn for three months in 1990. At the end of my stay there was an annual informal meeting of mostly European mathematicians, called

Arbeitstatgung, where the latest hot results were presented. The opening lecture by Michael Atiyah was about a new surprising conjecture of Witten concerning matrix models and the topology of moduli spaces of algebraic curves. In two days I came up with an idea of how to relate moduli spaces but with a completely new type of matrix model, and explained it to Atiyah. People at MPIM were very impressed and invited me to come back the following year. During the next 3 – 4 years I was visiting mostly Bonn, and also IAS in Princeton and Harvard. My then future wife Ekaterina, whom I met in Moscow, accompanied me, and in 1993 we were married. In Bonn I finished several works which became very well-known: one on Vassiliev invariants, and another on quantum cohomology (with Yu Manin, whose seminar I had attended back in Moscow). Scientifically, a very important moment for me was Spring 1993 when I came to the idea of homological mirror symmetry, which was an opening of a grand new perspective. In 1994, I accepted an offer from Berkeley, but one year later I moved to IHES in France, where I continue to work. In 1999 my wife and I were granted French citizenship (keeping our Russian citizenship as well), and in 2001 our son was born.

For a few years I visited simultaneously Rutgers University, where my teacher Gelfand moved to after the perestroika, and IAS in Princeton. During the last six years I have regularly visited the University of Miami.

In my work I often change subjects, moving from Feynman graphs to abstract algebra, differential geometry, dynamical systems, finite fields. Still, mirror symmetry remains the major line. The interaction during the last two decades between mathematics and theoretical physics has been an amazing chain of breakthroughs. I am very happy to be a participant in this dialogue, not only absorbing mathematical ideas from string theory, but also giving something back, like a recent wall-crossing formula which I discovered with my long-term collaborator Yan Soibelman, and which became a very important tool in the hands of physicists, simultaneously answering questions concerning supersymmetric particles, and solving the classical problem about asymptotics for equations depending on small parameter.

Organization

Preparatory Committee (Until July 2003)

Professor Lin Ma (Promoter of the Committee)
Senior Advisor
Board of Trustees, Shaw College
The Chinese University of Hong Kong

Professor Yue-Man Yeung (Chairman of the Committee)
Emeritus Professor of Geography and Resource Management
The Chinese University of Hong Kong

Mr Raymond Wai-Man Chan
Director
Shaw Movie City Hong Kong Limited

Professor Pak-Chung Ching
Pro-Vice-Chancellor
The Chinese University of Hong Kong

Professor Kwok-Pui Fung
Professor of Biochemistry and
Director of the Institute of Chinese Medicine
The Chinese University of Hong Kong

Professor Sunny Kai-Sun Kwong
Dean of General Education, Wu Yee Sun College
Associate Dean of Social Science
Associate Professor, Department of Economics
The Chinese University of Hong Kong

Mrs Mona Shaw
Chairperson
The Shaw Prize Foundation

Professor Samuel Sai-Ming Sun
Master
S H Ho College
The Chinese University of Hong Kong

Professor Kwok-Kan Tam
Dean & Chair Professor
School of Arts and Social Sciences
The Open University of Hong Kong

* **Preparatory Committee (Until July 2003)**

Front row, from right to left

* Professor Kwok-Pui Fung

* Professor Lin Ma

Professor Chen-Ning Yang

Mr Run Run Shaw

* Professor Yue-Man Yeung

* Mrs Mona Shaw

Back row, from right to left

* Mr Raymond Wai-Man Chan

* Professor Pak-Chung Ching

* Professor Samuel Sai-Ming Sun

* Professor Kwok-Kan Tam

* Professor Sunny Kai-Sun Kwong

Mr Charles Cheuk-Kai Cheung

Mr Koon-Fai Chor

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;

Mr Run Run Shaw,
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 and

The Late Professor Shiing-Shen Chern (1911-2004),
Laureate in Mathematical Sciences.

The Shaw Prize 2005

From right to left:

Professor Michel Mayor,
Laureate in Astronomy;

Professor Geoffrey Marcy,
Laureate in Astronomy;

Mr Run Run Shaw,
Founder of The Shaw Prize;

Mr Rafael Hui,
Acting Chief Executive of HKSAR (2005);

Sir Michael Berridge,
Laureate in Life Science and Medicine and

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;

Mr Run Run Shaw,
Founder of The Shaw Prize;

Professor Xiaodong Wang,
Laureate in Life Science and Medicine;

Professor David Mumford,
Laureate in Mathematical Sciences and

Professor Wentsun Wu,
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;

Mr Run Run Shaw,
Founder of The Shaw Prize;

Mr Henry Tang,
Acting Chief Executive of HKSAR (2007);

Professor Robert Langlands,
Laureate in Mathematical Sciences and

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;

Professor Keith H S Campbell,
Laureate in Life Science and Medicine;

Mr Run Run Shaw,
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 and

Professor Ludwig Faddeev,
Laureate in Mathematical Sciences.

The Shaw Prize 2009

From right to left:

Professor Frank H Shu,
Laureate in Astronomy;

Professor Douglas L Coleman,
Laureate in Life Science and Medicine;

Mr Run Run Shaw,
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 and

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;

Mr Run Run Shaw,
Founder of The Shaw Prize;

Mr Donald Tsang,
The then Chief Executive of HKSAR;

Professor David Julius,
Laureate in Life Science and Medicine and

Professor Jean Bourgain,
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;

Mr Run Run Shaw,
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 and

Professor Richard S Hamilton,
Laureate in Mathematical Sciences

The Shaw Prize Foundation

Council Members

Mrs Mona Shaw

Professor Lin Ma

Professor Chen-Ning Yang

Professor Kenneth Young

Professor Sheung-Wai Tam

Council Member

Mrs Mona Shaw

Mona Shaw, wife of Sir Run Run Shaw, is Chairperson of The Sir Run Run Shaw Charitable Trust, The Shaw Foundation Hong Kong Limited and The Shaw Prize Foundation. A native of Shanghai, China, she is an established figure in the Hong Kong media and entertainment industry and Chairperson of the Shaw Group of Companies. She was Deputy Chairperson and Managing Director of Television Broadcasts Limited until her resignation in March this year, and is now a Non-Executive Director of the company.

Council Member

Professor Lin Ma

Professor Lin Ma is Senior Advisor of the Board of Trustees of Shaw College and was Professor of Biochemistry (1972 – 78) and Vice-Chancellor (1978 – 87) of The Chinese University of Hong Kong; he is Emeritus Professor of Biochemistry and has published largely on protein chemistry. Professor Ma also served as Chairman of the Board of Trustees of Shaw College, The Chinese University of Hong Kong (1987 – 2011) since its inauguration. He has received honours from Great Britain, Japan and Germany, and honorary degrees from several international universities as well as from universities in Hong Kong, Macau and China.

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

Council 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 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, Royal Society of London and the Russian Academy of Sciences.

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

Council Member

Professor Kenneth Young

Professor Kenneth Young is a theoretical physicist, and is Professor of Physics and Master of C W Chu College 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 held the position of Chairman, Department of Physics and later Dean, Faculty of Science, Dean of the Graduate School and Pro-Vice-Chancellor. He was elected a Fellow of the American Physical Society in 1999 and a Member of the International Eurasian Academy of Sciences in 2004. He was also a Member of the University Grants Committee, HKSAR and Chairman of its Research Grants Council. He served as Secretary and then Vice-President of the Association of Asia Pacific Physical Societies. His research interests include elementary particles, field theory, high energy phenomenology, dissipative systems and especially their eigenfunction representation and application to optics, gravitational waves and other open systems.

Council Member

Professor Sheung-Wai Tam

Professor Sheung-Wai Tam is the President Emeritus of The Open University of Hong Kong (OUHK). With more than 30 years experience in teaching, research and university administration at The Chinese University of Hong Kong (1965 – 1995), Professor Tam has attained many achievements in higher education and demonstrated excellence in teaching and research in natural products, mass spectrometry and organometallic chemistry.

Professor Tam served as the President of the OUHK for 8 years (1995 – 2003). During this period the OUHK was heading towards the goal of becoming a regional Centre of Excellence in Distance and Adult Learning. As a result, the OUHK has won a number of accolades, including the '*Prize of Excellence for Institutions*' (International Council for Open and Distance Education) and the '*Award of Excellence for Institutional Achievement in Distance Education*' (Commonwealth of Learning) in 1999 as well as the '*Stockholm Challenge Award*' (City of Stockholm and European Commission) in 2000.

For his significant contributions to open and distance education, Professor Tam was awarded the '*Prize of Excellence for Individuals*' (International Council for Open and Distance Education) in 2001 and the '*Meritorious Service Award*' (Asian Association of Open Universities) in 2002, and honorary degrees: Hon D Univ (UKOU) 2002; Hon D Sc (OUHK) 2006; (Nottingham U) 2008; and Hon U Fellow (CUHK) 2011.

THE SHAW PRIZE 邵逸夫獎

Board of Adjudicators

Chairman

Professor Chen-Ning Yang
Professor
Tsinghua University, Beijing, PRC
and
Professor-at-large
The Chinese University of Hong Kong
Hong Kong

Vice Chairman

Professor Kenneth Young
Professor of Physics
and
Master of C W Chu College
The Chinese University of Hong Kong
Hong Kong

Members

Professor Peter Goldreich
Chairman of Astronomy Selection Committee
Lee A DuBridge Professor of Astrophysics & Planetary Physics, Emeritus
Division of Physics, Mathematics & Astronomy
California Institute of Technology
USA

Professor Yuet-Wai Kan
Chairman of Life Science and Medicine Selection Committee
Louis K Diamond Professor of Hematology
Department of Medicine
University of California, San Francisco
USA

Professor Peter C Sarnak
Chairman of Mathematical Sciences Selection Committee
Eugene Higgins Professor of Mathematics
Department of Mathematics
Princeton University
USA

Members of Selection Committees

Astronomy

Professor Reinhard Genzel
Director, Max Planck Institute for Extraterrestrial Physics, Germany

Professor Douglas N C Lin
Professor of Astronomy and Astrophysics, Department of Astronomy, University of California, Santa Cruz, USA

Professor Ramesh Narayan
Thomas Dudley Cabot Professor of the Natural Sciences, Harvard-Smithsonian Center for Astrophysics, Harvard University, USA

Professor Adam G Riess
Astronomer, Space Telescope Science Institute and Professor of Astronomy and Physics, Johns Hopkins University, USA

Life Science and Medicine

Professor Günter Blobel
HHMI Investigator and John D Rockefeller Jr Professor of Cell Biology, The Rockefeller University, USA

Professor Linda B Buck
HHMI Investigator and Member of Fred Hutchinson Cancer Research Center, Division of Basic Sciences, USA

Sir Tim Hunt
Principal Scientist, Clare Hall Laboratories, Cancer Research UK, UK

Professor Tony Hunter
Renato Dulbecco Chair, Molecular and Cell Biology Laboratory, and Director, Salk Institute Cancer Center, USA

Dr William E Paul
Chief, Laboratory of Immunology, National Institute of Allergy and Infectious Diseases, National Institutes of Health, USA

Professor Randy W Schekman
HHMI Investigator and Professor of Cell and Developmental Biology, Department of Molecular and Cell Biology, University of California, Berkeley, USA

Mathematical Sciences

Professor Tony F Chan
President, The Hong Kong University of Science and Technology, Hong Kong

Professor Yakov Eliashberg
Herald L and Caroline L Ritch Professor, Department of Mathematics, Stanford University, USA

Professor W Timothy Gowers
Royal Society 2010 Anniversary Research Professor and Rouse Ball Professor of Mathematics, Department of Pure Mathematic and Mathematical Statistics, University of Cambridge, UK

Professor Claire Voisin
Senior Researcher, CNRS and Director of Research, Jussieu Mathematics Institute, University of Paris VI (UPMC), France

Selection Committee Member

Professor Reinhard Genzel

Astronomy Committee

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 Full Professor of Physics, UC Berkeley since 1999.

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 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).

He is a Member of the European Academy of Sciences, the German Academy of Natural Sciences Leopoldina, the Bavarian Academy of Sciences. He is also a Foreign Member/Foreign Corresponding Member/Associate of the Academy of Sciences of France, the US National Academy of Sciences, the Royal Spanish Academy, and the Royal Society of London.

Selection Committee Member

Professor
Douglas N C Lin

Astronomy Committee

Professor Douglas Lin is the Founding Director of the Kavli Institute for Astronomy and Astrophysics at Peking University and Professor of Astronomy and Astrophysics at the University of California, Santa Cruz. He obtained his PhD at the Institute of Astronomy, Cambridge University. He held post-doctoral fellowships at Cambridge and Harvard University. He joined the faculty at the Department of Astronomy and Astrophysics, University of California, Santa Cruz in 1979, became a Full Professor in 1985, served as its Chair in 1998, and was elected as a Distinguished Faculty in 2009. For his research, he has won awards from the US, Germany, UK, and Russia. He was elected to the American Academy of Arts and Sciences in 2002 and an Honorary Fellow of the Royal Astronomical Society in 2010.

He is the author or co-author of over 200 research papers, mainly on astrophysics and planetary sciences and several science articles for the general public. He has frequent television and newspaper interviews and lectures widely, and has held visiting professorships at many universities around the world.

Selection Committee Member

Professor Ramesh Narayan

Astronomy Committee

Professor Ramesh Narayan is the Thomas Dudley Cabot Professor of the Natural Sciences at Harvard University.

Professor Narayan received a BSc in Physics from Madras University (1971), and an MSc (1973) and a PhD (1979) from Bangalore University. After a few years as a Research Scientist at the Raman Research Institute, Bangalore, he went in 1983 to Caltech, where he was a Senior Research Fellow. He joined the faculty at the University of Arizona in 1985, and moved to Harvard University in 1991.

Professor Narayan has carried out research in a number of areas of theoretical astrophysics, including accretion disks, gravitational lensing, gamma-ray bursts, neutron stars and black holes.

Professor Narayan is a Fellow of the Royal Society (London), a Fellow of the American Association for the Advancement of Science, and a Member of the International Astronomical Union and the American Astronomical Society.

Selection Committee Member

Professor
Adam G Riess

Astronomy Committee

Professor Adam G Riess is a Professor of Physics and Astronomy at Johns Hopkins University and a Staff Astronomer at the Space Telescope Science Institute. He received his bachelor's degree from MIT in 1992 in Physics and his PhD from Harvard in 1996. He leads the Higher-Z SN Search program, which uses the Hubble Space Telescope to discover distant supernovae. In 1998, he led the study for the High-Z Supernova Search Team which first reported evidence that the Universe is accelerating. Science Magazine named this the 1998 "Breakthrough of the Year."

In 1999 Professor Riess received the Trumpler Award from the ASP, the Bok Prize from Harvard University in 2001, the Warner Prize from the AAS in 2003 and the Sackler Prize in 2004. In 2006, he shared the Shaw Prize in Astronomy with Professors Schmidt and Perlmutter and the 2007 Gruber Prize with members of the High-Z team and the Supernova Cosmology Project. Professor Riess won a MacArthur Fellowship in 2008, was elected to the US National Academy of Sciences in 2009 and received the Einstein Medal in 2011. Last but not least, he was awarded the Nobel Prize in Physics 2011 together with Professor Saul Perlmutter and Professor Brian Schmidt.

Selection Committee Member

Professor Günter Blobel

Life Science and Medicine Committee

Born in Germany, Günter Blobel earned an MD degree from Tuebingen, Germany and a PhD degree in Oncology from Madison, Wisconsin. Following postdoctoral training, he became Full Professor of Cell Biology at Rockefeller University in New York in 1976. Since 1986 he is also Investigator of the Howard Hughes Medical Institute. He received numerous awards, among them the 1993 Lasker Award and the 1999 Nobel Prize in Medicine. He donated the entire proceeds of the Nobel Prize of one million USD to the reconstruction of the Frauenkirche and the Synagogue in Dresden, Germany. His research has focused on how proteins translocate across or integrate into membranes and on bidirectional traffic between the cytoplasm and the nucleus. A recent research objective is to piece together the atomic structure of the 100 MDalton nuclear pore complex by crystallographic and cryo electron microscopic analyses.

Selection Committee Member

Professor Linda B Buck

Life Science and Medicine Committee

Professor Linda B Buck is a Howard Hughes Medical Institute Investigator at Fred Hutchinson Cancer Research Center and Affiliate Professor of Physiology and Biophysics at the University of Washington. She received a BS from the University of Washington in 1975, a PhD from the University of Texas Southwestern Medical Center, Dallas in 1980, and was previously Professor of Neurobiology at Harvard Medical School. Professor Buck is a Fellow of the American Association for the Advancement of Science and a Member of the US National Academy of Sciences, the Institute of Medicine of the National Academies, and the American Academy of Arts and Sciences.

Professor Buck's research has provided key insights into the mechanisms underlying the sense of smell. In recognition of her contributions, she has received numerous awards, including The Lewis S Rosenstiel Award for Distinguished Work in Medical Research (1997), The Gairdner Foundation International Award (2003), and The Nobel Prize in Physiology or Medicine (2004).

Selection Committee Member

**Sir
Tim Hunt**

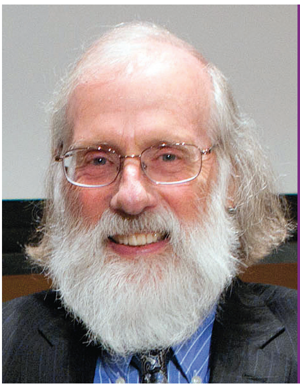
*Life Science and
Medicine Committee*

Sir Tim Hunt works at Cancer Research UK, Clare Hall Laboratories, in South Mimms, Hertfordshire. Sir Tim was born in 1943 and grew up in Oxford, moving to Cambridge in 1961 to read Natural Sciences. In 1968, he obtained his PhD in the Department of Biochemistry. He spent almost 30 years in Cambridge, working on the control of protein synthesis, with spells in the USA; he was a Postdoctoral Fellow with Irving London at the Albert Einstein College of Medicine in 1968 – 70 and spent summers at the Marine Biological Laboratory, Woods Hole from 1977 until 1985, both teaching and doing research.

In 1982, he discovered cyclins, which turned out to be components of "Key regulators of the Cell Cycle", and led to a share of the Nobel Prize in Physiology or Medicine in 2001, together with Lee Hartwell and Paul Nurse.

Sir Tim Hunt is a Member of the Scientific Council of the ERC. He was elected as Fellow of the Royal Society in 1991 and became a Foreign Associate of the US National Academy of Sciences in 1999. He was knighted in the Queen's Birthday Honours List of 2006 and was the Chair of EMBO Council from 2006 – 2010.

Selection Committee Member



Professor Tony Hunter

Life Science and Medicine Committee

Professor Tony Hunter was born in Ashford, Kent, England. He received his BA in 1965 from the University of Cambridge, and his PhD in 1969 for work on mammalian protein synthesis under Asher Korner in the Department of Biochemistry, University of Cambridge. He was a Research Fellow in the Department from 1968 – 1971, and a Postdoctoral Fellow at the Salk Institute from 1971 – 1973 working under Walter Eckhart on polyoma virus DNA replication. He rejoined the Salk Institute as an Assistant Professor in 1975 in the Molecular and Cell Biology Laboratory, where he is currently the Renato Dulbecco Chair in Cancer Research and Director of the Salk Institute Cancer Center.

In 1979, he discovered that polyomavirus middle T antigen and the RSV v-Src oncoprotein both exhibit a previously unknown protein kinase activity that phosphorylates tyrosine. He has spent most of the last thirty years studying protein kinases and phosphatases, and the role of protein phosphorylation in cell growth, the cell cycle, and cancer.

He has received many awards for his work on tyrosine phosphorylation. He is a Fellow of the Royal Society of London, an Associate Member of EMBO, a Member of the US National Academy of Sciences, the Institute of Medicine, and the American Philosophical Society.

Selection Committee Member

Dr William E Paul

Life Science and Medicine Committee

Dr William E Paul discovered the cytokine interleukin-4, demonstrated that it is the central regulator of allergic inflammation and is known for work on cytokine biology, lymphocyte dynamics, T-cell antigen-recognition and B-cell development. He is Chief of the Laboratory of Immunology of the National Institute of Allergy and Infectious Diseases and a National Institutes of Health Distinguished Investigator. He is also the editor of the advanced textbook Fundamental Immunology and the founding editor of the Annual Review of Immunology, now in its 30th volume. From 1994 to 1997, he was Director of the NIH Office of AIDS Research and was responsible for a new emphasis on HIV vaccine development. Dr Paul is a Member of the US National Academy of Sciences, its Institute of Medicine and the American Academy of Arts and Sciences. He received the Founder's Prize of the Texas Instruments Foundation, the 3M Life Sciences Award and the Max Delbruck Medal. Dr Paul was President of the American Society for Clinical Investigation and the American Association of Immunologists (AAI) and is a recipient of Lifetime Achievement Awards from the AAI and the International Cytokine Society. He is the recipient of honorary degrees from the Hebrew University of Jerusalem, the University of Rome La Sapienza, the National University of Athens and several other universities.

Selection Committee Member

Professor Randy W Schekman

Life Science and Medicine Committee

Professor Randy W Schekman is a Professor in the Department of Molecular and Cell Biology at UC Berkeley and an Investigator of the HHMI. Schekman's lab elucidated key components and events of the secretory pathway in Saccharomyces cerevisiae. His group discovered that protein transport in yeast is mediated by the same organelles and proteins that operate in mammalian cells.

Among his honours are the Eli Lilly Award in microbiology, the Lewis S Rosenstiel Award in basic biomedical science, the Gairdner International Award, the Amgen Award from the Protein Society, the Albert Lasker Award for Basic Medical Research, the Louisa Gross Horwitz Prize of Columbia University. He is a Member of the US National Academy of Sciences, the American Academy of Arts and Sciences and the American Philosophical Society. Professor Schekman is Past President of the American Society of Cell Biology and was Editor-in-Chief of the Proceedings of the US National Academy of Sciences until 2011. He currently serves as Scientific Director of the Jane Coffin Childs Memorial Fund for Medical Research and Editor-in-Chief of a new online, open access journal, eLife, supported by the HHMI, the Wellcome Trust and the Max Planck Society.

Selection Committee Member

Professor
Tony F Chan

Mathematical Sciences Committee

Professor Tony F Chan received his BS and MS from Caltech and PhD in Computer Science from Stanford University (1978). He taught at Yale before joining UCLA as Professor of Mathematics in 1986. At UCLA, he served as Mathematics Department Chair (1997 – 2000), Director of the Institute for Pure and Applied Mathematics (2000 – 2001) and Dean of Physical Science (2001 – 2006). From 2006 to 2009, he served as Assistant Director of the Mathematical and Physical Sciences Directorate at the US National Science Foundation and managed research funding of over US$1B a year in astronomy, physics, chemistry, mathematical sciences and material science.

He is an elected Fellow of the Society of Industrial and Applied Mathematics and the American Association for the Advancement of Science. He served on the US National Committee for Mathematics and was one of five US representatives to the International Union of Mathematicians in 2006. He is one of ISI's most cited mathematicians.

Selection Committee Member

Professor Yokov Eliashberg

Mathematical Sciences Committee

Professor Yakov Eliashberg is currently the Herald L and Caroline L Ritch Professor at Stanford University. His research interests lie in symplectic and contact geometry, several complex variables, singularity theory and low-dimensional topology. He is one of the founders of symplectic topology, a new and active area of research which emerged in 1980s and found important applications in other areas of mathematics and theoretical physics.

Professor Eliashberg was born in 1946 in Leningrad (now St Petersburg), Russia. He received his doctoral degree in Leningrad University in 1972 under the direction of V A Rokhlin, and in the same year he joined Syktyvkar University in northern Soviet Union as an Associate Professor. In 1988 he emmigrated to the United States and in 1989 became a Professor at Stanford University. He is a Member of US National Academy of Sciences and received a Guggenheim Fellowship in 1995. He was awarded the Oswald Veblen Prize in 2001 from the American Mathematical Society and in 2009 awarded the degree of Doctor Honoris Causa at the École Normale Supérieure de Lyon, France.

Selection Committee Member

Professor
W Timothy Gowers

Mathematical Sciences Committee

Professor Timothy Gowers was born in Marlborough, England, in 1963. From 1973 to 76 he was a chorister in the choir of King's College, Cambridge, after which he went as a scholar to Eton College. He studied mathematics at Trinity College, Cambridge, where he also did his PhD, under the supervision of Bèla Bollobàs. In 1989 he became a research fellow at Trinity, moving to University College London two years later as a Lecturer. In 1995 he returned to Cambridge, and Trinity, where he was first a Lecturer and then a Professor. He is currently a Royal Society Research Professor and also holder of the Rouse Ball Chair in Mathematics. In the early part of his career he solved some old problems in Banach space theory, including two of Banach himself. He then discovered the first quantitative proof of Szèmèrèdi's theorem and has subsequently worked in additive combinatorics. For this work he was awarded a Fields Medal in 1998.

Selection Committee Member

**Professor
Claire Voisin**

*Mathematical Sciences
Committee*

Professor Claire Voisin, born in 1962, is a French mathematician. She is currently a CNRS Senior Researcher at the Institut de Mathématiques de Jussieu. She received her PhD and permanent position at CNRS in 1986.

Professor Voisin is noted for her work in algebraic geometry. Her work stands at the interface between projective and Kähler geometries, using the theory of Hodge structures to study their topology. On the algebraic geometry side, she also works on algebraic cycles, motives, and Hodge structures.

She is Editor-in-chief of Publications Mathématiques de l'Institut des Hautes Études Scientifiques, Editor of Journal of the European Mathematical Society, Communications in Contemporary Mathematics, Journal de Mathématiques Pures et Appliquées.

She received the Sophie Germain Prize in 2003 and the Clay Research Award in 2008. She was a Plenary Speaker at the 4th European Congress of Mathematics, Stockholm (2004) and International Congress of Mathematicians, Hyderabad, India (2010).

Professor Voisin has been elected Member of the Académie des Sciences (2010), and Foreign Member of the Deutsche Akademie der Naturforscher Leopoldina (2009), Istituto Lombardo (2006) and Accademia dei Lincei (2011).

Presenter

Ms
Do Do Cheng

Award Winning Actress
Versatile TV Performer
Programme Host

Award winning actress, versatile TV performer and programme host Ms Do Do Cheng has starred in many TVB classic dramas and won film awards, local and international. Her hosting of the Hong Kong version of "The Weakest Link" and starring in Television Broadcasts Limited's (TVB) sit-com "War of the Genders" became talk-of-the-town. Ms Cheng's success in hosting the TVB gameshow on legal knowledge "Justice for All" brought her career to a new height. She also hosted the 2008 Beijing Olympics for TVB and has been one of the presenters for the Shaw Prize Award Presentation Ceremony since its inception in 2004.

THE SHAW PRIZE 邵逸夫獎

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 music for the movie "Perhaps Love" won him a Golden Horse Award and a Hong Kong Film Award. For the stage, he received five Best Score awards for his musicals in Hong Kong. He was the musical director of Jacky Cheung's 2004 world tour of "Snow, Wolf, Lake". Recent works include "Takeaway", the first major British Chinese musical which premiered in London in 2011. 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 Arts Development Council.

Special Acknowledgement

(Airlines in alphabetical order)

AIR CHINA
中国国际航空公司
A STAR ALLIANCE MEMBER

AIRFRANCE
SKYTEAM

BRITISH AIRWAYS

CATHAY PACIFIC
國泰航空公司

DELTA
美國達美航空公司

DRAGONAIR
港龍航空

Special Acknowledgement

香港君悅酒店
GRAND HYATT HONG KONG™

CODESIGN LTD

HPCL
日億視聽有限公司
Hiller Pharma Co.,Ltd.
Hong Kong • Beijing • Shanghai • Shenzhen
www.hpcl.hk

靈活聯繫

TVB

邵氏影城香港有限公司
Shaw Movie City Hong Kong Limited

THE SHAW PRIZE 邵逸夫獎

For more information, please visit our official website

www.shawprize.org

The Shaw Prize Secretariat

Harkima Shiu
Administration Advisor

Jeannie Lee
Administration Manager

Elaine Tam
Operations Manager

Eda Wong
Systems Administrator

10th Floor, Shaw House
Lot 220, Clear Water Bay Road
Kowloon, Hong Kong

Tel: (852) 2994 4888
Fax: (852) 2994 4881
Email: info@shawprize.org

Booklet designed by

JMSC HKU
Journalism and Media Studies Centre
The University of Hong Kong
香港大學新聞及傳媒研究中心
http://jmsc.hku.hk/