香港中文大學理學院
FACULTY OF SCIENCE, THE CHINESE UNIVERSITY OF HONG KONG

Science Faculty Research Day 2012

Outstanding Research in Science Faculty

DATE: Friday, 29 June 2012
TIME: 09:45 - 16:15
VENUE: LT3, Lady Shaw Building,
The Chinese University of Hong Kong

Outstanding Research Event

Morning Session:

09:45 - 10:15 **Opening Ceremony**

10:15 - 10:45 "Group LASSO for Structural Break Time Series"
Prof. CHAN Ngai-Hang
Department of Statistics
Recipient of *Econometric Theory Multa Scripsit Award* and *Research Excellence Award 2011-12*

10:45 - 11:00 **Tea Break**

11:00 - 11:30 **"Molecular Engineering and Interface Engineering for Organic Electronic Devices"**
Prof. MIAO Qian
Department of Chemistry
Recipient of *Young Researcher Award 2011-12*

11:30 - 12:00 **"Eco-Friendly Syntheses of Versatile Organic Compounds: Novel Protocols for Gem-Olefins Directed by NHC-Ni Hydride"**
Ms. HE Lisi, Ph.D. Student
Centre of Novel Functional Molecules, Department of Chemistry
Recipient of *Postgraduate Research Output Award 2011-12*

Afternoon Session:

13:30 - 13:45 "Assembly of Preactivation Complex for Urease Maturation in *Helicobacter pylori*"
Mr. FONG Yu-Hang Ivan, Ph.D. Student, School of Life Sciences

13:45 - 14:00 "Photocatalytic Carbon-Carbon Bond Activation of Ketones by Rhodium(III) Porphyrins"
Ms. LEE Siu-Yin, Ph.D. Student, Department of Chemistry

in Science Faculty

Programme

14:00 - 14:15	"Surface Plasmon Enhanced Drug Efficacy Using Core Shell Au@SiO_2 Nanoparticle Carrier" Mr. CHU Zhiqin, Ph.D. Student, Department of Physics
14:15 - 14:30	"Investigation on the Anti-Diabetic Effects of Selected Chinese Herbs/Natural Products by Inhibiting the Activity of Sodium-Glucose Cotransporter 2 (SGLT2)" Ms. QU Yue, M.Phil. Student, School of Chinese Medicine
14:30 - 14:45	"When Fourier Meets Fractals" Mr. LAI Chun-Kit, Ph.D. Student, Department of Mathematics
14:45 - 15:00	Tea Break
15:00 - 15:15	"The Golgi-Localized *Arabidopsis* Endomembrane Protein12 Contains Both Endoplasmic Reticulum Export and Golgi Retention Signals at Its C Terminus" Mr. GAO Caiji, Ph.D. Student, School of Life Sciences
15:15 - 15:30	"Microwave-Assisted Solid-Phase Peptide Synthesis of Antimicrobial Defensin" Ms. LEUNG Chui-Fan, Year 3 Student, Department of Chemistry
15:30 - 15:45	"Rabi Oscillation and State Construction in a Gravity Quantum System" Mr. LEUNG Shing-Chau, Year 3 Student, Department of Physics
15:45 - 16:00	"Wave Equation on Fractals" Mr. LEE Yin-Tat, Year 3 Student, Department of Mathematics

Message from the Dean of Science

This is the 7th 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 undergraduates and research postgraduates 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

and

Speaker Introductions

Award-winning Faculty Members and Student

Prof. CHAN Ngai-Hang

Department of Statistics
The Chinese University of Hong Kong

Prof. CHAN Ngai-Hang, Chair Professor of Statistics and Chairman of the Department of Statistics at The Chinese University of Hong Kong (CUHK), is a world renowned statistician. He is an appointed member of both the Risk Management Committee of Hong Kong Exchanges and Clearing Limited, and the Statistics Advisory Board for the Commissioner for Census and Statistics, HKSAR. His current research interests include time series, finance and econometrics, risk management and statistical finance, oceanography and inference for stochastic processes.

Professor Chan's contributions in the field of statistics have been recognized with numerous awards and honours including Fellowship of the Institute of Mathematical Statistics, Fellowship of the American Statistical Association, Elected Membership of the International Statistical Institute, Honorary Membership of the Hong Kong Statistical Society, and the recently announced Econometric Theory Multa Scripsit Award. He is the recipient of the Research Excellence Award from the Faculty of Science of CUHK this year.

Group LASSO for Structural Break Time Series

Consider a structural break autoregressive (SBAR) process

$$Y_t = \sum_{j=1}^{m+1} \boldsymbol{\beta}_j^{0T} \mathbf{Y}_{t-1} I(t_{j-1} \le t < t_j) + \varepsilon_t,$$

where $\mathbf{Y}_{t-1} = (1, Y_{t-1}, \ldots, Y_{t-p})^T$. $\boldsymbol{\beta}_j^0 = (\beta_{j0}^0, \beta_{j1}^0, \ldots, \beta_{jp}^0)^T \in \mathbf{R}^{p+1}$, $j = 1, \ldots, m+1$, $1 = t_0 < t_1 < \ldots < t_{m+1} = n+1$, $\{t_1, \ldots, t_m\}$ are change points, $\{\varepsilon_t\}$ are independent and identically distributed (i.i.d.) innovations with zero mean and unit variance. In practice, it is usually assumed that m is known and small, because a large m would involve a huge amount of computational burden in parameters estimation. By reformulating the problem in a regression variable selection context, the group least absolute shrinkage and selection operator (LASSO) is proposed to estimate an SBAR model when the number of change points m is unknown. It is shown that the number of change points and the locations of the changes can be consistently estimated from the data and the computation can be efficiently performed. Furthermore, the convergence rate of the breaks is shown to be nearly optimal. An improved practical version that incorporates group LASSO and stepwise regression variable selection technique are discussed. Simulation studies are conducted to assess the finite sample performance.

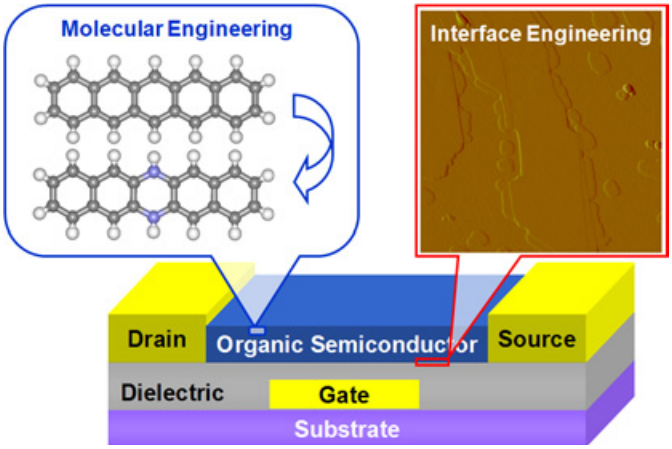
Prof. MIAO Qian

Department of Chemistry
The Chinese University of Hong Kong

Prof. MIAO Qian graduated from University of Science and Technology of China with a B.Sc. degree in 2000, and received his Ph.D. degree in chemistry from Columbia University in 2005. After one-year postdoctoral research at University of California, Los Angeles, he joined the Chinese University of Hong Kong as an assistant professor in 2006. His group has conducted an interdisciplinary research involving organic chemistry, supramolecular chemistry, surface chemistry and semiconductor device engineering. The major efforts of his research have been focused on design and synthesis of functional π-molecules, organic semiconductors and organic electronic devices. One successful example of his research is developing N-heteropentacenes as a general design for high-performance organic semiconductors. He is the recipitent of Young Researcher Award 2011-12.

Molecular Engineering and Interface Engineering for Organic Electronic Devices

Although organic compounds are generally known as insulators, a special group of conjugated molecules can function as semiconductors. In comparison with inorganic counterparts, organic semiconductors are mechanically flexible, compatible with low-cost fabrication over large areas and, through molecular design and organic synthesis, capable of various functionalities. Organic thin film transistors (OTFTs) are elemental units that drive individual pixels in light-weight and flexible displays as well as operating radio-frequency identification tags and sensors. OTFTs are interface devices with their performance highly depending on the structures and properties at the interfaces. Therefore, to develop high-performance OTFTs, engineering device interfaces is of the same key importance as designing and synthesizing new semiconductor molecules. This presentation introduces our recent efforts on both molecular engineering and interface engineering for OTFTs, which have not only led to high-performance organic semiconductor materials, but also allowed us to better understand the relationship between structures and functions.



Ms. HE Lisi

Supervisor: Prof. HO Chun-Yu
Centre of Novel Functional Molecules
Department of Chemistry
The Chinese University of Hong Kong

Ms. HE Lisi obtained her B.Sc. degree from the Sun Yat-Sen University in 2009. Under the supervision of Prof. HO Chun-Yu, she received her M.Phil. degree in chemistry from the Chinese University of Hong Kong in 2011, and is now pursuing her Ph.D. degree in the same group supported by the HK-PhD Fellowship. She received a number of research awards including a Junior ACP Award from Taiwan. Her research interest is using N-heterocyclic carbene (NHC) with transition metal for catalytic multi-component reactions.

Eco-Friendly Syntheses of Versatile Organic Compounds: Novel Protocols for Gem-Olefins Directed by NHC-Ni Hydride

New methodologies for the syntheses of olefins are one of the most important aspects in chemistry. This is not only because of the conceptual advances it revealed during the development, but also because of the strategic advantages it may offer in organic syntheses and materials preparations. However, despite decades of research, the catalytic selective production of the unsymmetric gem-disubstituted olefins from chemical feed stocks directly remains challenging.

In the present research, inspired by the observations in using N-heterocyclic carbene ligand with nickel for alkene bi-functionalization,[1] we have developed the first methodologies for highly selective syntheses of valuable but less readily available Gem-olefins by using a NHC-Ni hydride with several chemical feed stocks produced in metric megatons per year: 1) a cross-hydroalkenylation of vinylarenes and α-olefins,[2] and 2) a new tool for catalytic preparation of gem-olefins functionalized with organometalloids.[3] Mechanisms and scopes will be discussed during the presentation.

References

[1] Ho, C.-Y. *Chem. Commun.* **2010**, *46*, 466;

[2] a) Ho, C.-Y.; He, L. *Angew. Chem. Int. Ed.* **2010**, *49*, 9182 (Highlighted thrice);
b) Ho, C.-Y.; He, L.; Chan, C.-W. *Synlett* **2011**, *Synpacts*, 1649; c) US2011201840A1

[3] a) Ho, C.-Y.; He, L. *Chem. Commun.* **2012**, *48*, 1481 (Featured in *Emerging Investigator Issue*);
b) US2012071681A1

[4] Financial support of these works are provided by GRF 401208, CUHK TBF 3120090, and NSFC 21102122 and Hong Kong PhD Fellowship.

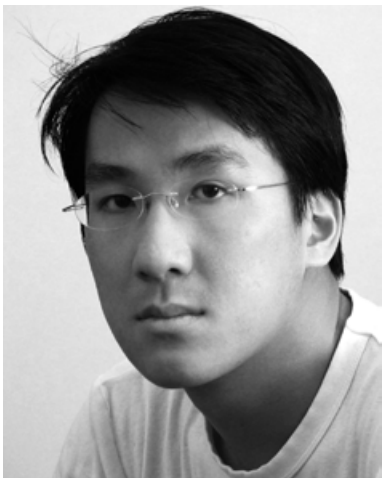
Presentation Abstracts

and

Speaker Introductions

Student Research

Mr. FONG Yu-Hang Ivan



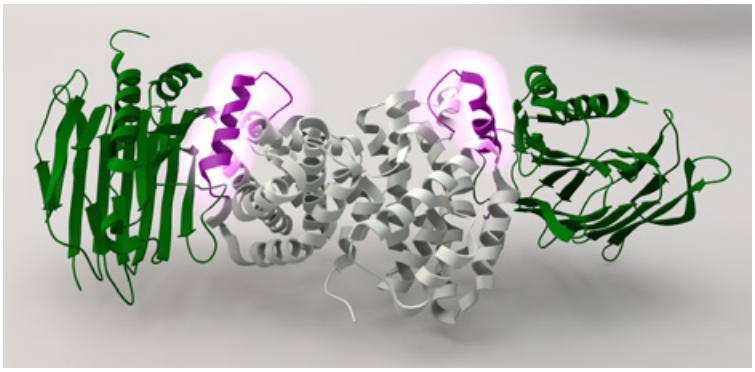
Supervisor: Prof. WONG Kam-Bo
School of Life Sciences
The Chinese University of Hong Kong

Mr. FONG Yu-Hang Ivan graduated from Purdue University, West Lafayette, Indiana USA in 2007, majoring in biochemistry and molecular biology. He joined Prof. WONG Kam-Bo's research group in 2008 as a graduate student to study urease maturation mechanism. His research focuses on the use of x-ray crystallography to determine protein structures, which provide fundamental insights into the underlying biological processes. In December 2011, he and his colleagues published a protein structure in the Journal of Biological Chemistry that illustrated how the protein machinery responsible for activating urease is assembled. This paper was chosen by the Journal as "Paper of the Week".

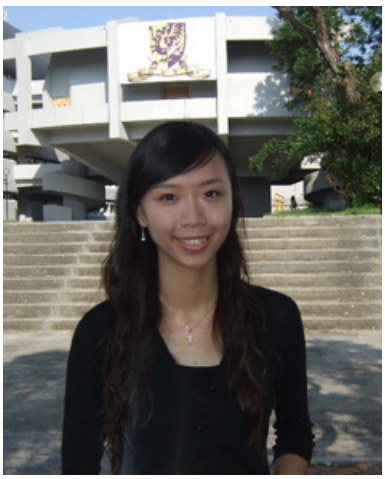
Assembly of Preactivation Complex for Urease Maturation in *Helicobacter pylori*

Yu-Hang Fong*, Ho Chun Wong, Chi Pang Chuck, Yu Wai Chen, Hongzhe Sun and Kam-Bo Wong

Helicobacter pylori colonizes the acidic environment of the human stomach, causing stomach ulcer and carcinoma. Urease is a metalloenzyme that enables the pathogen to survive under acidic condition of the stomach by hydrolyzing urea into ammonia to neutralize gastric acid. Urease is first synthesized as an apo-enzyme, which later undergoes a maturation process involving the carboxylation of an active site lysine and insertion of nickel ions. This maturation process is facilitated by the formation of an essential pre-activation complex involving urease and its accessory protein UreF, UreG and UreH. Crystal structure of the UreF-UreH complex revealed that UreF undergoes conformational changes after complex formation with UreH. Site directed mutagenesis identified these conformational changes enable the UreF-UreH complex to recruit an essential GTPase, UreG. In addition, unique two-fold symmetry observed on both *H. pylori* urease and UreF-UreH complex enabled us to propose a topology model of the pre-activation complex for urease maturation.



Crystal Structure of Urease Accessory Protein UreF-UreH Complex. Highlighted in purple is the region of UreF undergoing conformational change after UreF-UreH complex formation.



Ms. LEE Siu-Yin

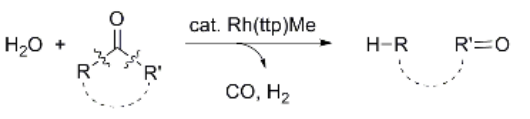
Supervisor: Prof. CHAN Kin-Shing
Department of Chemistry
The Chinese University of Hong Kong

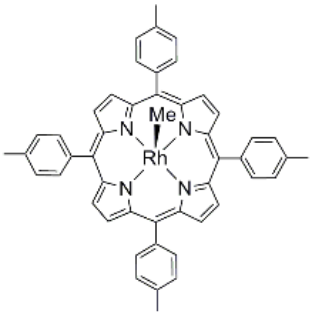
Ms. LEE Siu-Yin is currently a Ph.D. student in the Department of Chemistry at the CUHK. She received her B.Sc. degree from the same university in 2009. Her research career started in 2007 when she worked on her undergraduate thesis under the supervision of Prof. CHAN Kin-Shing. She is interested in organometallic chemistry and her research work is focused on the catalytic carbon-carbon bond activation of ketones using rhodium porphyrins. She has published her previous findings in six international journals.

Photocatalytic Carbon-Carbon Bond Activation of Ketones by Rhodium(III) Porphyrins

LEE Siu Yin* and CHAN Kin Shing

Catalytic cleavage of unactivated carbon-carbon bond is an attractive yet very challenging aspiration in organometallic chemistry. Traditionally, the catalytic carbon-carbon bond activation (CCCA) was accomplished under thermal conditions. However, the high temperature required is energy-intensive and it introduces selectivity problems. Recently, the goal has been achieved with the help of abundant natural resources: light and water. To pursue a mild, selective and catalytic bond cleavage, light has been introduced into the reaction. We discovered the selective CCCA of unstrained ketones by rhodium(III) porphyrins to yield the corresponding O-incorporated organics. In the presence of water, the photocatalysis was achieved under ambient conditions with good turnovers. Through mechanistic studies, we propose Rh(ttp)OH as a key intermediate and water acts as an oxidizing agent.





Structure of Porphyrin, Rh(ttp)Me

Mr. CHU Zhiqin

Supervisor: Prof. LI Quan
Department of Physics
The Chinese University of Hong Kong

Mr. CHU Zhiqin is currently a Ph.D. candidate in the CUHK Physics Department under the supervision of Prof. LI Quan. He received his B.Sc. degree in Physics in 2008 from Northwestern University, China. His research interests focus on synthesis, functionalization and structural design of nanomaterials for biomedical application, and studying their interaction with biological systems.

Surface Plasmon Enhanced Drug Efficacy Using Core Shell Au@SiO_2 Nanoparticle Carrier

CHU Zhiqin

The plasmonic effect of Au has recently been proposed as an enhancing mechanism for effective cancer therapeutics. Nevertheless, clear experimental evidence with either in vitro or in vivo proof showing that plasmonic effect is indeed responsible for the enhanced drug efficacy was not obtained. For many cases, the Au photothermal effect was mixed up with possible plasmonic effect, with the drug working mechanism being unclear. Consequently, whether the plasmonic effect can indeed be employed as an enhancing mechanism for nanodrug design remains uncertain.

In the present study, by combining advantages of SiO_2 (its biocompatibility) and Au (plasmonic effect), we have designed Au@SiO_2 core-shell nanoparticles (NPs) with photosensitizer methylene blue (MB) incorporated into the SiO_2 shell. We have deliberately excluded the Au photothermal effect and unambiguously demonstrated plasmonic enhanced drug efficacy in the Au@(SiO_2-MB) core-shell NP-treated cells. We have identified two criteria in enabling the strong plasmonic effect, which is responsible for the enhanced drug efficacy, i.e., the spatial overlap of the PS molecules and the Au core, and the energy match between the PS absorption and the Au surface plasmon resonance. The present work suggests a promising nanocarrier system for cancer therapeutics with plasmonic enhanced drug efficacy.

Ms. QU Yue

Supervisors: Prof. Albert LEUNG Wing-Nang
School of Chinese Medicine
The Chinese University of Hong Kong

Ms. QU Yue obtained her B.Sc. Degree from the Department of Pharmacology of Herbal Medicine in NanJing University of Chinese Medicine in 2010. During her undergraduate studies, she also worked as an intern at the State Key Laboratory of Pharmaceutical Biotechnology, Research and Development center of Nanjing Yifang, Nanjing University, during which she finished her undergraduate dissertation about quality study of injection of water-soluble vitamins. She is currently an M.Phil. student in the School of Chinese Medicine, Chinese University of Hong Kong (CUHK), researching Diabetes Mellitus (DM), focusing on investigating the anti-diabetic effects of selected natural products/Chinese herbs by inhibiting the activity of Sodium-Glucose Cotransporter2 (SGLT2).

Investigation on the anti-diabetic effects of selected Chinese herbs/natural products by inhibiting the activity of sodium-glucose cotransporter 2 (SGLT2)

Qu Yue*, Judy Y. W. Chan, Clara B. S. Lau, and Albert W. N. Leung

Diabetes Mellitus (DM) is a disorder of glucose metabolism characterized by abnormally high blood glucose level affecting almost 6% of the world's population. Reabsorption of filtered glucose by sodium-glucose cotransporters (SGLTs) is one of the renal mechanisms affecting glucose metabolism. SGLT2 has been proposed as a novel target for diabetic therapy.

So far, only very little information has been found on natural products or traditional Chinese medicine (TCM) that possess SGLT inhibitory action. In this project, we aim to search for anti-diabetic TCM/natural products which specifically inhibit the activity of SGLT2 *in vitro* and attenuate plasma glucose level *in vivo* via increasing glucose excretion through urination.

Results of *in vitro* 14C-α-methyl-D-glucopyranoside (14C-AMG) uptake assay demonstrated ethanolic extract of *Fructus Schisandrae chinensis* (FSC, 五味子) and the compound paeonol showed significant inhibitory effects on both SGLT1/2. *In vivo* study using the Zucker Diabetic Fatty (ZDF) rats on paeonol showed no significant effect both on attenuating the plasma glucose and increasing glucose excretion through urination. Bioassay-guided fractionation was used to isolate active fractions from the ethanolic extract of FSC. *In vitro* study on one of the fractions (F8) of the ethanolic extract of FSC showed potential inhibitory effect on SGLT 2.

Mr. LAI Chun-Kit

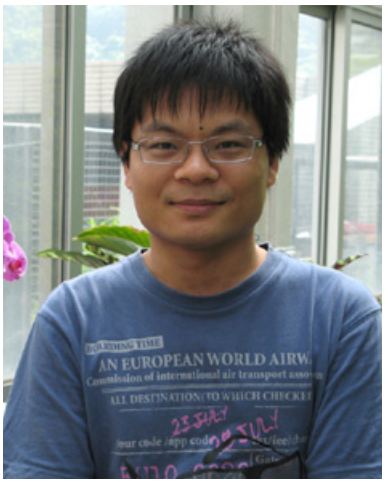
Supervisor: Prof. LAU Ka-Sing
Department of Mathematics
The Chinese University of Hong Kong

Mr. LAI Chun-Kit graduated from the CUHK in 2007, and he recently completed his Ph.D. programme in mathematics, also at the CUHK, under the supervision of Prof. LAU Ka-Sing. His research interests are Fourier and harmonic analysis, fractal geometry, and tiling theory.

When Fourier Meets Fractals

LAI Chun-Kit

The ingenious idea of Fourier asserted that any generic functions on the interval [0; 1] can be represented by the superposition of trigonometric functions $\{e^{2\pi i n x} : n \in Z\}$, known as the Fourier series. It is also known that perturbations of the set Z will produce Fourier frames which can still be used to expand the functions. In recent years, it was found that a certain kind of fractals also admits such kind of Fourier expansions for the functions living on it. In this talk, we will review and explore the kind of sets (or more generally measures) in which we can do Fourier analysis. This research also has a surprising delicate relationship with translational tiling.



Mr. GAO Caiji

Supervisor: Prof. JIANG Liwen
School of Life Sciences
The Chinese University of Hong Kong

Mr. GAO Caiji is currently a fourth year Ph.D. student in the School of Life Sciences, CUHK. Under the supervision of Prof. JIANG Liwen, he is conducting research on the trafficking and sorting mechanisms of *Arabidopsis* endomembrane protein 12 (EMP12) as well as the molecular function of a novel *Arabidopsis* FYVE-domain containing protein in plant vacuolar transport. After graduation, he plans to continue his current research as a postdoctoral fellow.

The Golgi-Localized *Arabidopsis* Endomembrane Protein12 Contains Both Endoplasmic Reticulum Export and Golgi Retention Signals at Its C Terminus

Caiji Gao* and Liwen Jiang

Endomembrane Proteins (EMPs), belonging to the evolutionarily conserved transmembrane nine superfamily in yeast and mammalian cells, are characterized by the presence of a large lumenal N-terminus, nine transmembrane domains (TMD) and a short cytoplasmic tail (CT). The *Arabidopsis* genome contains 12 EMP members (*EMP1 to EMP12*), but little is known about their protein subcellular localization and function. Here, we studied the subcellular localization and targeting mechanism of EMP12 in *Arabidopsis* and demonstrated that 1) both endogenous EMP12 (detected by EMP12 antibodies) and green fluorescent protein (GFP)-EMP12 fusion localized to the Golgi apparatus in transgenic *Arabidopsis* plants; 2) GFP fusion at the C-terminus of EMP12 caused mis-localization of EMP12-GFP to reach post-Golgi compartments and vacuoles for degradation in Arabidopsis cells; 3) the EMP12 CT contained dual sorting signals, i.e., an ER export motif and a Golgi retention signal that interacted with COPII and COPI subunits, respectively; and 4) the Golgi-retention motif of EMP12 retained several post-Golgi membrane proteins within the Golgi apparatus in gain-of-function analysis. These sorting signals are highly conserved in all plant EMP isoforms, and thus likely represent a general mechanism for EMP targeting in plant cells.

This article is a *Plant Cell* Advance Online Publication. The date of its first appearance online is the official date of publication. The article has been edited and the authors have corrected proofs, but minor changes could be made before the final version is published. Posting this version online reduces the time to publication by several weeks.

The Golgi-Localized *Arabidopsis* Endomembrane Protein12 Contains Both Endoplasmic Reticulum Export and Golgi Retention Signals at Its C Terminus

Caiji Gao, Christine K.Y. Yu, Song Qu, Melody Wan Yan San, Kwun Yee Li, Sze Wan Lo, and Liwen Jiang

School of Life Sciences, Centre for Cell and Developmental Biology, The Chinese University of Hong Kong, Shatin, New Territories, Hong Kong, China

Endomembrane proteins (EMPs), belonging to the evolutionarily conserved transmembrane nine superfamily in yeast and mammalian cells, are characterized by the presence of a large lumenal N terminus, nine transmembrane domains, and a short cytoplasmic tail. The *Arabidopsis thaliana* genome contains 12 EMP members (EMP1 to EMP12), but little is known about their protein subcellular localization and function. Here, we studied the subcellular localization and targeting mechanism of EMP12 in *Arabidopsis* and demonstrated that (1) both endogenous EMP12 (detected by EMP12 antibodies) and green fluorescent protein (GFP)-EMP12 fusion localized to the Golgi apparatus in transgenic *Arabidopsis* plants; (2) GFP fusion at the C terminus of EMP12 caused mislocalization of EMP12-GFP to reach post-Golgi compartments and vacuoles for degradation in *Arabidopsis* cells; (3) the EMP12 cytoplasmic tail contained dual sorting signals (i.e., an endoplasmic reticulum export motif and a Golgi retention signal that interacted with COPII and COPI subunits, respectively); and (4) the Golgi retention motif of EMP12 retained several post-Golgi membrane proteins within the Golgi apparatus in gain-of-function analysis. These sorting signals are highly conserved in all plant EMP isoforms and, thus, likely represent a general mechanism for EMP targeting in plant cells.

INTRODUCTION

In the endomembrane system of eukaryotic cells, secretory proteins start their journey from the endoplasmic reticulum (ER) prior to reaching the Golgi apparatus for further sorting to post-Golgi compartments, such as the trans-Golgi network (TGN) and prevacuolar compartment (PVC) (Bankaitis et al., 1994). Protein traffic between the ER and Golgi apparatus is mediated by two distinct coated vesicles (i.e., coat protein complex II [COPII] and COPI), which mediate anterograde and retrograde transport, respectively (Cosson and Letourneur, 1997; Kuehn et al., 1998; Rabouille and Klumperman, 2005; Donohoe et al., 2007). Integral membrane proteins that traffic between the ER and Golgi usually contain specific sorting signals that are essential for selective package into COPII vesicles for ER export or into COPI vesicles for ER retrieval and Golgi retention (Barlowe, 2003; Beck et al., 2009).

In mammals and yeast, various ER export signals have been identified, including the diacidic motif (DXE) of vesicular stomatitis virus glycoprotein, the dihydrophobic (LL) motif of ERGIC-53, and the diaromatic motif (FF, YY) of 46-kD Endomembrane Protein Precursor (Emp46p) (Nishimura and Balch, 1997; Nufer et al., 2002; Sato and Nakano, 2002). All of these typical ER export signals are found to reside on the cytosolic regions of transmembrane proteins that interact with COPII vesicles (Barlowe, 2003). Similarly, the dilysine motif, KKXX, is one of the best known sorting signals required for retrograde Golgi-to-ER transport of several type I membrane proteins that interact with COPI vesicles (Cosson and Letourneur, 1994; Schröder et al., 1995; Harter and Wieland, 1998; Gomez et al., 2000). Recently, the semiconserved Phe-Leu-Ser-like motifs were identified as Golgi retention signals in the cytoplasmic tails (CTs) of glycosyltransferases, a group of Golgi-resident integral membrane proteins in yeast (Tu et al., 2008). These motifs were shown to interact with COPI vesicles via Vps74p to maintain the steady state Golgi localization of the glycosyltransferases, thus providing the best known molecular mechanism of Golgi retention of membrane proteins in eukaryotic cells (Tu et al., 2008).

Several studies have been performed to analyze the targeting mechanisms of integral membrane proteins in plant cells. The transmembrane domain (TMD) and CT of binding protein 80 kD (BP-80), a type I integral membrane protein belonging to the vacuolar sorting receptor (VSR) family of proteins (Paris et al., 1997; Li et al., 2002), were shown to be essential and sufficient for its correct targeting to the PVC, which has been identified as a multivesicular body (MVB) in plant cells (Jiang and Rogers, 1998; Tse et al., 2004, 2006; Robinson et al., 2008). In addition, the length of the TMD may affect the subcellular localization of an integral membrane protein, as green fluorescent protein (GFP) fusions with different TMD sequences of 17, 20, or 23 amino acids in length showed distinct subcellular localization to the ER, Golgi, and plasma membrane (PM), respectively (Brandizzi et al., 2002). Similarly, the TMD length and cytosolic

* Address correspondence to jiangl@cuhk.edu.hk.
The author responsible for distribution of materials integral to the findings presented in this article in accordance with the policy described in the Instructions for Authors (www.plantcell.org) is: Liwen Jiang (jiangl@cuhk.edu.hk).
Some figures in this article are displayed in color online but in black and white in the print edition.
Online version contains Web-only data.
www.plantcell.org/cgi/doi/10.1105/tpc.112.096057

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These results have been published online in Plant Cell (IF = 9.7).

Ms. LEUNG Chui-Fan

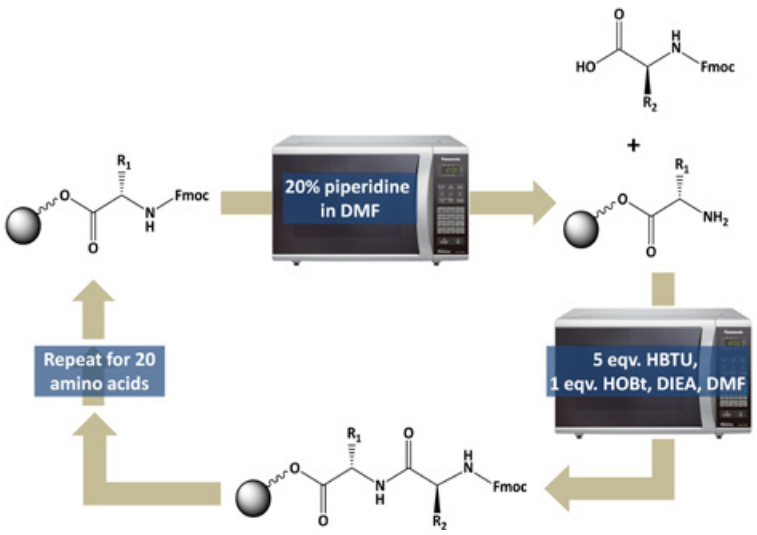
Supervisor: Prof. XIA Jiang
Department of Chemistry
The Chinese University of Hong Kong

Ms. LEUNG Chui-Fan is currently a final-year chemistry undergraduate student. She, together with three other students, worked on a final-year group research project for the exploration and construction of efficient protocols of utilizing inexpensive domestic microwave oven for solid peptide synthesis, under the supervision of Prof. XIA Jiang.

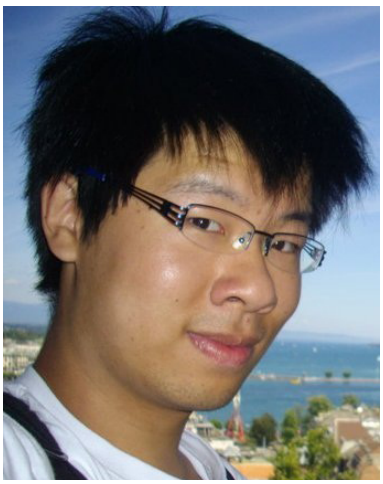
Microwave-assisted Solid-phase Peptide Synthesis of Antimicrobial Defensin

Leung Chui Fan*, Kwok Ka Ngai, Lee Yin Lam, Cheng Fung Yee, Zhang Han, and Xia Jiang

Antimicrobial defensin, which has a 20 amino acid sequence KNKEHLLSGRCRDDFRCWCT, was successfully synthesized by Fmoc based solid-phase peptide synthesis (SPPS), with reaction conditions optimized and generalized in a domestic microwave oven at constant power level. The entire synthesis was completed in one day. SPPS was also performed with the laboratory batch microwave reactor and the standard conventional method at room temperature respectively to justify the microwave-assisted efficiency. The power level used in the domestic microwave oven was confirmed with the laboratory batch microwave reactor. The identity and purity of the peptide chains synthesized from different methods were characterized by mass spectra and HPLC, and their percentage yields were measured. Flexibility of scaling up of microwave-assisted SPPS was also tested and surprisingly unfolded the reaction time was reduced with increased amount of resin, overruling the common belief that the radiation time is proportional to the heated volume. Syntheses at lower power level and at elevated temperature in water bath were also conducted, but they failed to show substantial efficiency, revealing the existence of the non-thermal effect of microwave.



The coupling-wash-deprotection-wash procedure under microwave radiation



Mr. LEUNG Shing-Chau

Supervisor: Prof. LAW Chi-Kwong
Department of Physics
The Chinese University of Hong Kong

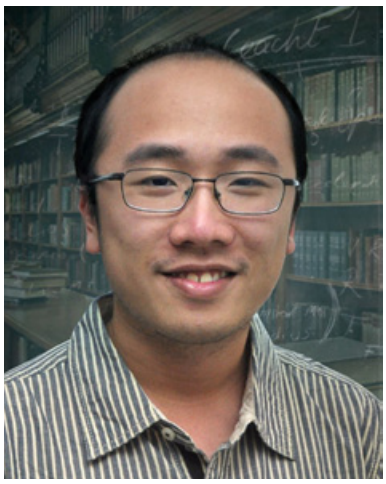
Mr. LEUNG Shing-Chau has just completed his undergraduate programme in physics in May 2012. Starting in August, he will be an M.Phil. student in the Physics Department under the supervision of Prof. CHU Ming-Chung. Mr. Leung is interested in quantum physics and particle physics. Last year, he was selected by the Physics Department to go to CERN as a summer exchange student. His project at CERN was to construct Cathode Strip Chambers for the End-cap Muon system, which will be installed during the coming LHC luminosity upgrade. Mr. Leung is also interested in theoretical physics, and his final year project was supervised by Prof. LAW Chi-Kwong.

Rabi Oscillation and State Construction in a Gravity Quantum System

LEUNG Shing-Chau

The quantum bouncing ball system is one of the recent experiments addressing the quantum behaviour of a neutral particle interacting with gravity. Such a system is constructed by passing ultra-cold neutrons through an oscillation platform, on which the neutrons interact with the earth's gravitational potential and an oscillating reflective ground surface. In this project, we investigate how the oscillating surface induces Rabi oscillations between different excited states of the system. In addition, we present a method to generate general quantum superposition states by controlling the oscillations of the ground boundary.

Mr. LEE Yin-Tat



Supervisor: Prof. Robert S. STRICHARTZ
Department of Mathematics
Cornell University

Mr. LEE Yin-Tat is interested in partial differential equations (PDE) and their applications. He conducted research at Cornell University and University of Pennsylvania. He has diverse research interests and has made some progress on PDE on fractals, image segmentation and computational geometry. Beginning in September 2012, he will pursue his doctorate degree at the Massachusetts Institute of Technology.

Wave Equation on Fractals

LEE Yin-Tat

The finite difference method for the wave equation on p.c.f. fractals suggests that the propagation speed of the wave equation may be infinite. We prove this is indeed true if the heat kernel satisfies a sub-Gaussian lower bound. Furthermore, we provide a sub-Gaussian upper bound for the wave kernel given the heat kernel sub-Gaussian upper bound.

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