香 港 中 文 大 學 理 學 院
FACULTY OF SCIENCE, THE CHINESE UNIVERSITY OF HONG KONG

*Science Faculty Research Day 2011*

# Outstanding Research in Science Faculty

**DATE:** Thursday, 9 June 2011
**TIME:** 09:30 - 17:30
**VENUE:** L2, Science Centre,
The Chinese University of Hong Kong

# Outstanding Research Event

## Morning Session:

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| 09:30 - 09:45 | **Opening Ceremony** |
| 09:45 - 10:15 | **"From Spots, Stripes, Soup Films, to De Giorgi Conjecture"**<br>Professor WEI Juncheng<br>Department of Mathematics<br>Recipient of *Morningside Silver Medal of Mathematics 2010, Higher Education Outstanding Scientific Research Output Award 2010, and Research Excellence Award 2009-2010* |
| 10:15 - 10:45 | **"Cholesterol-Lowering Functional Foods and Nutraceuticals"**<br>Professor CHEN Zhen-Yu,<br>Food and Nutritional Sciences Programme, School of Life Sciences<br>Recipient of *Higher Education Outstanding Scientific Research Output Award 2010* |
| 10:45 - 11:00 | **Tea Break** |
| 11:00 - 11:30 | **"Protection of Quantum Coherence of Spins and Applications"**<br>Professor LIU Renbao<br>Department of Physics<br>Recipient of *Young Researcher Award 2009-2010* |
| 11:30 - 12:00 | **"Late Transition Metal-Carboryne Complexes and Their Reactions with Alkenes and Alkynes"**<br>Dr. QIU Zaozao<br>Department of Chemistry<br>Recipient of *Postgraduate Research Output Award 2009-2010* |

## Afternoon Session:

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| 14:00 - 14:15 | **"Using Living Organisms as a Massively Parallel Data-Storage Device"**<br>CUHK iGEM team 2010, Biochemistry Programme<br>Recipient of *iGEM Competition 2010 Gold Medal* |
| 14:15 - 14:30 | **"Solar Energy Harvesting for Chemical Reactions through Plasmon Resonance"**<br>LI Chuanhao, Ph.D. Candidate, Department of Chemistry<br>WANG Feng, Ph.D. Candidate, Department of Physics<br>*1st-Runner Up* at the *Professor Charles K. Kao Student Creativity Awards* |

# in Science Faculty

## Programme

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| 14:30 - 14:45 | **"Structure-Function Relationship of Influenza A Virus Nucleoprotein"**<br>NG Ka-Leung Andy, Ph.D. Candidate, Molecular Biotechnology Programme |
| 14:45 - 15:00 | **"Mild, Selective and Economic Carbon(CO)-Carbon(α) Bond Cleavage of Ketone with Water by Group 9 Metalloporphyrins"**<br>FUNG Hong Sang, Ph.D. Candidate, Department of Chemistry |
| 15:00 - 15:15 | **"The Epidermal Co-culture Models for Melanogenesis Studies"**<br>CHEUNG Wing-ki Florence, Ph.D. Candidate, School of Chinese Medicine |
| 15:15 - 15:30 | **"Carboryne Insertion Goes Two Ways"**<br>WANG Rixin Sunewang, Ph.D. Candidate, Department of Chemistry |
| 15:30 - 15:50 | **Tea Break** |
| 15:50 - 16:05 | **"Expanded CAG RNA Trigger Cell Death by Disrupting Nucleolar Function"**<br>TSOI Ho, Ph.D. Candidate, Biochemistry Programme |
| 16:05 - 16:20 | **"Protecting Quantum Systems by Nested Dynamical Decoupling"**<br>WANG Zhen-Yu, Ph.D. Candidate, Department of Physics |
| 16:20 - 16:35 | **"SYZ Mirror Symmetry for Local Calabi-Yau Manifolds"**<br>LAU Siu-Cheong, Ph.D. Candidate, Department of Mathematics |
| 16:35 - 16:50 | **"Molecular Characterization of EXPO-Mediated Plant Exocytosis"**<br>WANG Juan, Ph.D. Candidate, Molecular Biotechnology Programme |
| 16:50 - 17:05 | **"A Unified Framework for the Comparison of Treatments with Ordinal Responses"**<br>LU Tongyu, Ph.D. Candidate, Department of Statistics |
| 17:05 - 17:20 | **"Understanding Plasmon–Fluorophore Interactions"**<br>MING Tian, Ph.D. Candidate, Department of Physics |
| 17:20 - 17:30 | **Closing Ceremony** |

# Message from the Dean of Science

This is the 6th year the Faculty of Science has held a Faculty Research Day. Each spring, our faculty members and students gather to showcase their recent advances in research, and we are glad to have you with us today. Like previous years, the Science Faculty Research Day aims to promote and foster interaction and collaboration among faculty members. Today we will also take the opportunity to highlight the work done by our own students, the next generation of scientists.

The theme for this year's event is entitled "Outstanding Research in Science Faculty", and we have invited some of our award-winning faculty members and students to share with us the fruits of their labour, the research that has earned them distinction in their field. Some of our Ph.D. candidates will also make a research presentation; their dedication to and creativity in research will give us a glimpse into future developments in various fields of science.

We at the Faculty of Science are committed to nurturing a new generation of scientists and improving the overall quality of research as our Faculty leads Hong Kong in scientific innovation. We hope that today's event will serve to stimulate discussions and collaborations in scientific research, while giving due recognition to our outstanding staff and students. Thank you for being a part of our celebration of excellence in research.

Yours sincerely,

NG Cheuk-yiu

# Presentation Abstracts & Speaker Introductions

## Award-winning Faculty Members and Student

# Professor WEI Juncheng

**Department of Mathematics**
**The Chinese University of Hong Kong**

Professor Wei obtained his B.Sc. degree from Wuhan University and his Ph.D. degree from University of Minnesota in 1994. After one year of postdoctoral work at La Scuola Internazionale Superiore di Studi Avanzati (SISSA), he joined the Chinese University of Hong Kong in 1995. He is the recipient of the Croucher Senior Fellowship (2005) and Morningside Silver Medal in Mathematics (ICCM, 2010). He is also included in ISI Highly Cited.

## From Spots, Stripes, Soup Films, to De Giorgi Conjecture

Stripes and spots are common patterns in nature. In this talk, we will discuss a mathematical theory for stripes and spots. An unexpected outcome is the complete resolution of the famous De Giorgi Conjecture.

# Professor CHEN Zhen-Yu

**Food and Nutritional Sciences Programme**
**School of Life Sciences**
**The Chinese University of Hong Kong**

Professor Chen is Professor and Programme Director of the Food and Nutritional Sciences Programme, The Chinese University of Hong Kong. He received his Ph.D. degree from University of Massachusetts at Amherst, USA, and then took his postdoctoral research position in the Department of Nutritional Science at the University Toronto. Before he joined the Chinese University of Hong Kong, Professor Chen worked in Health Protection Branch, Health Canada.

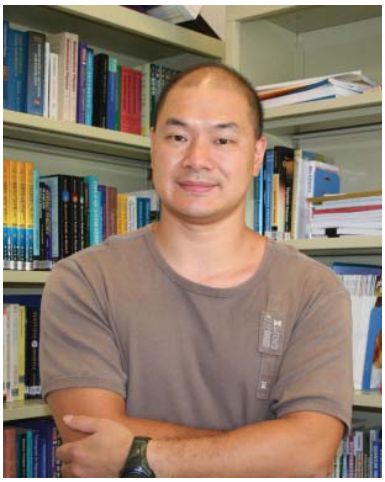
Professor Chen's research interest focuses on bioactivity of nutraceuticals, functional foods, fatty acids and cholesterol. He has published more than 180 original scientific papers in peer-reviewed journals. He is currently an associate editor of the Journal of Agricultural and Food Chemistry. He is also an editorial board member of various journals, including *Biomedical and Environmental Sciences*, *Acta Nutrimenta Sinica*, *Recent Patents on Food, Nutrition & Agriculture*, and *Food Science*. Professor Chen is the recipient of Research Excellence Award 2009 of the Chinese University of Hong Kong, the State Natural Science Award - Second Class Award, and the Ministry of Education (MOE) Higher Education Outstanding Scientific Research Output Award 2010.

## Cholesterol-Lowering Functional Foods and Nutraceuticals

Cholesterol has acquired an unsavory reputation for many years due to the strong correlation between the level of blood total cholesterol (TC) and the incidence of coronary heart disease (CHD). Cholesterol homeostasis is maintained by a complex mechanism of sterol absorption, anabolism, catabolism and excretion. Nutraceuticals and functional foods which lower TC must affect the genes which regulate cholesterol homeostasis. In general, cholesterol-lowering functional foods and nutraceuticals can be classified into seven types, namely intestinal Niemann-Pick C1 like 1 (NPC1L1) competitors, intestinal acyl-CoA: cholesterol acyltransferase 2 (ACAT2) inhibitors, 3-hydroxy-3-methylglutaryl (HMG-CoA) reductase inhibitors, LDL receptor up-regulators, bile acid reabsorption inhibitors, cholesterol-7$\alpha$-hydroxylase (CYP7A1) activators, and plasma cholesteryl ester transporting protein (CETP) inhibitors. This presentation summarizes the findings of our recent studies on the production, application, efficacy and mechanisms of popular cholesterol-lowering nutraceuticals and functional foods.

# Professor LIU Renbao

**Department of Physics**
**The Chinese University of Hong Kong**



Professor Liu graduated from the Department of Physics, Nanjing University in 1995 and obtained his Ph.D. degree from the Institute of Semiconductors, Chinese Academy of Sciences in 2000. He joined the Department of Physics, The Chinese University of Hong Kong in 2005 as an assistant professor and was promoted to associate professorship in 2010. His research focuses mainly on theoretical study of physical foundations of spin-based information technologies. He has published more than 40 papers in leading international journals, including Nature, Nature Nanotechnology, and Physical Review Letters, and has been invited to give more than 50 talks to international conferences and research institutions. In collaboration with experimentalists, his group has demonstrated protection of electron spin coherence in realistic solid-state systems, which was elected as one of the 2009 Top 10 Progresses in Science and Technology in China. Professor Liu is currently a member of the National Committee of Condensed Matter Theory and Statistical Physics.

## Protection of Quantum Coherence of Spins and Applications

Spins, as tiny compasses associated with particles like electrons and nuclei, are quantum objects and can be simultaneously in a superposition of different states. Quantum coherence of spins is a vital resource for information technologies like quantum computing and magnetic resonance spectroscopy. The spins in solids, however, are coupled to noisy environments which causes the loss of quantum coherence. In this talk Prof. Liu will discuss quantum theories for understanding such loss of coherence and schemes for protecting the coherence by dynamical quantum control over the spins. Several surprising physical effects will be shown. With the coherence protected, novel applications in information technologies of spins may be developed, such as nuclear magnetic resonance spectroscopy with single-molecule sensitivity.

# Dr. QIU Zaozao

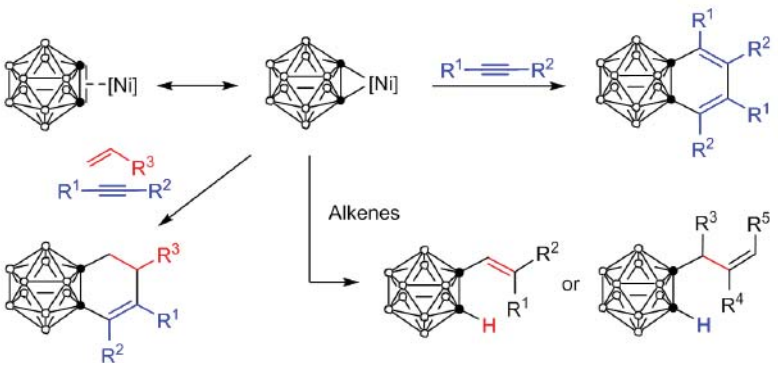
**Department of Chemistry**
**The Chinese University of Hong Kong**

Dr. Qiu received her B.Sc. in 2002 and M.Sc. in 2005, both from Lanzhou University, for work on organic synthesis. After serving for one year as a Research Assistant in the Shanghai Institute of Organic Chemistry, the Chinese Academy of Sciences, she moved to The Chinese University of Hong Kong and earned her Ph.D. degree in 2010 under the supervision of Professor Xie Zuowei. Currently, she is working as a postdoctoral fellow in the laboratory of Professor Xie. Her research interests include the synthesis and reactivity of late transition metal-carboryne complexes.

## Late Transition Metal-Carboryne Complexes and Their Reactions with Alkenes and Alkynes

*QIU Zaozao*

Intrigued by their unique structures, versatile reactivity, and wide applications in medicinal, materials, and catalysis science, carborane chemistry has fascinated chemists for decades. Some carborane containing molecules with aromatic or conjugated moiety have attracted great interest due to the conjugated linker provides electronic coupling between the bridged units, permitting intercomponent processes. Although several methods for the synthesis of these compounds have been investigated, they are either multi-step or low-yield synthetic procedures. Dr. Qiu's Ph.D. work has developed several powerful strategies to assemble useful complex molecules from very simple precursors in a single operation, which include exceptionally efficient routes from metal-carboryne to alkenylcarboranes, 1,2-benzo-o-carboranes, 1,2-dihydrobenzo-o-carboranes, and 1,3-benzo-o-carboranes. This work breaks a new ground in metal-carboryne chemistry, which has a significant impact on synthetic/cluster/material chemistry.[1]




**References:**

[1] Qiu, Z.; Ren, S.; Xie, Z. *Acc. Chem. Res*. **2011**, *44*, 299–309.

# Presentation Abstracts & Speaker Introductions

## Outstanding Student Research


# YU Chi-shing, YIM Kay-yuen and LOO Fong-cheun

**Supervisor: Professor CHAN Ting-Fung**
**Biochemistry Programme**
**The Chinese University of Hong Kong**


As the first-time participants representing the Chinese University of Hong Kong in the iGEM competition 2010, our team comprises of eight Biochemistry undergraduates. We also have student instructors and faculty advisors guiding us throughout the project.

## Using Living Organisms as a Massively Parallel Data-Storage Device


*YU Chi-shing, LI Jing-woei, YIM Kay-yuen, LOO Fong-chuen, CHIU Wai-yin, MAK Ka-yan, WONG In-chun, WONG Kit-ying, CHU Tin-yi, CHOI Ricky Thomson, LIU Si-si and CHAN Ting-Fung*


Putting digital information into the genome of living organisms may revolutionize the current storage technologies. As the host organism replicates, the encoded data is duplicated as well, forming a naturally redundant data storage system. With the help of extremophiles, digital information can be placed in exotic places where no machine can exist (e.g. high radiation areas).

Using DNA as a general storage device has been previously reported, yet there were drawbacks. For instance, the data storage size is limited to the capacity of a single cell, which often does not exceed several KB. The encoded data was also susceptible to damages due to DNA mutations.

To unlock the potentials of biological data storage, we introduced a massively-parallel data-storage system, based on high throughput gene synthesis and sequencing. We designed a framework to translate between the binary digits in computing system and A, T, G, C in DNA. An error-tolerant DNA-data packet infrastructure was proposed to allow a maximum storage capacity of 650TB per gram of *E. coli*.

We also explored the possibility of harnessing a biological system as an alternative solution for data en/decryption. We have created an encryption module with the R64 Shufflon-Specific Recombinase to further secure the encoded data.

# WANG Feng[1] and LI Chuanhao[2]

[1]Supervisor: Professor WANG Jianfang
Department of Physics
[2]Supervisor: Professor YU C. Jimmy
Department of Chemistry
The Chinese University of Hong Kong


WANG Feng is a joint Ph.D. candidate in Peking University and the Chinese University of Hong Kong. He is currently studying in Professor Wang's group in the Department of Physics. He obtained his B.Sc. degree (2006) from Peking University. His research interest is the localized surface plasmon resonances of noble metal nanocrystals and their related applications, especially exploring plasmon-assisted catalytic properties. Based on his previous studies, he has published and co-published six academic papers.

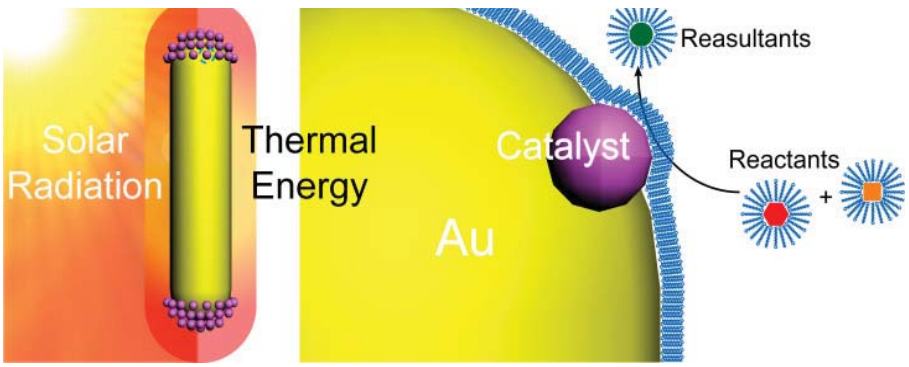
LI Chuanhao is a joint Ph.D. candidate in Professor Yu's group in the Department of Chemistry. He obtained his B.Sc. (2005) and M.Sc. (2008) degrees from Anhui University. His research interest is investigating nearinfrared-assisted photocatalysis. Based on his previous studies, he has published and co-published six academic papers.

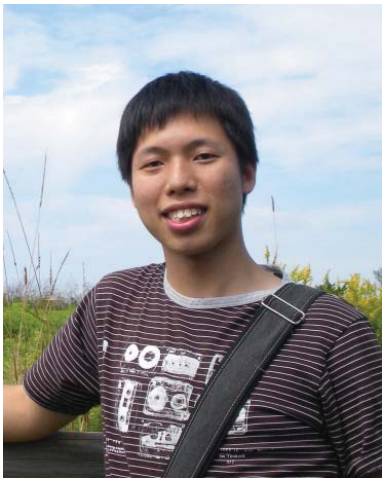
## Solar Energy Harvesting for Chemical Reactions through Plasmon Resonance

*WANG Feng, LI Chuanhao, WANG Jianfang and YU C. Jimmy*

One out of ten barrels of fossil oil extracted every day is used as fuels for chemical industries. The increase in the demand for petroleum products as well as the spread of unrest across the Middle East has boosted the price of fossil oil to historic levels. In the meantime, direct combustion of these fossil fuels not only increases the atmospheric $CO_2$ concentration, but also emits millions of tons of harmful gases every year.

In this short report we will introduce recent progresses in our group to harvest solar energy for chemical reactions through plasmon resonance. Au-Pd and Au-Pt nanostructures have been synthesized to harness the solar energy while simultaneously serving as a catalyst for chemical reactions. The Au nanorods will function as the plasmonic photothermal converter to absorb the solar energy and subsequently convert it to heat. The photothermal conversion will raise the local temperature around the Pd or Pt nanoparticles to induce the catalytic reactions on them. The success of this practical approach is beneficial for chemical industries as well as for the society at large, being able to replace the consumption of fossil fuels with a clean and renewable energy source.





# NG Ka-Leung Andy

**Supervisor: Professor SHAW Pang-Chui**
**Molecular Biotechnology Programme**
**The Chinese University of Hong Kong**

NG Ka-Leung Andy was admitted to the Chinese University of Hong Kong through the Early Admission Scheme in 2003 and received his B.Sc. in Molecular Biotechnology with First Class Honour in 2007. He has been working under the supervision of Professor Shaw since his undergraduate studies, first as a summer project student, and currently as a Ph.D. candidate in Molecular Biotechnology. With the support of the Global Scholarship for Research Excellence, he has worked in Professor Wang Jiahuai's laboratory in Harvard Medical School for two summers during his Ph.D. study. He has published two original research articles in FASEB Journal and Journal of Virology and one review paper in Science in China. He was awarded the Croucher Foundation Research Studentship in 2009 for his Ph.D. study. He has also received a prize in the 2010 Hong Kong Inter-University Biochemistry Postgraduate Symposium and the Dr. Walter Szeto Memorial Scholarship from the Faculty of Science in 2011.

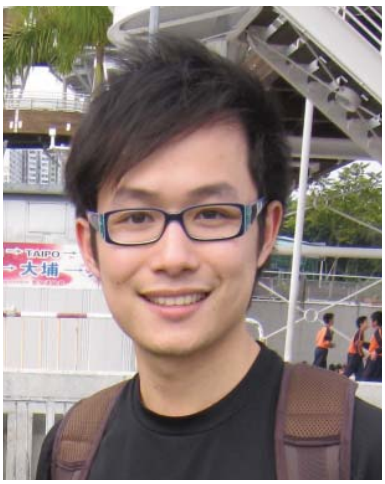
## Structure-Function Relationship of Influenza A Virus Nucleoprotein

*NG Ka-Leung Andy, CHAN Wai-Hon, ROBB Nicole, LAM Ka-Han Mandy, CHAN Kay-Sheun Paul, AU Wing-Ngor Shannon, FODOR Ervin, WANG Jia-Huai and SHAW Pang-Chui*

Influenza virus has long been a major threat to public health worldwide. The nucleoprotein (NP) of the virus binds the RNA genome and plays an essential role in transcription and replication during the virus life cycle. We have determined the 3.3 Å crystal structure of H5N1 NP, which is composed of head and body domains and a tail loop. Using surface plasmon resonance, we have identified a protruding element, an arginine-rich groove and a flexible basic loop for RNA-binding. The crystal structure also revealed that NP forms homo-oligomers by inserting its distinctive tail loop into the body groove of a neighboring NP molecule. Using ribonucleoprotein (RNP) reconstitution assays, we identified six crucial and four supportive residues for forming a functional RNP. Further characterization by static light scattering and co-immunoprecipitation showed that the reduction of RNP activities was due to interference with NP homo-oligomerization. We concluded that the NP oligomerization event is governed by three factors: (1) interaction between the tail loop and the insertion groove; (2) maintenance of the tail loop conformation; and (3) stabilization of NP homo-oligomer. Our study of H5N1 NP sheds light on inhibitor design for combating influenza virus.

# FUNG Hong Sang

**Supervisor: Professor CHAN Kin Shing**
**Department of Chemistry**
**The Chinese University of Hong Kong**

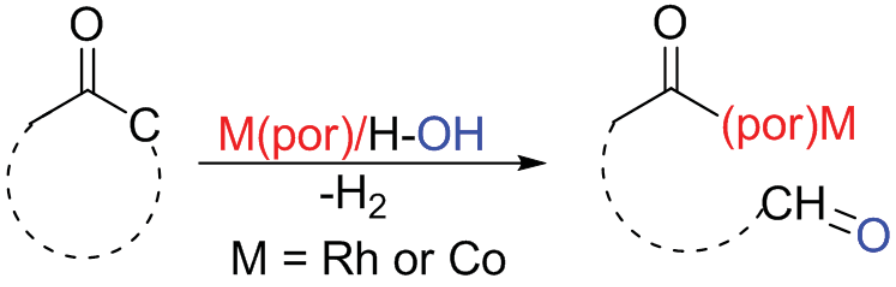


FUNG Hong Sang received his B.Sc. degree in Chemistry from the Chinese University of Hong Kong in 2007. He is currently a Ph.D. candidate under the supervision of Professor Chan in the same department. He started his research career in 2006 in Professor Chan's group, where he carried out undergraduate research. His research interest is organometallic chemistry, in which he studies the carbon-carbon bond cleavage of ketones with group 9 (rhodium and cobalt) metalloporphyrins.

## Mild, Selective and Economic Carbon(CO)-Carbon(α) Bond Cleavage of Ketone with Water by Group 9 Metalloporphyrins

*FUNG Hong Sang and CHAN Kin Shing*

In organometallic chemistry, carbon-hydrogen (C-H) and carbon-carbon (C-C) bond cleavages by transition metal complexes have attracted much attention due to their potential utility in organic transformations. However, C-C bond cleavages are challenging due to their inertness and the selectivity problems caused by the harsh conditions employed. To pursue a mild, selective and economic C-C cleavage, group 9 (rhodium and cobalt) metalloporphyrins have been used to react with ketones. It was found that the CO-C(α) bond of ketone was cleaved with water in the presence of metalloporphyrins. We believe metalloporphyrin transfers the hydroxyl group from water to the α-carbon of ketone, while the metalloporphyrin itself is attached to the CO carbon. Overall, there is a M-O insertion to the CO-C(α). The reaction can occur at room temperature and the cobalt porphyrin used is an economically attractive transition metal complex to cleave the C-C bond.



# CHEUNG Wing-ki Florence

**Supervisors: Professor LEUNG Wing-nang,**
**Professor LIU Wing-keung and Professor CHE Chun-tao**
**School of Chinese Medicine**
**The Chinese University of Hong Kong**

CHEUNG Wing-ki Florence received her B.Sc. degree in Biology (Human Biology) in 2003 from the Chinese University of Hong Kong (CUHK). After spending two years as a Research Assistant in the School of Chinese Medicine, she continued her study in search of anti-cancer candidates from herbal medicine and received her M.Phil. degree in 2008 from the CUHK. Since then, she has been pursuing her Ph.D. studies with specific focus on melanogenic properties of Chinese herbal medicines as well as molecular mechanisms mediating protein trafficking during melanogenesis under the supervision of Professor Leung, Professor Liu and Professor Che. She has published her results and findings in six academic papers in international journals.

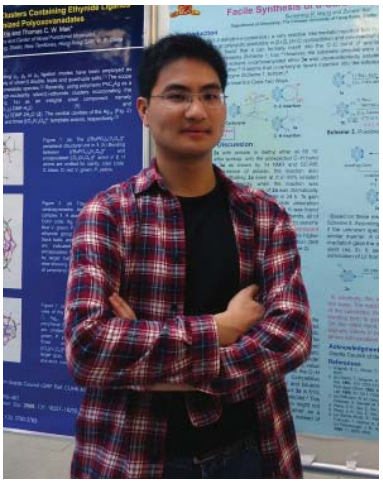
## The Epidermal Co-culture Models for Melanogenesis Studies

*CHEUNG Wing-ki Florence, LEUNG Wing-nang, LIU Wing-keung and CHE Chun-tao*

Skin, the largest organ of the body, composes of dermis and epidermis in which the epidermal melanocytes and keratinocytes interact with each other, forming the functional pigmentary "epidermal melanin unit" of the skin. Traditionally, mono-culture of melanocytes is used for pre-clinical study of pro- and anti- pigmentary compounds. However, the mono-culture cannot properly reflect the importance of spatial arrangement and interaction of the skin cells. Recent studies have also revealed significant morphological and physiological changes of melanocytes in the absence of keratinocytes. To mimic the response of "epidermal melanin unit", co-cultures of human melanocytes and keratinocytes with or without physical contact are constructed to study pigmentary activities of bioactive compounds for hyper- and hypopigmentary diseases. Since many Chinese herbal drugs, such as *Polygonum multiflorum* (何首烏), *Eclipta prostrate* (墨旱蓮), and *Cuscuta chinensis* (兔絲子) are traditionally used as pigmentary agents, and their extracts are also major active ingredients in many commercial products but the mechanisms mediating their melanogenesis are largely unknown. The objectives of our co-culture system do not only provide platforms to evaluate the melanogenic properties of Chinese herbs and their active ingredients, but also allows basic research of cell-cell interaction during normal physiological condition and carcinogenic situations.

# WANG Rixin Sunewang

**Supervisor: Professor XIE Zuowei**
**Department of Chemistry**
**The Chinese University of Hong Kong**

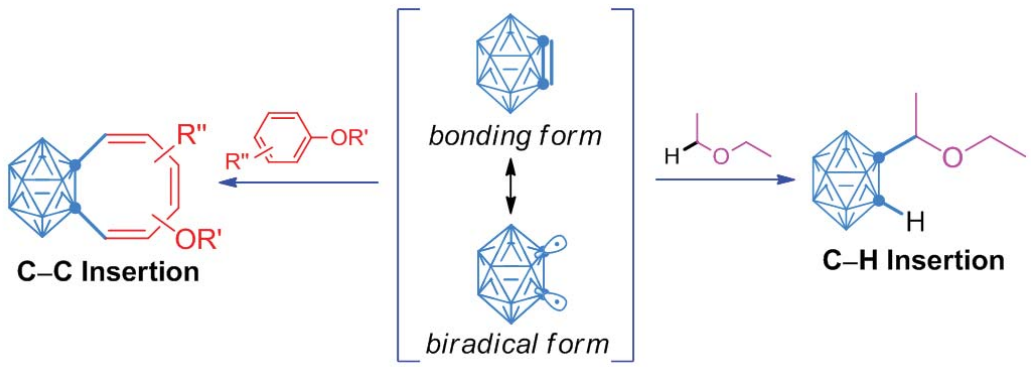


WANG Rixin graduated with a B.Sc. degree (2006) from Shanghai Jiao Tong University (SJTU), and subsequently obtained his Master's degree in organic chemistry from the Shanghai Institute of Organic Chemistry (SIOC), The Chinese Academy of Sciences (2009). In the same year, he joined the Department of Chemistry of CUHK as a Ph.D. student under the supervision of Professor Xie Zuowei. Currently, his research focuses on exploration of carboryne chemistry, aiming at the development of efficient accesses to functionalized carboranes.

## Carboryne Insertion Goes Two Ways

*WANG Rixin Sunewang and XIE Zuowei*

Carboryne (1,2-dehydro-o-carborane) is in effect a three-dimensional relative of benzyne. Recently, we found that this reactive intermediate can exist in two resonance forms that exhibit significantly different reactivities: the bonding form of carboryne inserts into a C–C bond of aromatic rings in a [2+2] cycloaddition, expanding the six-membered ring of anisoles to eight-membered rings (shown, left);[1] on the other hand, the biradical form undergoes regioselective insertion into the C–H bond of ethers (shown, right).[2] The pair of reactions serves as a new strategy for generating functionalized carboranes, which feature extensively in the synthesis of polymers, ceramics, catalysts, and radiopharmaceuticals.




**References:**
[1] Wang, S. R.; Qiu, Z.; Xie, Z. *J. Am. Chem. Soc.* **2010**, *132*, 9988–9989.
[2] Wang, S. R.; Qiu, Z.; Xie, Z. *J. Am. Chem. Soc.* **2011**, *133*, 5760–5763.

# TSOI Ho

**Supervisors: Professor CHAN Ho Yin Edwin**
**Biochemistry Programme**
**The Chinese University of Hong Kong**

TSOI Ho received his B.Sc. degree in Biochemistry from the Chinese University of Hong Kong in 2008. He is currently a Ph.D. student under the supervision of Professor Chan in the Biochemistry programme, School of Life Sciences at the CUHK. His main research interest is on investigating the pathogenesis of polyglutamine (polyQ) diseases using both Drosophila and cell models. Currently, he is focusing on mechanistic studies of expanded CAG transcripts mediated toxicity in polyQ diseases.

## Expanded CAG RNA Trigger Cell Death by Disrupting Nucleolar Function

*TSOI Ho and CHAN Ho Yin Edwin*

Polyglutamine (polyQ) diseases are a class of dominantly inherited neurodegenerative disorders caused by the expansion of CAG repeats encoding glutamine within the coding region of the respective genes. Expanded CAG RNA has been reported to contribute to cell death in polyQ diseases. We demonstrated that expanded CAG RNA retained in the nucleus, particularly in the nucleolus. Nucleolus is a critical sub-nuclear compartment where ribosomal RNA (rRNA) synthesis occurs. Once the nucleolus is disrupted, rRNA synthesis will be suppressed and cells will die. We found that the accumulation of expanded CAG RNA in the nucleolus caused repression of rRNA synthesis and attempted to address how RNA affected rRNA synthesis. We found that expanded CAG RNA disrupted the function of a cellular protein, nucleolin. This protein is important for protecting rRNA promoter from hyper-methylation. Once the rRNA promoter is hyper-methylated, rRNA synthesis will be suppressed. It subsequently resulted in cell death. In summary, our study describes the involvement of the nucleolus, a sub-compartment of the nucleus, in polyQ disease pathogenesis. This study will allow us to better understand the pathogenic details of this disease which will in the long run contribute to therapeutic development.

**References:**

[1] Grummt, I. and Pikaard, C.S. (2003) Epigenetic silencing of RNA polymerase I transcription. *Nat Rev Mol Cell Biol*, **4**, 641-649.

[2] Li, L.B., Yu, Z., Teng, X. and Bonini, N.M. (2008) RNA toxicity is a component of ataxin-3 degeneration in *Drosophila. Nature*, **453**, 1107-1111.

[3] Rickards, B., Flint, S.J., Cole, M.D. and LeRoy, G. (2007) Nucleolin is required for RNA polymerase I transcription *in vivo. Mol Cell Biol*, **27**, 937-948.

# WANG Zhen-Yu

**Supervisor: Professor LIU Renbao**
**Department of Physics**
**The Chinese University of Hong Kong**

WANG Zhenyu is a Ph.D. candidate in Professor Liu's group in the Department of Physics. He received his B.Eng. degree in Information Engineering (2005) and M.Sc. degree in Optics (2008) from South China Normal University in Guangzhou. His current research interests include the theories and applications of quantum-based technologies, such as dynamical decoupling and optimal control for quantum computing and spectrometry.

## Protecting Quantum Systems by Nested Dynamical Decoupling

*WANG Zhen-Yu and LIU Renbao*

Both in quantum computing and in high-precision magnetic resonance spectroscopy, it is important to find efficient methods to suppress unwanted couplings within a quantum system and between the system and its environment (bath). Dynamical decoupling is a technique originated from the spin echo in nuclear magnetic resonance, which averages out the unwanted couplings through fast control on the system. In this talk, Wang will present a scheme of dynamical decoupling that can protect quantum systems in generic quantum baths to arbitrary decoupling orders with the number of pulses increasing polynomially with decoupling order. For multi-quantum-bit systems, this scheme uses only control over single quantum bits. We also establish a theorem which generalizes universal control schemes over time-independent systems to time-dependent systems.

# LAU Siu-Cheong

**Supervisor: Professor LEUNG Nai-Chung**
**Department of Mathematics**
**The Chinese University of Hong Kong**

LAU Siu Cheong is currently a Ph.D. student in the Institute of Mathematical Sciences under the supervision of Professor Leung. His research interest includes symplectic geometry, algebraic geometry and their relations with modern Physics. More specifically, he is working on the mathematical aspects of mirror symmetry. He will be a postdoctorate at The Institute for the Physics and Mathematics of the Universe in 2011-12, and Benjamin Peirce fellow at Harvard University in 2012-14.

## SYZ Mirror Symmetry for Local Calabi-Yau Manifolds

*CHAN Kwok-Wai, LAU Siu-Cheong, and LEUNG Nai-Chung*

String theory asserts that our universe is made up of a specific class of geometries, namely "Calabi-Yau manifolds". It was discovered in the 90's that Calabi-Yau manifolds appear in pairs, such that "complex geometry" of a Calabi-Yau manifold reflects "symplectic geometry" of its partner. This phenomenon is called mirror symmetry. It is currently studied extensively by mathematicians since complicated symplectic geometry can then be derived from classical complex geometry in the mirror side.

To explain mirror symmetry, Strominger-Yau-Zaslow (SYZ) proposed to use "torus duality" which is simply undergraduate linear algebra. Yet their ideas receive "quantum" corrections in practical situations, which can be expressed in terms of Fourier series. In this short report, Lau will explain how basic linear algebra and Fourier analysis help mathematicians to understand the mysterious mirror phenomenon.

# WANG Juan

**Supervisor: Professor JIANG Liwen**
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WANG Juan is currently a Ph.D. student of Molecular Biotechnology programme, School of Life Sciences at CUHK. She received her B.Med. degree from Sun Yat-sen University in Guangzhou in 2006. After spending one year as a Research Assistant at CUHK in 2007, she began her postgraduate study under the supervision of Professor Jiang in 2008 and obtained her M.Phil. degree from CUHK in 2010. Her current research focuses on studying the roles of a novel exocyst-positive organelle (EXPO) in mediating plant exocytosis.

## Molecular Characterization of EXPO-Mediated Plant Exocytosis

*WANG Juan, DING Yu, WANG Junqi, LO Sze Wan and JIANG Liwen*

Using transgenic *Arabidopsis* and tobacco (*Nicotiana tabacum*) BY-2 cells expressing various GFP fusions as tools, we have recently identified a novel organelle termed EXPO (exocyst-positive organelle) that mediates an unconventional cytosol to cell wall secretion in plant cells. EXPO is a double-membrane structure that fuses with the plasma membrane (PM), releasing a single membrane vesicle into the cell wall. Current research focuses on molcular characterization of EXPO-mediated plant exocytosis, including isolation and proteomic analysis of EXPO, EXPO dynamic and EXPO-PM (plasma membrane) fusion in living cells, EXPO membrane origins and biogenesis, and EXPO function in plants.

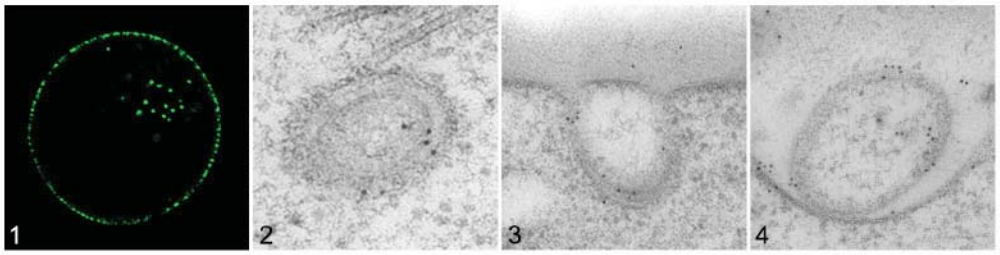


Figure: EXPO dynamics and structure. Panel 1, shows GFP-tagged EXPO in a plant protoplast; panels 2-4, immunogold electron microscope images showing the EXPO-PM fusion profiles. GFP, green fluorescent protein; EXPO, exocyst-positive organelle; PM, plasma membrane.

**Reference:**

[1] Wang, J., Ding, Y., Wang, J., Hillmer, S., Miao, Y., Lo, S.W., Wang, X., Robinson, D.G., and Jiang, L. (2010). EXPO, an exocyst-positive organelle distinct from multivesicular endosomes and autophagosomes, mediates cytosol to cell wall exocytosis in *Arabidopsis* and tobacco cells. Plant Cell 22, 4009-4030.


# LU Tongyu

**Supervisor: Professor POON Wai-Yin**
**Department of Statistics**
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LU Tongyu is a final year Ph.D. candidate of the Department of Statistics supervised by Professor Poon. His research interests lie in the comparison of treatments with ordinal responses. The main objective of his research is to develop effective comparison methods for treatments with ordinal responses and address the related applications. Currently, some results have been achieved for the comparison of two treatments, the comparison of treatments with longitudinal responses, and the multiple comparisons of treatments. A unified framework for treatment comparison with ordinal responses is also established. The framework not only subsumes the existing methods, but also overcomes some problems of the existing methods. He also has interest in sample size determination and experimental design for treatment comparisons.

## A Unified Framework for the Comparison of Treatments with Ordinal Responses

*LU Tongyu, POON Wai-Yin and CHEUNG Siu Hung*

The comparison of treatments to detect possible treatment effects is a very important and interesting topic in statistical research. Our study focuses on the comparison of treatments with ordinal responses. The Wilcoxon-Mann-Whitney (WMW) test may be the most popular nonparametric method used to investigate the effect between two treatments with ordinal responses. However, our study finds that the WMW test and the corresponding sample size determination methods derived based on the WMW test may be quite questionable for some cases. We establish a unified framework for treatment comparisons with ordinal responses, which allows various treatment comparison methods be comprehended using a unified perspective. Our major statistical approach is to consider ordinal responses as manifestations of some underlying continuous random variables with a distribution that is any member of the location-scale family. A two-step procedure to identify the model and produce the parameter estimates is proposed. Based on this procedure, many important statistical inferences can be conveniently conducted. Furthermore, a new sample size determination method based on the latent variable method is proposed, which is also compared with the existing methods. This presentation is based on a joint work with Professor Poon and Professor Cheung.

# MING Tian

**Supervisor: Professor WANG Jianfang**
**Department of Physics**
**The Chinese University of Hong Kong**

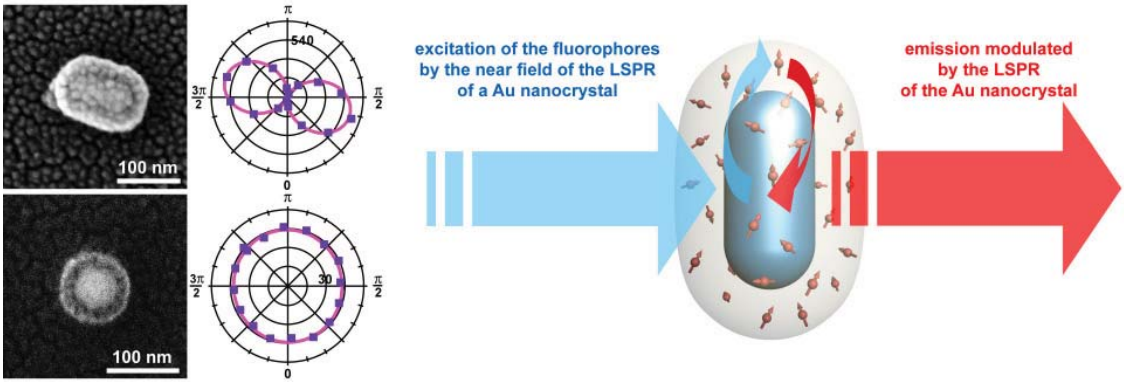
MING Tian received his B.Sc. degree (2007) in Physics from Fudan University. He is now pursuing his Ph.D. degree in Materials Science and Engineering at the Chinese University of Hong Kong, working under the supervision of Professor Wang. His research interests focus on design and synthesis of noble metal nanocrystals, assembly of noble metal nanocrystals, plasmon-enhanced spectroscopy, coupling between plasmonic and molecular resonances, and nanostructured multifunctional materials. Based on his previous studies, he has published and co-published 21 academic papers.

## Understanding Plasmon–Fluorophore Interactions

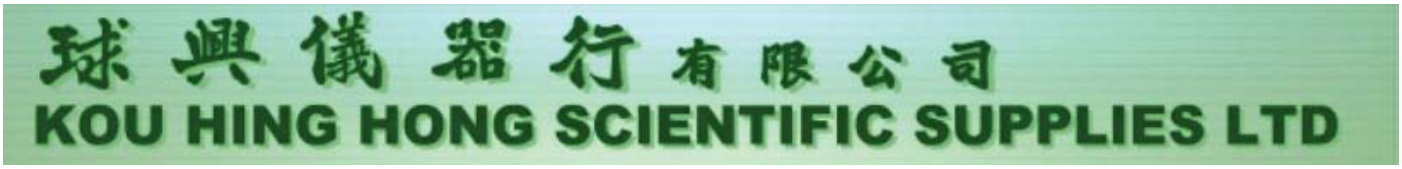
*MING Tian, ZHAO Lei and WANG Jianfang*

Plasmonic nanoantennas can efficiently confine optical fields in regions below the diffraction limit, bridge the mismatch between typical optical wavelengths and much smaller nanoscale optical species, and pave the way to fine tailoring of interaction between light and single atoms or molecules. Applications of plasmonic nanoantenna ranges from plasmon-enhanced solar energy conversion, ultra-sensitive biosensing/bioimaging, to plasmon manipulated light source, and etc.

Among all of these applications, a basic issue plays the key role. That is, how does the plasmon interact with a light harvester or a light emitter? Fluorophore is one of the most common quantum optical species that preserve both light harvesting and emitting properties. In this short report, Ming will briefly introduce some recent progress in Prof. Jianfang Wang's group on studying the plasmon–fluorophore interaction by both excitation and emission polarization experiments on single gold nanorod–fluorophore hybrid nanostructures.



# Special Thanks:

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