HONG KONG INSTITUTION OF SCIENCE

The 23rd Annual Conference

5 December 2015 (Saturday)

LT6, Cheng Yu Tung Building
The Chinese University of Hong Kong

Organizers:

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INTRODUCTION OF
HONG KONG INSTITUTION OF SCIENCE

The Hong Kong Institution of Science (HKIS) was established in 1992 to foster the development of science in Hong Kong and to facilitate the development of links with scientific communities in the Chinese mainland, Taiwan and overseas. The Institution has nearly 400 members covering the fields of physical science, life science, engineering science and mathematics. It has been taking an active role in supporting the development of innovation and technology in Hong Kong.

Major Objectives

1. To foster and increase the general knowledge of the public in the sciences;

2. To promote and encourage for the benefit of the public the advancement of knowledge in the field of scientific studies, research, developments and practice in all respects;

3. To promote education, training and research in the field of general and/or specific pure and/or applied scientific research, development and practice;

4. To sponsor and co-ordinate scientific interchange and cooperation between science practitioners in all science related departments of all tertiary educational institutions, government and industrial sector (collectively called as "the Hong Kong scientific community");

5. To organize courses, seminars, conferences, exhibitions, television and radio programmes and other events for the dissemination of knowledge and information in science;

6. To award prizes, scholarships and bursaries to such persons and for such purposes as are conducive to the promotion of science;

7. To organize competitions and similar events for the promotion of invention, research and development in science;

8. To organize and/or provide funding for research projects, study groups and other events for the promotion of invention, research and development in science;

9. To facilitate the exchange of knowledge and information in science on local, regional and international levels.

[Website: http://www.science.org.hk/]

PROGRAMME

5 December 2015 (Saturday)
The Chinese University of Hong Kong

08:45 Registration

09:00 Opening Ceremony

Welcome Speech – by Prof. Benjamin W. WAH
(Provost, The Chinese University of Hong Kong)

Welcome Speech – by The Honorable Mrs. Fanny LAW FAN Chiu-fun, GBS, JP
(Chairperson, Board of Directors,
Hong Kong Science and Technology Parks Corporation)

Welcome Speech – by Prof. Tony F. CHAN
(President, Hong Kong Institution of Science
President, The Hong Kong University of Science and Technology)

09:15 Souvenirs Presentation
Photo-taking Session

09:20 Keynote Lecture

Speaker: **Prof. YANG Huanming** *(Beijing Genomics Institute, China)*

10:15 Light Refreshment

10:30 2015 Young Scientist Award – Oral Presentation
- *A. Physical / Mathematical Science Stream*
- *B. Life Science Stream*
- *C. Engineering Science Stream*

12:45 Lunch

14:00 Young Scientist Awards Presentation

14:30 Hong Kong Institution of Science Annual Meeting *(For Members Only)*

14:50 End of Programme

KEYNOTE SPEAKER

Prof. YANG Huanming, Ph.D.

Professor & Chairman
Beijing Genomics Institute (BGI) – China, Shenzhen

Biography

Dr. Yang is the co-founder and Chairman of *Beijing Genomics Institute (BGI) – China*. He and his partners have made a significant contribution to the international HGP, HapMap, and G1K projects, as well as many other animals, plants, and microorganisms, with many publications in *Science, Nature,* and other internationally prestigious journals.

Dr. Yang obtained his Ph.D. from University of Copenhagen (Denmark) and postdoctoral trainings in France and USA. He was elected as an associate member of European Molecular Biology Organization (EMBO) in 2006, an academician of Chinese Academy of Sciences in 2007, a fellow of TWAS in 2008, a foreign associate of National Academies of India in 2009, of Germany in 2012, and of the USA in 2014.

Abstract of Keynote Lecture

From the HGP to "Precision Medicine"

***YANG Huanming**, Beijing Genomics Institute (BGI) – China, Shenzhen*

The International Human Genome Project (HGP) is acknowledged as "*the second revolution*" in life sciences which has "*changed biology and biotech forever*" since the completion of the human genome draft sequences 15 years ago, by cultivating a new culture of COLLABORATION which has changed the model and scope of global research, a new field of GENOMICS as another basic and frontier of life sciences, and a new technology of SEQUENCING to make life digital.

Genomics has two pillars, "*life is in sequence*" proposed by J. Watson and "*life is digital*" by J. Sulston, which have been dramatically changing our views of the life world and have paved the pathway to *precision medicine*, which is symbolized by DNA double helix, characterized by big data, including both genotypic and phenotypic data, based on personal information and to benefit all.

Four major well established protocols have expanded the application of sequencing to clinic medicine: 1) The whole genome/exome sequencing and targeted region sequencing for monogenic/chromosomic diseases and molecular typing of cancer and other common/complex diseases; 2) Metasequencing for metabolic diseases and microbiomes especially pathogenomes as well as interactions between hosts and pathogens; 3) Single cell sequencing for cancer heterogeneity studies; 4) Trace DNA sequencing for NIPT (Non-Invasive Prenatal Testings) and PGS/PGD (Pre-implantation Genenic Screening/Diagnosis) of many chromosomic and monogenic diseases.

ABSTRACTS OF
YOUNG SCIENTIST AWARD 2015 FINALISTS

Physical / Mathematical Science Stream

- Abstract 1 -

Design, synthesis and functionalization of luminescent alkynylplatinum(II) complexes of tridentate *N*-donor ligands as building blocks for metallofoldamers, supramolecular assemblies and nanostrutures

***LEUNG Yu Lut**, Department of Chemistry, The University of Hong Kong*

In nature, there are a lot of examples of supramolecular chemistry, for instances, the self-assembly of lipids to form membranes, the formation of double helical DNAs, and the self-assembly of proteins to form tertiary and quaternary structures and many others, mainly stabilized by hydrogen bonding, π–π stacking interaction, hydrophobic–hydrophobic interaction. My research work is about the understanding of the molecular self-assembly, in which molecules would spontaneously adopt a well-defined arrangement, driven by unique metal–metal interactions. Particularly, I am very much interested in the square-planar platinum(II) complexes, not only because of their interesting luminescence property, but also their propensity to exhibit metal metal interactions. My work on the platinum(II)-containing foldamers involves the use of metal–metal interaction to control the helix-coil folding transition. The versatile behavior of the Pt···Pt and π–π interactions also provides an attractive spectroscopic probe for the study and understanding on the folding mechanism. In addition, the utilization of the inherently chiral binaphthol moiety as the backbone controls the spatial arrangement for the formation of the right- or left-handed helix. This work demonstrates the versatility and the reversibility of the metal···metal and π–π interactions in the stabilization of dynamic metallo-foldamers in diverse structural architectures. Furthermore, a dinuclear alkynylplatinum(II) terpyridine complex containing an amphiphilic binaphthol bridge is shown to display cylindrical columnar assemblies. This study shows that not only can one manipulate the folding and unfolding of helical conformation in a molecule, but also

one can align these helical folded molecules in an order into columnar stacks with luminescence enhancement behaviours. It is envisaged that metal–metal interactions play an important role in the stabilization of supramolecular assembly in solution and provide intriguing luminescence and spectroscopic features upon the self-assembly.

- Abstract 2 -

Efficient systems and algorithms for big data processing

***YAN Da**, Department of Computer Science & Engineering, Hong Kong University of Science & Technology*

Dr. Yan Da's research focuses on the development of scalable systems and algorithms for big data. Today we live in a world submerged in data, and scalable techniques for efficient data processing are in high demand. An important type of big data that Dr. Yan studies is graph data, which are common in real applications such as online social networks and mobile communication networks. Dr. Yan devised the first cost model for designing algorithms with guaranteed performance in Google's Pregel, a well-established distributed framework for large-scale graph processing. He further proposed important techniques that address various aspects of distributed graph processing, including computational cost, communication cost, main-memory cost, fault tolerance, and response time of online querying, all of which are challenging open problems and thus, Dr. Yan's work has significantly advanced the research in the field. Recently, he proposed a novel computation model for distributed graph processing, namely the block-centric model, and implemented it in a distributed system called Blogel. The system improves the performance of existing graph processing systems by up to several orders of magnitude. Besides big graphs, Dr. Yan also worked on other types of big data. He studied efficient query processing in various geo-spatial settings, including road networks, terrain meshes, Euclidean space, indoor environment and trajectories. He also studied querying and mining big data in the context of data uncertainty. The results of his research were published in top-tier conferences and journals. All Dr. Yan's works are open-source, and the systems he developed have been deployed in big companies and used by researchers in universities all over the world.

Life Science Stream

- Abstract 1 -

Aptamer-functionalized lipid nanoparticles targeting osteoblasts as a novel RNA interference-based bone anabolic strategy

***LIANG Chao**, School of Chinese Medicine, Hong Kong Baptist University*

Metabolic skeletal disorders associated with impaired bone formation (*e.g.*, osteoporosis) remain major clinical challenges. RNA interference (RNAi)-based approaches aiming at promoting osteoblastic bone formation may hold therapeutic potential. However, a major bottleneck for translating RNAi-based approaches into the clinic is lack of osteoblast-specific delivery systems for osteogenic siRNAs. Aptamers, selected by cell-based systematic evolution of ligands by exponential enrichment (cell-SELEX) are single-stranded oligonucleotides and can specifically bind to target cells based on their distinct tertiary structures. In this work, we screened an aptamer (termed CH6), which selectively recognized rat and human osteoblasts with high affinity. Then, we conjugated CH6 aptamer to lipid nanoparticles (LNPs) encapsulating osteogenic pleckstrin homology domain-containing family O member 1 (*Plekho1*) siRNA, *i.e.*, CH6-LNPs-siRNA. Our results showed that CH6-LNPs-siRNA had good serum stability, satisfactory particle size and high *in vitro* binding ability with osteoblasts. Furthermore, CH6 aptamer facilitated *in vitro* osteoblast-selective uptake of *Plekho1* siRNA mainly via macropinocytosis and boosted *in vivo* osteoblast-specific *Plekho1* gene silencing, which promoted bone formation, improved bone microarchitecture, increased bone mass and enhanced mechanical properties in both osteopenic and healthy rodents. These results indicate that osteoblast-specific aptamer-functionalized LNPs could act as a new RNAi-based bone anabolic strategy, thus advancing the targeted delivery selectivity of osteogenic siRNAs from the tissue level to the cellular level and opening a new gate for therapeutic intervention in conditions such as osteoporosis.

- Abstract 2 -

Structural and functional characterization of two distinct motors: myosin X and myosin 1c by combination of structural biology, biochemistry and cell biology

***LU Qing**, Division of Life Science, The Hong Kong University of Science and Technology*

Living organisms use a group of nano-scale engines, known as molecular motors, to convert chemical energy into various forms of cellular motions, including muscle contraction, cargo transportation, force sensing. As one type of the cytoskeleton motors, myosin superfamily is a class of actin-based motors essential for a larger number of cellular processes. Different members of myosins share conserved catalytic motor head, but have distinct functional domains presented in the tail regions, each responsible for their specific cellular functions. In order to understand how different myosins achieve their unique cellular functions, my research focused on investigations of the tail domains of two myosins: myosin X and myosin 1c, by combining structural biology, biochemistry and cell biology approaches.

As processive transporter, myosin X is essential for numerous developmental functions such as neuronal network formation and angiogenesis. Myosin X contains a motor head, a coiled coil neck and a tail region. Our work demonstrated that, on actin filaments, the anti-CC-mediated myosin X dimer can take straddled, duck-like walking steps, providing a mechanistic explanation to the long processivity of the motor. In the myosin X tail, the cooperative interactions of its PH123 and MyTH4-FERM tandems with PIP_3 and DCC respectively, confer both high specificity and affinity to the motor's cargo. In contrast to dimeric, transporting myosins, the class I myosins are a representative family of the monomeric, tension-sensing myosins. We determined the crystal structure of myosin 1c, a representative member of the largest unconventional myosins subfamily. This atomic level structure provides insights into how myosins can transduce/sense forces in a Ca^{2+}-dependent manner. Therefore, with an effective combination of in vitro biochemical and structural studies with in vivo imaging investigations, we achieved a comprehensive characterization of these two distinct motors: myosin X as a dimeric transporter and myosin 1c as monomeric force transducer.

Engineering Science Stream

- Abstract 1 -

Balancing revenue and social welfare in spectrum allocation between licensed and unlicensed service

***CHEN Yanjiao**, Department of Computer Science & Technology, The Hong Kong University of Science and Technology*

To match wireless users' soaring traffic demand, spectrum regulators are considering allocating additional spectrum to the wireless market. There are two major directions for the spectrum allocation: licensed (e.g., 4G cellular service) and unlicensed services (e.g., Super Wi-Fi service). The 4G service provides a ubiquitous coverage, has a higher spectrum efficiency, and often charges users a high service price. The Super Wi-Fi service has a limited coverage, a lower spectrum efficiency, but often charges users a low service price. The spectrum regulator now simply allocates the spectrum to maximize its income, but such an income-centric allocation does not ensure the best spectrum utilization by the users. We suggest that the spectrum regulator should consider end-user utility in the spectrum allocation process for a better supervision of spectrum utilization in the end-market. To address this problem, we design a new spectrum allocation scheme which jointly considers the spectrum regulator's income and the users' aggregate utility by investigating three market tiers: the spectrum regulator, 4G and Super Wi-Fi operator coalitions, and all the wireless users. We formulate it as a three-stage game and derive the unique sub-game perfect equilibrium. Compared with the traditional income-centric allocation, we prove that the proposed scheme significantly improves users' aggregate utility with a limited spectrum regulator's income loss. Furthermore, under the proposed spectrum allocation scheme, the wireless operator will lower their service prices and serve more wireless users.

- Abstract 2 -

Bioinspired interfacial materials: engineering and applications

***LIU Yahua**, Department of Mechanical & Biomedical Engineering, City University of Hong Kong*

Engineering robust water-repellent (superhydrophobic) surfaces for multifunctional applications ranging from water harvesting, energy saving, environment and diseases transmission prevention, has received increasing attention but proved extremely challenging. One central question is the maximization of water repellency or the minimization of the contact time of an impinging droplet with the underlying solid surface. However, there exists a minimum contact time limit which is imposed by the classical hydrodynamics. In this talk, I will discuss our recent progress to this classical and important problem. First, by designing novel surfaces made from arrays of widely spaced tapered posts, an impinging droplet can bounce off with a pancake-like shape without retracting, leading to a fourfold reduction in contact time compared with conventional rebound and the droplet can be shed away much faster than that on any engineered and natural materials. Our approach signifies a new direction in the design of bio-inspired materials for various applications. Inspired by the asymmetric structure of *Echeveria*, more recently, we designed a series of cylindrical surfaces with a convex/concave architecture of size comparable to that of the drop, on which the impinging drop exhibits asymmetric bouncing that leads to a 40% reduction in the total contact time. We believe that the discovery of pancake bouncing and asymmetric bouncing which can achieve significantly shortened contact times through manipulating the surface structure will stimulate new applications. For example, the complete and fast rebound of droplets, especially impinging supercooled droplets, from the underlying solid surface may considerably suppress the ice nucleation to achieve an overall anti-icing performance.

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ACKNOWLEDGEMENT

Major Sponsors

The Croucher Foundation

裘槎基金會

The Croucher Foundation is an independent private foundation established by the late Noel Croucher in 1979 to promote the standard of the natural sciences, technology and medicine in Hong Kong. The work of the Foundation is organised into five broad areas:

- scholarships and fellowships for promising young Hong Kong scientists and medical doctors to pursue research overseas; - research fellowships to enable scientists in Hong Kong to pursue their intellectual inclinations, and to engage in bold new work;
- conferences, workshops and collaborative research to facilitate the exchange of ideas between Hong Kong scientists and their counterparts overseas;
- demonstration lectures to promote a wider understanding of science among Hong Kong school students and undergraduate students; and
- support for any undergraduate student in Hong Kong experiencing sudden financial difficulty.

Noel Croucher entrusted the governance of his Foundation to the discretion of a Board of Trustees. Lord Todd, the Nobel Laureate and Master of Christ's College, Cambridge was the founding President of the Foundation. The current Chairman is Professor Tak Wah Mak, a Fellow of the Royal Society, a foreign associate of the US National Academy of Sciences, a Fellow of the Royal Society of Canada and an internationally recognised pioneer in the fields of immunology and cancer research. Professor Mak took up the chairmanship of the Croucher Foundation in June 2011. The immediate past Chairman is Professor Yuet Wai Kan FRS.

[Source: http://www.croucher.org.hk/about-us]

Hong Kong Science & Technology Parks Corporation
香港科技園公司

Comprising Science Park, InnoCentre and Industrial Estates, **Hong Kong Science & Technology Parks Corporation** (HKSTP) is a statutory body dedicated to building a vibrant innovation and technology ecosystem to connect stakeholders, nurture technology talents, facilitate collaboration, and catalyse innovations to deliver social and economic benefits to Hong Kong and the region.

Established in May 2001, HKSTP has been driving the development of Hong Kong into a regional hub for innovation and growth in several focused clusters including Electronics, Information and Communications Technology, Green Technology, Biomedical Technology, Material and Precision Engineering. We enable science and technology companies to nurture ideas, innovate and grow, supported by our R&D facilities, infrastructure, and market-led laboratories and technical centres with professional support services. We also offer value added services and comprehensive incubation programmes for technology start-ups to accelerate their growth.

Technology businesses benefit from our specialised services and infrastructure at Science Park for applied research and product development; enterprises can find creative design support at InnoCentre; while skill-intensive businesses are served by our three industrial estates at Tai Po, Tseung Kwan O and Yuen Long.

[Source: http://www.hkstp.org/en-US/About-Us/Overview.aspx]

Sponsor of Young Scientist Award

The Hong Kong and China Gas Company Limited
香港中華煤氣有限公司

Founded in 1862, **The Hong Kong and China Gas Company Limited** (Towngas) was Hong Kong's first public utility. Today, it is one of the largest energy suppliers in Hong Kong, operating with world-class corporate management and leading-edge business practices. For the past years, Towngas has been growing with Hong Kong, evolving from the simple gas company supplying fuel for street lamps to their current leading position in the energy industry in the greater China region.

A major reason for their success has been the reputation they have established over the years, enabling them to win the trust of the people of Hong Kong. Their core business in the territory consists of the production and distribution of gas, marketing and sale of gas, the sale of gas appliances, as well as comprehensive after-sales services. With a pipeline network consisting of more than 3,500km of gas pipes, they supply town gas to over 1.76 million customers in Hong Kong. Expanding their business horizons in recent years, they have diversified their business into telecommunications, building services, engineering and the new eco-energies, among many others.

Towngas moved into the gas business in mainland China in 1994. Currently, they have more than 150 projects, including piped city-gas projects, upstream and midstream developments, water and wastewater treatment schemes, natural gas filling stations, as well as new energy exploration and utilisation ventures, across 22 provinces, municipalities and autonomous regions throughout the country.

[Source: http://www.towngas.com/eng/corp/abttg/overview/index.aspx]