

RESEARCH PROJECTS

The Integral and Modular Properties of C-algebras

✉ SHUM Kar Ping • LEUNG Chi Wai (Dept of Mathematics)

☐ 1 November 2003

❖ Research Grants Council (Earmarked Grants)

The theory of groups is to describe the symmetry properties of structures. However there are many neat and regular structures that can not be described by groups, for example, the character structure and the conjugacy class structures of finite groups; the distance structures in coding theory and the Schur algebras etc.

Schur first considered Schur rings which are used to describe some regular structures generated by finite groups. Higman in 1950 described the conjugacy class structure. Since 1990, Arad, Blau, Fisman, Muzuchuk, G.Y. Guo and others have concentrated on C-algebras and Table algebras. Fruitful results have been obtained in these new setting.

The PI and his collaborators X.Y. Guo and W.B. Guo have studied the normalities of subgroups of finite groups and described the structure of groups in terms of normal series. And the research of the

co-investigator is C*-algebra. In this project, we will develop our results obtained in finite groups to table algebras by using Fourier transformations for discrete objects. Also we are going to investigate these objects how to relate the theories of C*-algebras.

(CU03023)

Please refer to previous issues of this publication for more details of the following ongoing research at the department:

Edition	Title/Investigators
2001-02	Representations and Structures of Regular Semigroups, Regular Rings and Related Topics (PS01260) ✉ SHUM Kar Ping
2002-03	Formation Theory of Finite Groups and Algebras (CU02031) ✉ SHUM Kar Ping

RESEARCH PROJECTS

Characterization of Sumoylation and Desumoylation Pathways in Ovary

✉ AU Wing Ngor Shannon • CHAN Wood Yee
(Dept of Anatomy) • NGAI Sai Ming (Dept of
Biology)

□ 1 October 2003

❖ CUHK Research Committee Funding (Direct
Grants)

Sumoylation has emerged as an important new protein post-translational modification that can mediate physiological and pathological responses in humans. Its biological roles are diverse, including modulation of transcriptional activity, protein stability, protein-protein interaction and nuclear transport. Sumoylation is a dynamic and reversible process; conjugation of SUMO to target substrates is catalyzed by a cascade of SUMO E1, E2 and E3 ligases, whereas deconjugation from its precursor protein and from its conjugated substrate is catalyzed by SUMO specific proteases. However, the underlying structural basis and physiological significance of sumoylation and desumoylation is not understood.

Recently, SUMO E3 ligases have been found to affect androgen-mediated gene activation and thus androgen signaling in prostate cancer cells.

Taken together with the fact that a number of SUMO-conjugated substrates, such as p53, Mdm2, c-jun and Smad4 etc., are well recognized to be involved in carcinogenesis, we believe that sumoylation is essential in the development of carcinogenesis.

This project aims to apply functional proteomic approach to identify specific target substrates in ovarian and ovarian cancer cells, and to characterize the expression pattern of ligases and proteases in ovarian cancer cell cultures. Knowledge gained from the proposed research will not only generate a sumoylated substrate database for ovary and give insights into the physiological significances of sumoylation, but also provide us with critical leads to discover an alternative pathological pathway in carcinogenesis.

(BL03832)

Genetic and Proteomic Studies of Chaperone-mediated Suppression of Polyglutamine Toxicity in Drosophila

✉ CHAN Ho Yin Edwin • LILLEY Kathryn S.* •
RAZZAQ*

□ 31 December 2003

❖ Research Grants Council (Earmarked Grants)

To date, at least nine human degenerative brain diseases are caused by the CAG trinucleotide repeat expansion mechanism. The expanded CAG repeats typically translate into polyglutamine chains and confer toxic gain-of-function properties on the disease protein. Expression of the expanded polyglutamine protein leads to neural dysfunction, degeneration, and eventually neuronal cell death in distinct brain regions. One common feature of polyglutamine disease is the formation of heterogeneous insoluble macroscopic protein aggregates that typically reside in the nucleus of degenerating neurons. Although the chemical nature and functional roles of these aggregates or nuclear inclusions (NIs) remain largely unknown, polyglutamine disease proteins appear to be one major constituent. Molecular chaperones,

components of the cell's protein folding machinery, are also recruited to NIs indicating protein misfolding in disease. Polyglutamine disease has faithfully been modeled in the fruit fly *Drosophila*. With the use of the fly disease models, genetic and chemical suppressors of polyglutamine disease have been identified. *In vivo* overexpression of one class of genetic suppressor, the molecular chaperones, results in mitigation of neural degeneration. Using genetic and proteomic approaches, we sought to investigate the molecular mechanisms of chaperone-mediated suppression of polyglutamine-induced degeneration in *Drosophila*. This study will also benefit studies of other devastating protein aggregation diseases including Parkinson's and Alzheimer's diseases.

(CU03314)

To Establish a *Drosophila* Model for Traditional Chinese Medicine Testing

✉ CHAN Ho Yin Edwin • LIANG Songming (School of Chinese Medicine) • CHEN Shuying (School of Chinese Medicine) • CHAN Kam Leung (School of Chinese Medicine)

☐ 1 January 2004

❖ CUHK Research Committee Funding (Direct Grants)

Although *in vitro* cell culture models allow high-throughput screening of drugs, they may not always fully recapitulate pathogenic conditions modeled. In addition, drugs that show promising pharmacological effects *in vitro* may not be efficacious *in vivo*. On the contrary, *in vivo* disease models, such as mouse and rat, would offer a more accurate pathophysiological environment for drug testing. However expensive and lengthy testing procedures usually limit the throughput of the screen. An intermediate *in vivo* model that bridges the *in*

vitro and existing *in vivo* models would smoothen the transferal of *in vitro* experimental results, and avoid premature commitment to the use of expensive and labour-intensive *in vivo* models for screens. The fruit fly, *Drosophila melanogaster*, would be one of such bridging models. Large numbers of human disease genes are found in the *Drosophila* genome, and numerous genetic, physiological and biochemical assays are available. Because of its relatively short lifespan, *Drosophila* has successfully been used to study various anti-ageing Traditional Chinese Medicines (TCMs). Taken together, *Drosophila* would serve as a suitable model for TCM drug screening. To validate this approach, a proof-of-principal project is proposed. Malfunctioning of the insulin-regulated glucose homeostasis causes elevation of plasma glucose levels, and results in diabetic conditions. It has been shown that the insulin pathways are evolutionarily conserved between humans and *Drosophila*, and depletion of insulin in flies causes diabetic-like symptoms. The effect of a well-known anti-diabetic TCM will be used as a reference to test the efficacy of *Drosophila* as a TCM drug screening model.

(BL03977)

Antioxidant Activity of Green Tea Catechin Metabolites

✉ CHEN Zhenyu

☐ 1 November 2003

❖ CUHK Research Committee Funding (Direct Grants)

The proposed project is to study the antioxidant activity of metabolites of green tea catechins (GTCs). Tea leaf contains four major GTCs namely (1)-epicatechin (EC), (2)-epicatechin gallate (ECG), (3)-epigallocatechin (EGC) and (4)-epigallocatechin

gallate (EGCG). Plasma and urine analysis in rats found that after administration, GTCs are mainly present as their **metabolites**, including methylated, glucuronidated and sulfoglucuronidated forms. GTCs have demonstrated to be anticarcinogenic, hypolipidemic, antioxidative and vasorelative. However, no studies to date have addressed the biological activity of GTC's **metabolites**. The specific objectives of the proposed study will: (1) isolate and purify the various metabolites of tea catechins from the urine and serum of rats orally administered with the tea drink, and (2) using human low-density lipoprotein(LDL) and DPPH stable free radical as models, investigate the potency of GTCs' metabolites compared with their corresponding precursors.

(BL03434)

Molecular and Functional Studies of Antiquitin in Fish

✉ FONG Wing Ping • CHENG Hon Ki
Christopher (Biochemistry)

□ 1 October 2003

❖ Research Grants Council (Earmarked Grants)

The word "antiquitin" was coined in 1994 for a protein which shows remarkable conservation throughout evolution. This protein is believed to be involved in osmotic balance and the regulation of cellular turgor. Antiquitin shows ~30% homology with some aldehyde dehydrogenases, suggesting that it may play a catalytic role in certain adaptive metabolic pathways related to osmotic stress. Unfortunately, all previous studies by other groups on antiquitin have been confined to the nucleotide level, and the protein has never been expressed nor purified to enable a direct functional assay of the protein. In 2002, we successfully isolated antiquitin and

demonstrated for the first time that the protein possesses acetaldehyde-oxidizing activity. Nevertheless, the low catalytic efficiency suggests that acetaldehyde may not be the physiological substrate of this enzyme. In the proposed study, we intend to extend our previous study and to search for the physiological substrate(s) of antiquitin. Aldehydes involved in the synthesis of osmoprotectants and aldehydes known to be generated during osmotic stress will be tested as substrates for antiquitin under *in vitro* conditions. Molecular cloning studies will be carried out to obtain the full-length sequence of antiquitin and to pave the way for studies on the structure-function relationship of the enzyme by site-directed mutagenesis. Using fish as an animal model, the effect of osmolarity and aldehyde-generating xenobiotics on the induction of antiquitin will be examined by Northern blot, RT-PCR, Western blot and enzyme activity assay. These studies will be important in revealing the physiological functions of antiquitin.

(CU03305)

Food Consumption Survey of the People of Hong Kong

✉ GULDAN Georgia Sue • SHUM Kwok Cheung
(Hong Kong Institute of Asia-Pacific Studies) •
AU YEUNG Kit Mei • HO CHAN Suzanne
(Dept of Community and Family Medicine)

□ 11 March 2004

❖ Food and Environmental Hygiene Dept, HKSAR
Government

This is a project to conduct the first population-based food consumption survey of adults in Hong Kong. The goal of the survey is to investigate the food consumption of 5,200 Hong Kong adults aged 20-84

years. The survey objectives are to (1) obtain up-to-date food consumption information (for example, the types and amounts of food consumed) by individual adults in Hong Kong; (2) collect height and weight measurements of the surveyed individuals; (3) identify common dishes consumed by individuals in Hong Kong; and develop a recipe database for the common dishes identified. The recipe database created during this Survey period will be a collection of representative or 'standard' recipes of the adult population grouped according to suitable categories that can be used in food consumption surveys and for risk assessment analyses. The survey will be conducted in collaboration with the HKSAR Food and Environmental Hygiene Department. Data collection will be performed over a year-long period to understand seasonal consumption patterns of the surveyed adults.

(MD03882)

Effects of Herbal Agrimonia on Hepatocarcinogenesis in Rats

✉ HO Wing Shing John

☐ 1 December 2003

❖ CUHK Research Committee Funding (Direct Grants)

Herbal Agrimony (HA), a medicinal herb, was found to display effects on the liver cells in the preliminary study. However, the active components and the biologic action of HA on liver tumor remain sketchy. An attempt will be made to identify the active fractions from the extracts of HA.

The effects of HA on hepatocarcinogenesis will be investigated in the *in vivo* models using S.D and fFischer rats. Hepatocarcinogenesis is initiated by diethylnitrosamine (DEN) and further promoted by carbon tetrachloride (CCl₄) in rats according to

established procedure. At the end of treatment, rats will be sacrificed. Pathological changes in the rat liver are to be evaluated by Hematoxylin and Eosin (H & E) staining of the liver sections and analysis of GST-P positive foci. The enzyme activities of cyclooxygenase-2 (COX-2), CYP2E1 and GST will be measured. The mRNA expression of GST-P and COX-2 genes will be analyzed by RT-PCR.

The study will provide information on the biologic actions of HA and its therapeutic benefits on liver tumor. The work will lead to the identification of the active fractions from the HA extract. More investigations are needed to characterize the active principles from the HA extract.

(BL03980)

Selection of Aptamer against Apoptotic Protein Cytochrome c

✉ KONG Siu Kai

☐ 1 December 2003

❖ CUHK Research Committee Funding (Direct Grants)

Aptamers are single-stranded DNA or RNA. With the A, T or U, C and G interactions, the chain folds into a specific 3D shape which allows it to bind tightly against its target molecule, analogous to an antibody-antigen interaction.

Aptamers are isolated from a pool of nucleotides with targets. In the selection process, a large pool of oligonucleotides, with ~40 random nucleotides in the core flanked with a known sequence at the 5' and 3' ends, is exposed to target molecules. Oligonucleotides that bind weakly are washed away. Those that remain bound to the target are amplified using PCR. After several rounds of selection, the core sequence of a selected aptamer will be sequenced and it can be produced in a large scale

using standard chemical and cloning techniques. In addition to high specificity, aptamers have very high affinities (pM to nM range) to their targets. Aptamers are chemically stable and are amenable for specific applications. For example, fluorescence resonance energy transfer can be used in aptamers to show binding signals. In the past decade, aptamers have been selected for different proteins, peptides, and many small molecules such as ATP.

In our project, we will use this technology to isolate aptamer for cytochrome *c*. Cytochrome *c* is a key regulator of apoptosis. After releasing from mitochondria, it triggers the final execution phase of apoptosis. With an aid of the aptamer technology, high throughput assay can be developed using cytochrome *c*-specific aptamer to screen apoptogenic and anti-cancer agents.

(BL03806)

Functional Characterization of a Novel Peroxisome Proliferator-activated Receptor Regulating Gene, SIP-1 - Identification of a Functional Peroxisome Proliferator Response Element, Subcellular Localization, and Its Role in Lipid Metabolism

✉ LEE Sau Tuen Susanna • CHEUNG Wing Tai
(Biochemistry)

☐ 1 December 2003

❖ Research Grants Council (Earmarked Grants)

The peroxisome proliferator-activated receptor alpha (PPAR α), a nuclear hormone receptor and a ligand-dependent transcriptional factor, has been known to play a key role in lipid metabolism. Sustained activation of PPAR by lipid-like chemicals, such as Wy-14,643, results in liver cancer. It is known that PPAR mediates its action via modulations of gene expressions. PPAR regulates its target

genes by forming heterodimer with retinoid X receptor and binds to a DNA consensus sequence named as the peroxisome proliferator response element (PPRE) on its target genes. Many PPAR target genes have been identified, however the whole spectrum of PPAR regulating genes involved in maintaining lipid homeostasis during energy deprivation, and peroxisome proliferator chemicals-induced liver cancer is still not fully known. In one of our previously funded RGC projects aiming to isolate novel PPAR target genes involved in lipid metabolism during energy deprivation, we identified a novel and putative PPAR regulating target gene, which we designated as Starvation-Induced Protein-1 (SIP-1). The function of SIP-1 is not known, but we for the first time, demonstrated that SIP-1 was dramatically up-regulated in livers of wild-type mice during 72-hr fasting or during 2-week Wy-14,643 treatment. PPAR was required for the transcriptional up-regulation of SIP, and preliminary evidence indicated that SIP-1 contains putative PPREs on its promoter. In this proposed research, we would like to extend our findings by: (1) characterizing the regulatory elements of SIP-1; (2) identifying the functional PPRE of SIP-1; (3) examining its subcellular localization; and (4) investigating its possible role in lipid metabolism.

(CU03328)

In vitro Studies on the Growth-inhibitory and Differentiation-inducing Activities of Glycyrrhizin and Its Major Metabolite on Neuroblastoma Cells

✉ LEUNG Kwok Nam

☐ 1 December 2003

❖ CUHK Research Committee Funding (Direct Grants)

Licorice, the root of *Glycyrrhiza* spp., has been used since ancient Egyptian, Greek, and Roman times in the West and since the Han dynasty in ancient China in the East. Traditionally licorice has long been used as a food and for medicinal purposes in the treatment of hepatitis, hepatocellular carcinoma, melanoma, inflammatory diseases, gastric ulcer and several viral diseases. Much of the sweetness of licorice is due to glycyrrhizin (GL), a water soluble triterpenoid saponin glycoside that occurs in the root. Research in the last two decades has shown that licorice exhibits diverse biological and pharmacological activities, including immuno-modulatory, anti-inflammatory, anti-viral, anti-carcinogenic, anti-allergic, anti-estrogenic, hepatoprotective, and anti-ulcer activities. Many of these pharmacological activities have been attributed to the major constituent GL and to its metabolized aglycone form, 18-glycyrrhetic acid (18 β -GA). Previous studies in our laboratory showed that both GL and 18 β -GA exhibited anti-leukemic activities by inducing the differentiation and apoptosis in myeloid leukemia cells, but whether they can induce differentiation in other types of tumors have not been elucidated. The aim of this study is to examine the neuropharmacological activities of GL and GA from licorice. We will focus our work on: (1) the anti-proliferative actions of GL and 18 β -G on neuroblastoma cells, and (2) the ability of GL and 18 β -GA to induce neuronal cell differentiation. It is hoped that the above findings could provide better insights into the direct anti-tumor effects of glycyrrhizin and 18 β -glycyrrhetic acid on neuroblastoma cells *in vitro*.

(BL03804)

Advances in Protein Sciences

✉ SHAW Pang Chui • WONG Kam Bo • TSUI Kwok Wing (Biochemistry) • WAYE Mary Miu Yee (Biochemistry) • LAM V M S* • ZHU G* • WONG Ngok Shun Ricky*

☐ 1 July 2003

❖ The Croucher Advanced Study Institute

Tremendous resources have been put towards different genome sequencing which aim at discovering the molecular basis of phenotypic expression of human and model organisms across the spectrum of life. As these genome projects accumulate a wealth of sequence data, the next wave of research is to study the structure and function of selected proteins, for understanding their roles in the biochemical processes and for rational design to alter a biochemical pathway or even an organism.

In order to strengthen our achievements in protein research and to update participants and postgraduate students on the latest development of protein sciences, we have planned to hold a 5-day meeting in “Advances in Protein Sciences”. Several internationally renowned researchers have been invited as the Croucher Foundation Advanced Study Institute Lecturers to share with us their insights and experience. The speakers will cover major fields in protein sciences, which include protein structure study by X-ray crystallography and nuclear magnetic resonance, protein bioinformatics, protein function analysis, viral and bacterial proteins for diseases. Concurrent hands-on workshops in protein bioinformatics and protein expression and purification have also been planned.

(BL03579)

Authentication and Quality Assessment of Chinese Medicinal Materials by DNA and Chemical Technologies

- ✉ SHAW Pang Chui • BUT Pui Hay Paul (Dept of Biology)
- 1 December 2003
 - ❖ Hong Kong Jockey Club Institute of Chinese Medicine Limited

Quality assurance of TCM products stems from genuine materials authenticated with unique and characteristic molecular and chemical profiles and markers. In order to provide high quality TCM products to compete for the international market and to avoid misuse of herbal materials, it is essential for Hong Kong to establish data and means for accurate quality assurance. We have extensive expertise and experience in the authentication and quality control of Chinese medicine. We propose to develop a combined DNA and chemical strategy for authentication and quality control. This strategy employs DNA sequences together with chemical profiles or markers, to serve as the basis for the development of protocols for fast identification and quality control. To establish the methodology and reference data, we shall start with a number of commonly used or toxic materials. For each medicinal material, commonly found related substitutes would also be tested, as they may have similar but not identical markers. The total number of medicinal materials involved will be 101 and 3-4 samples from different sources will be obtained for each material. The data will aid the authentication of raw materials and medicinal materials at various stages of manufacturing. The markers generated may also be used or further developed for quality control.

(BL03409)

Interaction of Trichosanthin with α -2 Macroglobulin Receptor

- ✉ SHAW Pang Chui
- 1 January 2004
 - ❖ CUHK Research Committee Funding (Direct Grants)

We have previously found that trichosanthin (TCS), a Chinese medicinal protein with multiple pharmacological properties, binds specifically to 2-macroglobulin receptor (α 2MR). This receptor is a member of the low density lipoprotein receptor family. The binding explains the pharmacological properties and side effects of TCS, as cells susceptible to TCS contain α 2MR.

To provide an in-depth understanding on the interaction between TCS and α 2MR, we propose to generate TCS variants with surface lysine or arginine residues converted to alanine. The binding affinity between TCS variants and purified α 2MR will be studied. The *in vitro* protein inhibitory activity, nephrotoxicity and cell entry ability of TCS variants that have altered binding affinity with α 2MR will be assayed to ensure that the change in affinity has not perturbed its *in vitro* biological activity.

The proposed work will help us understand how TCS interacts with α 2MR, the first step for carrying out the function of TCS. TCS variants with decreased affinity to α 2MR are potentially useful for generating immunotoxins, as cells with α 2MR are less susceptible to these variants. The results will further enhance the value of TCS, a value of TCS, a well-known Chinese medicinal protein, and the work will contribute to the modernization of Chinese medicine.

(BL03839)

Geng-Shu Capsule as a Safer and More Natural Alternative for Patients of Menopausal Symptoms

✍ WANG Jun • LEUNG Lai Kwok (Biochemistry)

• SUN Quanzhong*

☐ 2 July 2003

❖ Hong Kong Jockey Club Institute of Chinese Medicine Limited

Among the over 400 million postmenopausal women worldwide, 85% of them experience menopausal symptoms of various degree and 25% of them are serious patients of the disease and require medical attention. The main street therapy for these patients is ERT (Estrogen Replacement Therapy), as the symptoms are generally believed to be the consequence of estrogen diminishment in the postmenopausal women. The other major sector of ERT market, which reaches US\$3.2 billions last year and is projected to climb to US\$6.4 billions in 10 years, is as “fashion pharmaceutical”. However, the extensive application of ERT in the last 20 years brings increasing concerns of its side effects, which include higher incidence of breast and ovary cancer, CHD and cholecystitis. This provides a golden opportunity for a TCM alternative to ERT, as TCM is particularly suitable for the treatment of sub-health conditions or chronic illness. We have recently compiled a new TCM recipe Geng-Shu Capsule in response to the urgent need for a better medicine for the disease. The new drug, which is expected of free from the side effects of ERT, will be manufactured using modern pharmaceutical technology, subjected to strict measures of quality control and formulated as user-friendly product to benefit the patients and realize its potential huge commercial value.

(MD03699)

Structure-function of Ribosomal Protein P2 - Structure Determination of Human P2 by NMR Spectroscopy

✍ WONG Kam Bo • SHAW Pang Chui • SZE Kong Hung*

☐ 31 December 2003

❖ Research Grants Council (Earmarked Grants)

Human ribosomal protein P2 is a constituent of the P-complex that forms the stalk of eukaryotic ribosome, which involves in binding of translation factors and their activation by GTP-hydrolysis. To our knowledge, the structure of any acidic P proteins, including P2, is unknown. We propose to study the structure-function of P2 by determination of its high-resolution structure. Dynamics behaviour of P2 will be probed by ¹⁵N relaxation experiments. Interaction of P2 with other acidic P proteins will be studied by chemical shift perturbation experiments and other biochemical techniques. High-resolution structure of P2 obtained will complement recent structural studies of prokaryotic and archaeal ribosomes, and will contribute to a better understanding of structure-function of eukaryotic ribosome.

(CU03301)

Please refer to previous issues of this publication for more details of the following ongoing research at the department:

Edition	Title/Investigators
2001-02	Biochemical Characterization of Chaperone-Mediated Suppression of Polyglutamine Neurodegeneration: Identification of Proteins Required for Neurodegeneration Suppression (BL02445)

- ✎ CHAN Ho Yin Edwin • TUNG Kit Ching (Biochemistry) • BONINI Nancy M* 2002-03 Biochemical Characterization of Newly-identified UGT 1A8 in Rats (BL02543)
 ✎ HO Wing Shing John
- 2002-03 Biochemical Analysis of Dribble, a Single KH Domain-containing Protein (BL02693)
 ✎ CHAN Ho Yin Edwin • NGAI Sai Ming (Dept of Biology) 2000-01 Identification of Peroxisome Proliferator-activated Receptor-alpha (PPARalpha)-dependent Genes Involved in Hepatic Lipid Metabolism (CU00241)
 ✎ LEE Sau Tuen Susanna
- 2000-01 Hypolipidemic and Antioxidant Activity of Theaflavins and Thearubigins from Oolong and Black Tea (CU00237)
 ✎ CHEN Zhenyu • HUANG Yu (Dept of Physiology) 2001-02 Identification of Genes Involved in Carbon Tetrachloride-induced Liver Injury: A Model for Chemical Toxicity-mediated by Free Radicals (BL01135)
 ✎ LEE Sau Tuen Susanna
- 2002-03 Antioxidant and Vasorelaxative Properties of Green Tea Catechin Epimers (BL02638)
 ✎ CHEN Zhenyu • HUANG Yu (Dept of Physiology) • LEUNG Lai Kwok (Biochemistry) 2002-03 Functional Characterization of a Novel Peroxisome Proliferator-activated Receptor Regulating Gene, SIP-1 – Identification of a Functional Peroxisome Proliferator Response Element, Subcellular Localization, and Its Role in Lipid Metabolism (BL02732)
 ✎ LEE Sau Tuen Susanna
- 2001-02 Expression of His-Tag Plasmodium Falciparum Merizoite Surface Protein MSP1-42 in Baculovirus Using Silkworm as the Host (BL01994)
 ✎ HO Walter K. K. • HUI George* 2002-03 An Investigation on the Effects of 18 β -Glycyrrhetic Acid on the Proliferation, Differentiation and Apoptosis of Myeloid Leukemia Cells *In Vitro* (BL02967)
 ✎ LEUNG Kwok Nam
- 1998-99 Evaluation of Major Phytochemical Constituents in Radix Pseudostellariae and Glycyrrhizae in Detoxification and Anticancer Activity (BL98028)
 ✎ HO Wing Shing John • KWOK Tim Tak (Biochemistry) • LEE Hung Kay (Dept of Chemistry) 2001-02 Interaction of Ribosomal Proteins P0 and P1 with Trichosanthin (BL01145)
 ✎ SHAW Pang Chui • SZE Kong Hung* • WONG Kam Bo • ZHU Guang*

2001-02	An Infrastructure for Efficient Protein Expression, Purification and Structural Studies (BL02763) ✍ SHAW Pang Chui • WONG Kam Bo • WAYE Mary Miu Yee (Biochemistry) • TSUI Kwok Wing (Biochemistry) • LAM Sik Lok (Dept of Chemistry) • HUANG POON Wai Sin Dolly (Hong Kong Cancer Institute) • LO Kwok Wai (Dept of Anatomical & Cellular Pathology) • CHUI Yiu Loon (Clinical Immunology Unit)	2002-03	Optimization of Enzymes: Development of Novel Methodology for New Applications (BL02320) ✍ WANG Jun
2001-02	Interactions between Tumor Necrosis Factor-alpha and Beta-adrenergic Mechanism in Cultured Rat Astrocytes (BL01139) ✍ TSANG David Sau Cheuk • LEUNG Kwok Nam	2000-01	Structure-function of a Novel RNA-binding Motif-structure Determination of a Ribosomal Protein L30e from <i>Thermococcus Celer</i> by Multi-dimensional NMR Spectroscopy (CU00243) ✍ WONG Kam Bo
2001-02	Efficient, Economical and Environmentally-friendly Production of Key Intermediates of Major Antibiotics (BL01619) ✍ WANG Jun	2001-02	Structural Basis of Thermostability of a Protein from a Hyperthermophilic Archaea <i>Thermococcus Celer</i> - Protein Engineering and High Resolution Structure by Crystallography (BL01645) ✍ WONG Kam Bo
		2002-03	Structural Basis of Thermostability of Proteins - Protein Engineering of a Thermophilic Protein from a Hyperthermophilic Archaea <i>Thermococcus celer</i> (CU02254) ✍ WONG Kam Bo

RESEARCH PROJECTS

Provision of Services on Coral Monitoring in Hoi Ha Wan and Yan Chau Tong Marine Parks

✍ ANG Put Jr.

☐ 15 July 2003

❖ Agriculture, Fisheries & Conservation Dept,
HKSAR Government

Hoi Ha Wan and Yan Chau Tong Marine Parks are the first two marine parks established in Hong Kong. In order to assess the utility of the set up of these marine protected areas, periodic monitoring of changes in the biodiversity of these marine parks are necessary. This project will monitor changes in the coral diversity and the possible existence of other as yet undiscovered patches of coral communities within these two marine parks. The results will be compared with those collected in the previous years. A revised list of the number of coral species found within these marine parks will also be established.

(BL03747)

Provision of Services on Biological Monitoring in Sha Chau & Lung Kwu Chau Marine Park

✍ ANG Put Jr. • WONG Chong Kim • HUNG Samuel*

☐ 30 September 2003

❖ Agriculture, Fisheries & Conservation Dept,
HKSAR Government

The Sha Chau and Lung Kwu Chau Marine Park was established in November, 1996 primarily to protect the Indo-Pacific humpback dolphin *Sousa chinensis* (commonly known as the Chinese White Dolphin).

This project will monitor the activities of the Chinese White Dolphin with the aim of identifying the role of this marine park as a habitat for these animals. The activities of the dolphin to be monitored include feeding (chasing fish on water surface, following fishing boat); socializing (breaching, chasing and rubbing each other); traveling (moving in one direction); and milling/resting. Furthermore, the diversity and abundance of fish and benthos within the park will also be monitored. Data obtained from this monitoring programme will be compared with past data and usage of the marine park by the dolphins over the years will be assessed.

(BL03572)

Photosynthesis in Corals

✍ ANG Put Jr.

☐ 1 January 2004

❖ CUHK Research Committee Funding (Direct Grants)

Photosynthesis in Scleractinian corals of different growth forms belonging to different species found at different depths will be evaluated using a Pulse Amplitude Modulating System (PAMS). Irradiance at the time of measurement will also be taken. Seasonal differences will also be compared. This research aims at correlating the distribution pattern of corals with their photosynthetic abilities and thus will lend some additional information on the effect of environmental parameters on the survival and growth of corals in Hong Kong waters, especially in Tung Ping Chau Marine Park.

(BL03744)

Provision of Services of Underwater Photography of Coral Communities in Hong Kong Waters

✉ ANG Put Jr.

□ 1 February 2004

❖ Agriculture, Fisheries & Conservation Dept,
HKSAR Government

Eighty-four species of Scleractinian corals are currently recorded from Hong Kong waters. A reference guide for these corals is being prepared. This project will take the underwater photographs of these coral *in situ* so as to provide a pictorial guide to the shape and colour of these corals as they appear in the field. Close-up pictures of the detailed skeletal structure of the corals will also be taken.

(BL03357)

Non-digestible Carbohydrates as a Novel Functional Food Ingredient

✉ CHEUNG Chi Keung Peter

□ 1 January 2004

❖ CUHK Research Committee Funding (Direct Grants)

Fermentable non-digestible oligosaccharides (NDCs) such as dietary fiber and fructo-oligosaccharides (FOS) have been shown to be a functional food ingredient having beneficial physiological effect. Mushroom cell wall is constituted of substantial amount of NDC, which mainly include dietary fiber or non-starch polysaccharides. Preliminary results from our studies on the chemical and biological properties of mushroom DF have shown that mushroom sclerotium is rich in NDC and thus is a potential source of DF acting as a functional food ingredient. In this proposal, the preparation of novel mushroom DF and oligosaccharides from sclerotium by enzymatic hydrolysis will be investigated together with a comprehensive evaluation on their biochemical, structural and technological properties.

The potential use of these mushroom NDCs will be evaluated in light of these results.

(BL03351)

Mechanistic Studies of Apoptotic Cell Death Induced by Respiratory Syncytial Virus (RSV) in Human Lung Epithelium Cells

✉ CHIU Chi Ming Lawrence • OOI Vincent Eng Choon

□ 1 December 2003

❖ CUHK Research Committee Funding (Direct Grants)

Respiratory syncytial virus (RSV), a RNA virus that infects respiratory epithelium and causes substantial immunopathological alterations of the infected bronchi and alveoli, is an important pathogenic microbe which causes life-threatening acute bronchiolitis and serious pneumonia in infants and children. RSV infection also accounts for some common colds in adults. The recent outbreaks of common cold in elders and infants in Hong Kong have been identified being caused by this pathogenic virus.

Although previous studies have shown that RSV induces programmed cell death (or apoptosis) in the infected respiratory epithelium cells that may lead to their lethal morphological and molecular changes, the associated functional apoptotic gene expressions in the RSV-induced cytopathogenesis is still not clear. We therefore propose in this study, using state-of-the-art gene array technology, to have high throughput analyses of the effects of RSV infections on some known and well-characterized functional apoptotic gene expressions, including the members from TNF Ligand Family; TNF Receptor Family; Bcl-2 Family; Caspase Family; IAP Family; TRAF Family; CARD Family; Death Domain Family; Death

Effector Domain Family; CIDE Domain Family; and P53 and ATM Pathway, in the human lung and pharynx epithelial cells *in vitro*. Western-blot analyses will also be used to validate some of the results from the gene array studies. We anticipate that results from this study will allow a better understanding on the RSV-induced cytopathogenesis and its mechanistic pathways, which is fundamental but important for the future development of specific and efficacious antiviral strategies.

(BL03859)

Gene Expression During Ovarian Maturation in Penaeid Shrimp

✉ CHU Ka Hou • CHAN Siu Ming* • KWAN Hoi Shan

□ 1 November 2003

❖ Research Grants Council (Earmarked Grants)

Shrimp farming is an important aquaculture industry in many Asian countries. Yet the industry relies heavily on wild broodstock for the production of postlarvae because of failure of ovarian maturation in cultured stocks. Future development of this industry depends on novel broodstock maturation technology. Yet the molecular mechanism during ovarian maturation of shrimp is largely unknown. The proposed study aims to elucidate the molecular events in the process of ovarian maturation using RNA fingerprinting technology. Genes that are differentially expressed during ovarian maturation will be identified using differential display technique. The functions of the genes will be inferred by search for homology with known sequences in databases for the construction of a model of molecular events in this reproductive process. The molecular mechanisms of reproductive hormones and neurotransmitters in regulating maturation will also

be explored. The ultimate goal is to develop novel broodstock maturation technology for the shrimp farming industry.

(CU03323)

Population Genetics of Mitten Crabs in Eriocheir

✉ CHU Ka Hou

□ 1 January 2004

❖ CUHK Research Committee Funding (Direct Grants)

Mitten crabs in *Eriocheir sensu stricto* are important food species endemic to China, Korea and Japan. There are now three described species (*E. japonica*, *E. sinensis* and *E. hepuensis*) in this genus with the Chinese mitten crab *E. sinensis* being the most economically important species. Yet recent studies suggest that the phylogenetic relationship and species status of the three taxa are controversial. To elucidate their genetic relationship and taxonomic status are necessary for the management of fishery stocks as well as genetic improvement of aquaculture stocks. In this study, phylogenetic relationship of the three taxa will be elucidated by population aggregation analysis based on DNA sequence analysis of mitochondrial cytochrome *c* oxidase I and cytochrome *b* genes. The molecular population structure of the Chinese mitten crab will also be clarified based on analysis of microsatellite DNA.

(BL03941)

Reedbed System for Treating Urban Runoff

✉ CHU LM

□ 1 February 2004

❖ CUHK Research Committee Funding (Direct Grants)

Constructed wetlands have been a common option for wastewater treatment for small communities, particularly in temperate regions. They also provide ancillary benefits for wildlife conservation and public use. In Hong Kong, the new Wetland Park, which is the largest in the Territory, has a 8,000 m² twin-reedbed system which treats urban runoff from the Tin Shui Wai Development Area. A field sampling study will be conducted which focuses upon: () the treatment efficiency of the reedbed systems and () the nutrient/pollutant dynamics of the system. Such monitoring study is essential to performance assessment of the newly constructed reedbeds. Data on loading and removal rates for various important pollutants in the stormwater will be particularly useful for the early functioning of the system and could provide information for system modification to improve treatment efficiency.

(BL03617)

Evaluation of Modified Fish Diets on the Flavor Quality of an Aquaculture Fish

✉ CHUNG Hau Yin

□ 15 February 2004

❖ CUHK Research Committee Funding (Direct Grants)

In Hong Kong, the consumption and demand of seafood are very high. The local aquaculture sector plays an important part in maintaining and increasing the aquaculture supply for the local community. However, the flavor quality of the aquacultured products is generally not as high as that of the wild –typed counterparts. Currently, there is little investigation in the improvement of the flavor quality in these various aquacultured products. Therefore, this study aims to evaluate the different modified feeds on the flavor quality of an aquacultured fish by

modifying the feeds with materials known to contain natural flavoring components.

(BL03503)

Immunological and Molecular Mechanisms of Natural Resistance in *Microtus fortis* to *Schistosoma japonicum* Infection

✉ FUNG Ming Chiu • YI Xinyuan* • WU Zhongdao*

□ 1 March 2004

❖ CUHK Research Committee Funding (Direct Grants)

Schistosomiasis, a parasitic disease due to infection with parasitic worms, is estimated to cause over 200,000 deaths annually in the world. This second most prevalent tropical disease in the world is endemic along the Yangtze River and the several provinces in China. Toxic anti-parasitic drugs are currently used to cure this disease. Praziquantel, an anti-parasitic drug currently being used to treat the disease, is only effective to kill the worm of three and more than three weeks old, and drug resistant strains of *S. haematobium* and *S. mansoni* are frequently developed. Although a more recently developed drug artemether has been shown to kill schistosomula 6-10 days after infection, a low dose and long term administration of this drug in the areas of malaria resulted in a high risk of developing drug resistant malaria strains. Vaccination against the Schistosoma is the best way to prevent and control this tropical disease. Until now there is still no suitable vaccine that can give a consistent induction of 40% protection or better for the immunized animals. Recent study showed that a particular species of hamster, namely *Microtus fortis*, living in the endemic areas showed a natural resistance to *Schistosoma* infection. A few attempts had been

made to reveal the mechanisms of this natural resistance. Preliminary studies indicated that the inflammatory response, T-cell reactivity and antibody-dependent cell-mediated cytotoxicity appear to play a major role in the resistance to *Schistosoma* infection in *Microtus fortis*. However, the protective mechanisms are still not fully understood. In this proposal, we aim to identify and molecularly clone the protective antigens by producing and screening a panel of protective monoclonal antibodies. In addition, the role of cell-mediated immunity, especially the role of inflammatory response in *Schistosoma* infection in *Microtus fortis*, will be examined. Hopefully our result can lead to a development of better vaccine and treatment for the schistosomiasis.

(BL03710)

Signal Transduction Mechanism of Gonadotropin Inhibition of Activin β B Expression in the Zebrafish Ovary

✉ GE Wei

□ 1 January 2004

❖ CUHK Research Committee Funding (Direct Grants)

Fundable but not funded RGC grant (2003)

Activin is a dimeric growth factor consisting of two β subunits (βA and βB), and it plays critical roles in vertebrate reproduction. Our previous studies demonstrated that both activin A ($\beta A\beta A$) and activin B ($\beta B\beta B$) promote zebrafish oocyte maturational competence and final maturation, and that activin is likely a downstream mediator of gonadotropin in the zebrafish ovary. Interestingly, when applied to the cultured zebrafish ovarian follicle cells, gonadotropin (hCG) increases activin βA expression but down-regulates the expression of βB

B The differential regulation of the two β subunits by hCG can be mimicked by increasing the intracellular cAMP levels, suggesting involvement of the intracellular cAMP pathways. Interestingly, H89 (a specific inhibitor of protein kinase A, PKA) effectively blocks hCG- and forskolin-stimulated activin βA expression, but it cannot reverse the inhibitory effects of hCG and forskolin on βB expression. Based on these lines of evidence, we hypothesize that the hCG-stimulated activin βA expression is dependent on the activation of the classical cAMP- PKA pathway while the inhibitory effect of hCG on βB expression is likely mediated by a novel PKA-independent pathway. The objective of the present study is to investigate the mechanisms of signal transduction downstream of cAMP production that lead to the inhibition of activin βB expression by gonadotropin. Both pharmacological approach and Western blot analysis will be adopted in the present study. The potential signal transduction pathways to be investigated include P13K-PKB, P38^{MAPK} P42/44^{MAPK} and PKC pathways. Recently, increasing attention has been paid to cAMP- PKA-independent pathways in gonadotropin signaling in mammals. The present study will not only contribute to our understanding of the differential regulation of activin subunits, but also provide important insights into the mechanisms of gonadotropin actions in the vertebrate ovary and the evolution of such mechanisms.

(BL03676)

Characterization of Plant Prevacuolar Compartments

✉ JIANG Liwen

□ 31 December 2003

- ❖ CUHK Research Committee Funding (Direct Grants)

Plant prevacuolar compartments (PVCs) are membrane-bound organelles that mediate protein traffic between Golgi apparatus and vacuoles. However, PVC morphology and molecular mechanism remain to be elucidated. Here we propose to identify plant PVCs using immunocytochemical electron microscopy (immunoEM) with antibodies specific for vacuolar sorting receptor (VSR) proteins. Our study will provide the first insight on plant PVCs for their subsequent characterization at molecular and proteomic levels.

(BL03949)

Biogenesis of the Compound Protein Storage Vacuole

✉ JIANG Liwen

☐ 31 December 2003

- ❖ Research Grants Council (Earmarked Grants)

Plant cells compartment proteins and store products in vacuoles. Protein storage vacuoles (PSVs) in seeds are nature compartments for storing proteins during seed development and maturation. Upon seed germination these storage proteins are degraded by hydrolytic enzymes to provide nutrients for the embryo and seedling growth. PSVs purified from mature seeds contain a variety of hydrolytic enzymes that are capable of degrading the storage components but it has been unclear how both storage and lytic components coexist in one package, and the molecular mechanism by which storage proteins are degraded upon seed germination remain to be elucidated. Our recent studies have provided new insights into the structural organization and

functional implication of PSV subcompartments. We have recently demonstrated that the PSV subcompartments are functionally distinct because they contain marker proteins of different functional implications. Using tobacco as a model system, here we propose to further characterize seed PSV using molecular, transgenic, biochemical and immunocytochemical approaches. This proposal contains three major parts. First, we will study the biogenesis of PSV and its subcompartments in developing seeds using both immunocytochemical and transgenic approaches. Second, we will study molecular mechanism of protein mobilization upon seed germination. Third, we will test and develop a universal targeting system in which unique membrane sequences are used as anchors for delivering value-added proteins via specific vesicular pathways to PSVs for stable accumulation and specific post-translational modifications in plant bioreactors.

(CU03307)

Identification of Genes Related to Selected Agronomic Traits of Shiitake Mushroom

✉ KWAN Hoi Shan

☐ 1 December 2003

- ❖ CUHK Research Committee Funding (Direct Grants)

We aim to identify genes that are related to selected agronomic traits of Shiitake mushroom using extensive gene expression profiling. Thirty different Shiitake mushroom strains will be cultivated and their growth characteristics will be determined. The traits to be determined include: (1) vegetative mycelial growth rate, (2) ability to fruit, (3) time required for fruiting, (4) number of fruit bodies, and (5) yield. These traits of the strains will be

tabulated to group the strains with contrasting characteristics. Groups of 4 to 5 strains for each contrasting characteristics will be analyzed for gene expression profile using a set of about 2000 cDNA clones spotted on a microarray slide. Genes that have significant correlation with the contrasting characteristics will be identified and analyzed. Some of the metabolic pathways relating to each trait will be identified. The molecular and biochemical basis for the agronomic traits tested will be revealed. (BL03770)

Interaction between NaCl Stress and P Metabolism in Soybean

✉ LAM Hon Ming

□ 1 December 2003

❖ CUHK Research Committee Funding (Direct Grants)

Salinity and P deficiency are two major abiotic stresses affecting production of soybean. In many saline soils, salt stress is usually accompanied by the deficiency of P. However, the detailed molecular and biochemical basis of the interaction between these two stresses remain largely unknown. Our current data strongly suggest a close correlation between salinity and P metabolism. Some of our relevant findings include: () P supplement partially relieves NaCl damage; and () P supplement affects distribution of Na⁺ and Cl⁻ ions under salinity stress. Making used of the genetic materials collected and expertise established in the collaborating laboratories, the purposes of this research are to () understand the nutritional and physiological impacts of the interaction between salinity and P deficiency in soybean; and () delineate the underlying molecular and biochemical mechanisms. The specific objective for this proposal is to investigate the effect

of P status on ion distributions and expression of ion transporter genes.

(BL03467)

Molecular Cloning of cDNA Encoding a Novel Potent Antiviral Protein Isolated from the Chinese Medicinal Herb and Its Transgenic Expression in Plants

✉ OOI Vincent Eng Choon • CHIU Chi Ming Lawrence • OOI Shiou Mei Linda • SUN Sai Ming Samuel

□ 1 November 2003

❖ Research Grants Council (Earmarked Grants)

We have screened and discovered several potent bioactive proteins from edible and Chinese medicinal plants, with prominent immunomodulation and antiviral activities against herpes simplex viruses (HSV), respiratory syncytial virus (RSV), influenza A virus (H1N1), and bovine immunodeficiency virus (BIV). We have recently purified and characterized another novel potent protein from the Chinese medicinal herb *Gladiolus gandavensis* or *Polygonatum odoratum*, which shows unique antiviral activities. Moreover, this protein (GLA or POL) is effectively inhibitory against avian influenza virus (bird Flu virus H5N1). GLA or POL is a dimeric protein with a molecular mass of 28 kDa. The N-terminal amino acid sequence analysis shows that it is homologous to various extents to some known mannose-binding proteins. It is a weak agglutinin to rabbit erythrocytes, and does not agglutinate either human or chicken blood cells. We plan to clone a full-length cDNA encoding for this antiviral GLA or POL, and to transfer and express it in bacteria, edible plants or crop seeds. We will exploit the medicinal values and biotechnological potential of this bioactive transgenic

product for tangible development of the antiviral products against avian flu virus (H5N1) as chicken feed for commercialization.

(CU03324)

Diets and Trophic Guild of Larval and Juvenile Marine Fishes in Mangrove Habitats in Hong Kong

✍ WONG Chong Kim

☐ 1 February 2004

❖ CUHK Research Committee Funding (Direct Grants)

Mangroves are highly productive ecosystems that serve as nursery habitats for larval and juvenile marine fishes. The objectives of this study are to describe the diets and trophic guild of fish assemblages in mangrove habitats in Hong Kong. A food web based on the diet and the guild structure of major fish species is important to scientists and managers responsible for management decisions affecting mangrove habitats.

(BL03847)

Provision of Services on Water Quality Monitoring in Marine Parks, Marine Reserve and Other Ecological Significant Areas

✍ WONG Chong Kim • CHU LM

☐ 1 May 2004

❖ Agriculture, Fisheries & Conservation Dept, HKSAR Government

To conduct water quality monitoring at existing marine parks, marine reserve and other ecological significant areas in Hong Kong. To analyze data to detect annual trends in water quality and to evaluate compliance with water quality objectives. Results

from the study will be used by AFCD to further improve management, visitor services and planning in marine parks and marine reserve.

(BL03593)

Integrated Photochemical-Biological Treatment of Dye-containing Effluent of Textile and Dyeing Industry

✍ WONG Po Keung • HU Chun* • YU Jimmy C.
(Dept of Chemistry)

☐ 1 September 2003

❖ Research Grants Council (Earmarked Grants)

Azo dyes are toxic and recalcitrant and needed to degrade and detoxify them before discharge. In a previous study, photocatalytic oxidation (PCO) has been successfully and efficiently degraded free and bacterial cell-adsorbed azo dye(s). However a PCO resistant product, cyanuric acid (CA), was produced in the process for azo dyes containing triazine group. To completely eliminate the triazine-azo dye(s), an integration of PCO and biodegradation will be investigated. Two possible approaches will be conducted; (I) To use PCO to degrade triazine-azo dye(s) to CA with co-immobilized cells of an azo dye-adsorbing bacterium and TiO₂, followed by the complete mineralization of CA by another aerobic CA-degrading bacterium, and (II) To conduct PCO with co-immobilized of cells of selected bacterium which can adsorb triazine-azo dye(s) plus aerobically degrade CA from PCO. In order to reduce the operational cost and hazard, newly designed PCO reactor(s) using sunlight both 365 nm UV and sunlight irradiation for PCO process will be tested. Then, the optimum conditions for PCO degradation of triazine-azo dye(s) to CA and biodegradation (and mineralization) of CA by the selected bacterium(a) in approach (I) or (II) will be determined. The

toxicity and intermediates produced after PCO process or biodegradation will be monitored by sensitive bioassays (such as the Microtox® and Mutatox® test) and chromatographic analyses, respectively. Finally, the feasibility of the selected integrated system (i.e. either approach (I) or (II)) will be tested with synthetic effluent and effluent samples containing triazine-azo dye(s) collected from some representative dyeing factories in Hong Kong. (CU03325)

Adsorption of Di(2-ethylhexyl)phthalate by Spent Shrimp Shell

✉ WONG Po Keung

□ 1 January 2004

❖ CUHK Research Committee Funding (Direct Grants)

Spent shrimp shell will be used to remove toxic Di (2-ethylhexyl)phthalate (DEHP), which is the most common and persistent phthalate used as a plasticizer in the manufacturing of polyvinylchloride, from aqueous solution. The effects of pH, retention time, agitation rate, temperature and DEHP concentration on the adsorption of DEHP by spent shrimp shell will be determined. In addition, the kinetics and mechanism of DEHP adsorption by the spent shrimp shell will be studied. The present study aims to develop an effective process to remove and concentrate DEHP from aqueous solution for further treatment (degradation/mineralization and detoxification by biodegradation or photochemical degradation). (BL03994)

Anti-proliferative Effects of Selected Flavonoids

✉ WONG Yum Shing

□ 1 December 2003

❖ CUHK Research Committee Funding (Direct Grants)

Epidemiological studies support a prominent role of dietary flavonoids in the prevention of many chronic diseases such as cancer and cardiovascular disease. The health-beneficial property of this class of plant polyphenols is suggested to be associated with their antioxidant activities. Quercetin is a flavonoid widely distributed in food plants and it exhibits strong antioxidant activity. This flavonoid has been shown to have a wide spectrum of anti-cancer properties. Our previous studies indicated that some flavonoids with similar structure to quercetin also possess high antioxidant activities. We attempt to carry out a comparative study on the anti-proliferative effects of selected flavonoids on three human cancer cells lines. (BL03842)

Role of Aquaporin Water Channels in the Osmoregulatory Strategy of the Euryhaline Marine Teleost Sparus Sarba

✉ WOO Norman Ying Shiu

□ 1 December 2003

❖ Research Grants Council (Earmarked Grants)

Fish survive within an aquatic and osmotically challenging environment thus they need to actively regulate their internal ionic and osmotic milieu to maintain homeostasis. To date much information has been provided on mechanisms involved in ionic transport, in numerous fish species, and over the past 25 years, the PI has provided much information regarding ion transport, utilizing sea bream as a model. Whilst it is clear that mechanisms of ion transport are important, virtually nothing is known as

to how water is transported across osmoregulatory epithelia in fish. In recent years, the discovery of a series of water channel proteins (aquaporins) has opened new and interesting insights into water transport particularly in mammalian systems, although their role and function in fish remains to be elucidated. Preliminary studies in the PI's laboratory have clearly demonstrated the presence of aquaporins in sea bream osmoregulatory tissues and it has been shown that the expression profiles of these proteins are modulated dependent upon whether the environment is hydrating or dehydrating. In the proposed study, molecular, biochemical and localization studies will be utilized in order to study the significance of aquaporin expression for water transport in conditions of different salinities as well as effects of certain key osmoregulatory hormones.

(CU03318)

Validation of an *In vitro* System for Assessing the Effects of Mitogenic Hormones on Stress Protein Expression

✉ WOO Norman Ying Shiu • DEANE Eddie Edward

☐ 1 January 2004

❖ CUHK Research Committee Funding (Direct Grants)

The proposed work addresses the effects of mitogenic hormones [growth hormone (GH) and insulin-like growth factor I (IGF-I)] on the heat shock response of fibroblast and epithelial cell lines that have been derived from fin tissue of silver sea bream. By using an *in vitro* approach, the proposed work will be able to study the heat shock response without the use of live animals. Specifically, we aim to ascertain the heat shock response of the cell lines in a time versus temperature manner, by studying the

expression profiles of both cognate (hsc70) and inducible (hsp70) members of the heat shock protein 70 (HSP70) family. We will then be able to study the regulatory effects of GH and IGF-L on hsp70 expression. We will also aim to elucidate whether any of the regulatory effects of GH on hsc70/hsp70 expression are independent or mediated via LGF-I. The proposed work will shed light on the differential role of the cognate versus the inducible form of HSP on the stress response and provide new information on the regulatory role of hormones on HSP expression in fish cells.

(BL03484)

Centre for Marine Environmental Research and Innovative Technology - Establishment of Biochemical, Endocrinological and Molecular Markers for Exposure to Xenobiotics and Red Tide Toxins in Fish

✉ WOO Norman Ying Shiu • AU Doris W T* • WONG Christopher K C*

☐ 20 May 2004

❖ UGC Area of Excellence

Xenobiotics and red tide toxins impose considerable stress to organisms in the marine environment, and it is important to devise suitable methodologies that may act as predictive markers for their early detection. A biological indicator approach will be adopted which entails measurement of a suite of selected stress responses at several levels of biological organization so as to assess sublethal stress effects. We propose to develop a suite of biomarkers for detecting early exposure to xenobiotics and red tide toxins, using the sea bream as the model fish. Specifically, a three-tier approach will be adopted in which biochemical, endocrinological and molecular responses to stress at the growth, reproduction and

cellular levels will be studied. These combined approaches would lead to the detection of stress-related variables that are biologically and ecologically relevant, and will maximize predictive capabilities.

(BL03544)

Please refer to previous issues of this publication for more details of the following ongoing research at the department:

Edition	Title/Investigators
1998-99	Pharmaceutical, Nutritional and Biotechnological Application of Seaweed Resources in Hong Kong (BL98027) ✉ ANG Put Jr. • CHEUNG Chi Keung Peter • CHUNG Hau Yin • OOI Vincent Eng Choon
2001-02	Biodiversity of Marine Algae in Hong Kong (BL01416) ✉ ANG Put Jr.
2002-03	Recovery of Corals form Lesion and Injuries (BL02430) ✉ ANG Put Jr.
2002-03	Provision of Services on Marine Flora Studies in Hoi Ha Wan Marine Park (BL02515) ✉ ANG Put Jr.
2002-03	A Mechanistic Study of the Immunopotentiating and Antitumor Effects of Native and Chemically Modified Nonstarch Polysaccharides [(1

→ 3)- β -D-glucans] from Mushroom Sclerotia (CU02255)

✉ CHEUNG Chi Keung Peter • CHIU Chi Ming Lawrence • OOI Vincent Eng Choon

2002-03 Hypoglycemic Effect of Mushroom Dietary Fiber (Non-starch Polysaccharides) (BL02308)

✉ CHEUNG Chi Keung Peter

2002-03 Quantitative Analysis for Antiviral Activity of *Prunella vulgaris* and Related Medicinal Herbs with Flow Cytometry (BL02597)

✉ CHIU Chi Ming Lawrence • OOI Vincent Eng Choon

2001-02 Biotechnological Improvement of a Microbial Cultivar and Evidence-based Diversification of Microbial Products (BL01812)

✉ CHIU Siu Wai • NG Tzi Bun (Biochemistry)

2000-01 Isolation, Characterization, and Molecular Cloning of the Androgenic Hormone of the Mud Crab *Scylla* spp.: Development of Monosex Crab Aquaculture (CU00254)

✉ CHU Ka Hou • SUN Piera S* • LIU Hong*

2001-02 Molecular Population Structure of Penaeid Shrimp in the Indo-West Pacific (BL01157)

✉ CHU Ka Hou

- 2002-03 Development of an Animal Model of Shrimp Allergy (CU02256)
 ✍ CHU Ka Hou • CHIANG Bor Luen*
 • FUNG Ming Chiu • LEUNG Sai Cheong Patrick*
- 2002-03 DNA Strand Breaks in Crustaceans as a Pollution Indicator in Marine Environment (BL02819)
 ✍ CHU Ka Hou
- 2000-01 Revegetation of Newly Restored Landfills: Site Environmental Conditions and the Role of Native Species (CU00250)
 ✍ CHU LM
- 2002-03 Ecotoxicity of Herbicide Glyphosate (BL02633)
 ✍ CHU LM
- 1999-00 Origin and Mechanisms of the Formation of the Common Character Impact Volatile and Semi-volatile Flavor Components in Salted-dried Fishes for Nutrition and Food Safety Improvement (CU99164)
 ✍ CHUNG Hau Yin
- 2002-03 Characterization of Plain Sufu Extract Prepared by Supercritical Fluid Extraction (BL02767)
 ✍ CHUNG Hau Yin
- 2001-02 Cercariae Stage Sepecific and Immunogenic Antigen of *Schistosoma japonicum* (BL01154)
 ✍ FUNG Ming Chiu • CHEN Xiao Guang*
- 2002-03 Phosphatidylinositol Glycan (PIG-N) a Potential Target to Combat *Schistosoma* (BL02348)
 ✍ FUNG Ming Chiu
- 2001-02 Expression of Genes Encoding for Cellulyotic Enzymes and Laccase in *Volvariella volvacea* during Substrate Colonisation and Fruit Body Morphogenesis (BL01163)
 ✍ GE Wei • BUSWELL John Anthony (College Office, SC)
- 2001-02 Activin System in the Pituitary: How Important is It in the Differential Expression of Fish FSH and LH? (BL01150)
 ✍ GE Wei
- 2002-03 Epidermal Growth Factor (EGF) in the Ovary of Zebrafish - How is It Related to the Ovarian Activin System in Controlling Oocyte Development? (CU02258)
 ✍ GE Wei
- 2002-03 Molecular Cloning and Functional Characterization of Pituitary Adenylate Cyclase-activating Polypeptide (PACAP) in the Zebrafish Ovary (BL02574)
 ✍ GE Wei
- 2001-02 Sorting of Proteins to the Protein Storage Vacuole in Plant Cells (BL01156)
 ✍ JIANG Liwen • SUN Sai Ming Samuel

2001-02	Protein Sorting in the Plant Golgi (BL01648)	✍ KWAN Hoi Shan
	✍ JIANG Liwen • ROBINSON David G*	2002-03
		Molecular Authentication of Traditional Chinese Medicinal Plants (BL02977)
		✍ KWAN Hoi Shan
2002-03	Production and Characterization of Antibodies for Plant Vacuolar Sorting Receptor Proteins (BL02399)	1999-00
	✍ JIANG Liwen	Molecular and Biochemical Characterization of a Salt-tolerant Soybean Variety (CU99180)
		✍ LAM Hon Ming • SHAO Gui Hua*
2002-03	Molecular Characterization of Plant Prevacuolar Compartments (CU02260)	2000-01
	✍ JIANG Liwen	Sink-Source Relationship During Seed Development in Arabidopsis Thaliana - Molecular Regulation of Aspartate Family Amino Acids (CU00263)
2002-03	Molecular Mechanism of Plant Prevacuolar Compartments (BL02622)	✍ LAM Hon Ming • SUN Sai Ming Samuel
	✍ JIANG Liwen	
2002-03	Identification of Ultrastructural Components of the Secretory Pathway for Endoglucanase in the Edible Mushroom, <i>Volvariella volvacea</i> (BL02956)	2002-03
	✍ JIANG Liwen • BUSWELL John Anthony (College Office, SC)	Gene Regulation in the Signal Transduction Pathways of Broad-Spectrum Bacterial Blight Resistance Loci in Rice (CU02273)
		✍ LAM Hon Ming • LING Zhong Zhuan* • ZHANG Qi* • ZHAO Kai Jun*
1999-00	Germplasm Bank, Chemical and Molecular Characterization of Chinese Medicinal Plants Commonly Used in Hong Kong (BL99004)	2002-03
	✍ KWAN Hoi Shan • CHE Chun Tao (School of Chinese Medicine) • WONG Yum Shing	Characterization of a Purple Acid Phosphatase Gene in Soybean (BL02800)
		✍ LAM Hon Ming
		2002-03
		Protein Characterization Studies on <i>Cordyceps</i> (BL02556)
		✍ NGAI Sai Ming
2001-02	Identification and Characterization of Genes Differentially Expressed in Dikaryotic Mycelium of Shiitake Mushroom <i>Lentinula edodes</i> by cDNA Microarray Hybridization (BL01147)	2001-02
		Isolation, Characterization and Mode of Action of Novel Antiviral Agents from Seaweeds in Hong Kong (BL01367)
		✍ OOI Vincent Eng Choon • ANG Put Jr. • CHIU Chi Ming Lawrence

2001-02	Agents Against Dermatophytes from Traditional Chinese Medicine (TCM) (BL01632) ✍ OOI Vincent Eng Choon • OOI Shiou Mei Linda	Integrated Biosorption and Electrodeposition (BL00417) ✍ WONG Po Keung • CHUA Hong* • LO Wai Hung Thomas*
2002-03	In Vitro and In Vivo Anticancer Studies of Novel Polyunsaturated Fatty Acids (DHA, EPA) Purified and Characterized from Several Enriched Microalgae (CU02261) ✍ OOI Vincent Eng Choon • CHEN Feng Steven* • CHEUNG Chi Keung Peter • CHIU Chi Ming Lawrence	2002-03 Polychlorinated-dibenzo-dioxins (PCDDs) in Marine Sediment (BL01986) ✍ WONG Po Keung
2001-02	Heavy Metal Concentrations in Tilapia Collected from Hong Kong Rivers (BL01616) ✍ WONG Chong Kim	2002-03 A Comparative Study on the Application of Prolonged-photochemical and Integrated Photochemical-biological Processes to Degrade and Detoxify Polychlorinated-dibenzo-dioxins/furans in Contaminated Sediments (BL02775) ✍ WONG Po Keung
2001-02	Provision of Services on Water Quality Monitoring in Marine Parks, Marine Reserve & Other Ecological Significant Areas (BL01892) ✍ WONG Chong Kim • CHU LM • WONG Po Keung • CHU Ka Hou	1995-96 A Study of the Nutritional Quality and Potential Food Use of Some Underutilized Legumes (BL95043) ✍ WONG Yum Shing
2002-03	Nursery Functions of Mangrove Habitats for Marine Fishes (BL02478) ✍ WONG Chong Kim	2001-02 Evaluation of Castanea Mollissima Pigment as Natural Food Additive (BL01654) ✍ WONG Yum Shing
2001-02	Bioactive Substances from Marine Bacteria (BL01535) ✍ WONG Po Keung • QIAN P Y*	2002-03 Isolation and Characterization of Flavonoid Antioxidants in Vigna sinensis Seeds (CU02263) ✍ WONG Yum Shing • CHUNG Hau Yin
2002-03	A Novel Process for Removing and Recovery of Metal Contaminants Using	2002-03 Study on the Biological Activities of Narciclasine (BL02437) ✍ WONG Yum Shing
		1999-00 Protective Effects of Heat Shock Protein 70 (HSP70) against Environmental and

	Pathogenic Stress in the Marine Teleost <i>Sparus sarba</i> (CU99168) ✉ WOO Norman Ying Shiu		Metabolic Significance and Potential Applications (BL01146) ✉ WOO Norman Ying Shiu
1999-00	Strategies for the Improvement of Marine Fish and Shrimp Culture: A Molecular Biological Approach (BL99005) ✉ WOO Norman Ying Shiu • CHU Ka Hou • WONG Chong Kim • GE Wei • CHAN King Ming (Biochemistry) • CHENG Hon Ki Christopher (Biochemistry) • HO Walter K. K. (Biochemistry)	2001-02	Effect of Grass Carp Lectin on Teleost Macrophages and Lymphocytes (BL01353) ✉ WOO Norman Ying Shiu • NG Tzi Bun (Biochemistry)
2000-01	Modulation of Gill $\text{Na}^+\text{-K}^+\text{-ATPase}$ Expression by Salinity and Hormonal Factors in the Sea Bream, <i>Sparus sarba</i> (CU00252) ✉ WOO Norman Ying Shiu	2002-03	Growth Hormone and Insulin-like Growth Factor-I as Anti-apoptotic Factors via Modulated HSP70 Expression in Seabream (CU02264) ✉ WOO Norman Ying Shiu
		2002-03	Effects of Steroid Hormones on Seabream Macrophages (BL02640) ✉ WOO Norman Ying Shiu • NG Tzi Bun (Biochemistry)
2001-02	Stimulation of Glucose-6-Phosphate Dehydrogenase Activity in Sea Bream:		

RESEARCH PROJECTS

Study of Cross-stranded Hydrogen Bonds in DNA

✉ AU-YEUNG Chik Fun Steve

☐ 1 November 2003

❖ Research Grants Council (Earmarked Grants)

This study focuses on the evaluation of cross-stranded hydrogen bonds as proton transfer channels and their preferred networking in DNA. The result is expected to unveil the role of cross-strand hydrogen bond, which is suggested to serve as evidence in the form of “snap-shots” of proton transfer processes, occurring between neighboring basepairs along the longitudinal axis in DNA. It is also suggested that normal operation of the “Cathodic Protection” mechanism in DNA may be partially incapacitated when cross-stranded hydrogen bonds network is disrupted. Therefore, identifying how DNA damage is related to cross-strand hydrogen bonds is one important objective of this study because the resulting changes in the electronic structure of DNA may lead to hotspot formation thus rendering it susceptible to binding by external agents. Another objective is to determine the origin responsible for the binding pattern of both GG and AG basepairs in DNA to cisplatin and the results will be re-examined within the purview of DNA damage theory so that a coherent rationale can be advanced to explain cisplatin resistance by tumor. Quantum mechanical methods such as Natural Bond Orbital and Density Functional methods have been chosen to implement the study. A new set of characterization indicators will be developed to augment the 360° planarity

geometry rule in establishing the presence of cross-stranded hydrogen bonds.

(CU03001)

Activation of Carbon-Carbon Bonds of Nitriles by Metalloporphyrins

✉ CHAN Kin Shing

☐ 31 December 2003

❖ Research Grants Council (Earmarked Grants)

Activation of carbon-carbon bonds, especially aliphatic ones, by transition metal complexes is a fundamentally and industrially important chemical process. The intermolecular activation of aliphatic and non-strained carbon-carbon bonds by transition metal complexes has never been reported. Study of this process will deepen our understanding of the interaction of carbon-carbon bonds with transition metal complexes. As a result, development or improvement of industrially important processes such as oil reforming, hydrocarbon cracking, polymer depolymerization and catalytic functionalization of hydrocarbons by transition metal complexes will be benefited.

(CU03002)

Spectroscopic Study of Molecules in Very Strong DC Electric Fields: An Attempt at Controlling Molecular Dynamics

✉ CHAN Man Chor

☐ 1 November 2003

❖ Research Grants Council (Earmarked Grants)

We propose here experiments of controlling molecular dynamics and alignment in high static DC electric fields. Applying the novel supersonic molecular beam technique, molecules of interest will

be prepared in a collision-free environment for these studies. We plan to initiate our work by investigating the dynamics of tunneling motion of ammonia in DC electric fields. High-resolution laser spectroscopy combined with the novel optothermal detection will be used to study the dynamic effect from the rotationally resolved spectra. Results from this work will provide rigorous tests for theoretical models and high-level ab initio calculations of the dynamics of inversion tunneling. Dynamic studies of van der Waals molecules in DC fields will also be pursued to obtain information on intermolecular interactions and potentials, which are important in understanding a number of fundamental processes such as phase transition and mechanisms of chemical reactions. While we are fully aware of the unforeseeable difficulties in the experiments, we have little doubt that our experience on studies of HF dimers and other van der Waals molecules will help us accomplish our goal. It is hoped that this work will open up a new research discipline in experimental chemical physics for the science community of Hong Kong.

(CU03003)

Exploring Electron Capture as a Novel Dissociation Technique in Tandem Mass Spectrometry of Biomolecules

✉ CHAN Tak Wah Dominic

☐ 1 September 2003

❖ Research Grants Council (Earmarked Grants)

Electron capture dissociation (ECD) is a newly developed non-ergodic (dissociation proceeds prior to energy randomization) method for dissociating multiply-charge bio-molecules in mass spectrometry. It has been shown to provide unique sequence information for structural characterization of peptides/proteins. The theme of this project is to

undertake a systematic investigation of the mechanistic aspects of this novel dissociation method. This project comprises of (1) a systematic analysis of the cleavage behavior of a series of custom-made short-chain peptides; and (2) a comprehensive theoretical study on the electron capture and hydrogen-atom capture affinities of common amino acids. Results obtained from both studies will be correlated to provide important information on the structural parameters that influence the ECD process(es). With this study, it is hoped that more information regarding the mechanistic aspects of the ECD process(es) can be obtained. From the experimental evaluation of the cleavage behavior of peptides under controlled environments (such as charge-state and amino acid sequence), the possibility of generating a database for knowledge-based sequence analysis of the ECD of peptides/proteins will also be evaluated. With a better understanding of the underlying mechanism, substances that are currently not amenable to ECD dissociation might become amenable either by modification of the experimental parameters and/or simple chemical modifications.

(CU03006)

Amino Acid-based Organic Gelators: Design, Synthesis and Structural Optimization

✉ CHOW Hak Fun

☐ 1 November 2003

❖ CUHK Research Committee Funding (Direct Grants)

The design and synthesis of molecular gelating materials have become one of the important goals in material chemistry. Molecular gelating materials have found a number of applications in medicine, biology, separation technology and catalysis.

Simple organic materials that can form gels with a wide variety of organic solvents are particularly appealing because they can be prepared in fewer steps and their structure can easily be tailored made to meet the desired specifications. In this proposal we wish to embark on a synthetic and property study of a new series of amino acid-based organic gelating materials. This project is formulated due to an accidental finding that some amino acid-containing aromatic compounds possessed unusually strong gelation property towards a number of aromatic solvents. Based on the gelation mechanisms of other organic gelators reported in the literature, we decide to modify the structure of these compounds and to prepare a new series compounds with even better gelation power. It is anticipated that such investigations would improve our understanding of gelation mechanism and molecular self-assembly.

(PS03429)

Investigation of Nucleic Acid Binding Properties of the HPV E6 Oncogenic Protein

✉ LAM Sik Lok • BURGER Alain* • KIEFFER Bruno* • TRAVE Gilles*

□ 1 January 2004

❖ France/Hong Kong Joint Research Scheme

Cervical cancers are the second cause of cancer-related death for women. All cervical carcinomas evolve from lesions caused by human papillomaviruses (HPV), small DNA viruses that infect epithelial tissues. The majority of the papillomavirus types identified fall within the class of “low risk” HPVs and normally lead to the formation of benign warts. In contrast, infections caused by “high risk” HPV types have the potential to progress to cancer. One of the two proteins responsible of the tumorigenic activity of HPV is E6 which has

been shown to interfere with the “guardian of the genome” function of p53. E6 from “high risk” papilloma viruses binds to p53 in conjunction with an ubiquitin ligase known as E6-AP. The formation of the E6/E6-AP/p53 complex leads to degradation of p53 *via* the ubiquitin-mediated proteolysis pathway. This results in the loss of control over genetic integrity. A large number of other proteins have been reported to bind to E6 and, in the majority of cases, to undergo ubiquitin-mediated degradation. In addition, E6 has been shown to recognize particular structural motives in DNA such as four-way DNA junctions. The nucleic acid binding properties of E6 protein suggests that E6 might be involved in alternate biological pathways. The aim of this project is to investigate the structural aspects of the nucleic acid binding properties of the E6 protein using NMR spectroscopy.

(PS03762)

Structures and Dynamics of Catalytic Deoxyribozymes

✉ LAM Sik Lok

□ 1 June 2004

❖ CUHK Research Committee Funding (Direct Grants)

Deoxyribozyme is a class of DNA molecules that has recently been discovered to possess catalytic functions such as catalyzing DNA and RNA cleavage, DNA ligation, DNA capping and DNA phosphorylation. The diversity of its biocatalytic functions relates to the capability that single-stranded DNA molecules can fold into more complex structures to catalyze different types of chemical transformations. Yet, no three-dimensional crystal or solution structures of deoxyribozymes have been determined, thus limiting the structure-function

relationship studies of deoxyribozymes. In this proposal, high-resolution nuclear magnetic resonance spectroscopy will be used to determine the solution structures and dynamics of a 46-nucleotide DNA-cleaving deoxyribozyme. The three-dimensional structure and dynamics information will be useful to correlate with the catalytic DNA-cleavage function of the deoxyribozyme, thus establishing structure, dynamics and function relationships for this special class of DNA molecules. The results of this proposed research will also enhance the design of next-generation artificial biocatalysts for industrial and therapeutic applications.

(PS03370)

**Amides of Low-valent Iron, Cobalt, and Nickel:
Syntheses, Structure, and Reactivities**

✉ LEE Hung Kay

☐ 1 April 2004

❖ CUHK Research Committee Funding (Direct Grants)

Amides complexes [NRR'] of the late transition metals (Group 8-10) are known to involve in a number of important industrial and biological reactions. However, they are not as common as their early transition metal counterparts. It is believed that a mismatch between the "hard" π -donor amido ligand and the "soft" π -donor late transition metal renders the M-N bond relatively unstable. Thus, the synthesis of late transition metal amides devoid of "soft" donor ligands has been a challenging area. Even among those late transition metal amides reported in the literature, examples of those derived from *N*-alkylated amido ligands are rare. Recently, the chemistry of pyridine-functionalised amido ligands has elicited

much interest because of a high flexibility of these ligands in their coordination mode and their ability to stabilise metal complexes with unusual coordination geometries. Herein we propose to undertake a research project on synthetic and structural studies of late transition metal amides supported by *N*-alkylated pyridine-functionalised amido ligands. In addition, their reactivities towards protic reagents will also be investigated. We reason that the corresponding metal alkoxides, if obtained, are rare. The structure of all complexes will be characterized by single-crystal X-ray diffraction studies, in addition to various spectroscopic methods and elemental analysis. The results of this work will entail detailed structural information and provide insights to the properties of these late transition metal complexes.

(PS03425)

**Synthesis of Lithium Complexes from a
Multidentate Iminophosphoranyl Ligand**

✉ LEUNG Wing Por Kevin

☐ 1 April 2004

❖ CUHK Research Committee Funding (Direct Grants)

This project is to develop the synthesis of a novel iminophosphorane and its lithium derivatives as the ligand transfer reagent for the preparation of a series of metal complexes. The pyridine-functionalised phosphine PhP (CH₂Py)₂ (1) will be prepared and used as the starting compound for the synthesis of iminophosphorane PhP (CH₂Py)₂ =NSiMe₃ (2). Lithiated derivatives of 2 will be prepared by the reaction with *n*-butyllithium. The reactivities and the structures of the lithated compounds obtained will be investigated. By virtue of the coordination from the pyridyl nitrogen atoms and the imino-nitrogens, the anionic iminophosphoranyl compounds can

behave as a multidentate ligand for the synthesis of metal complexes. Early transition metal compounds derived from this ligand will be synthesized and its catalytic activities will be investigated. We will explore the potential of these early-transition metal in olefin polymerization. Furthermore, other metal complexes such as the rare-earth metals will also be investigated.

(PS03328)

Ab initio studies on the clusters of hydrated sulfate and oxalate anions [SO₄²⁻-(H₂O)_n and C₂O₄²⁻-(H₂O)_n]

✉ LIU Zhifeng

□ 1 October 2003

❖ Research Grants Council (Earmarked Grants)

Understanding the solvation of ions is of fundamental importance to solution chemistry and to numerous biological processes. We propose a computational study to calculate the structures and solvation dynamics for the doubly charged clusters of hydrated sulfate and oxalate anions [SO₄²⁻-(H₂O)_n and C₂O₄²⁻-(H₂O)_n]. Although both anions are important and commonly found in solutions, it is only possible recently to investigate their electronic structures experimentally by photoelectron spectra, which reveal interesting changes as the number of solvent molecules increases from n=4 to 40. The results suggest that the anions are buried inside the centre of the cluster, and a solvation shell is formed with n around 13 to 15. To completely understand these results, it is essential to calculate the geometrical and electronic structures, and the solvation dynamics for these clusters. We will use ab initio molecular dynamics to simulate the solvation process from first principles, and Gaussian based ab initio methods to obtain reliable data on the

energetics and structures. The expected results should lead to a better and more detailed model for the solvation around these anions.

(CU03018)

Host Network Assembly and Stabilization of Elusive Species

✉ MAK Thomas Chung Wai

□ 1 August 2003

❖ Research Grants Council (Earmarked Grants)

This project is concerned with in situ generation and stabilization of unstable chemical species of theoretical interest by hydrogen bonding in host lattices constructed with urea derivatives. Determination of the crystal structures of the resulting crystalline inclusion compounds leads to detailed information of molecular structure and hence a better understanding of reactivity.

In the context of crystal engineering, each cyclic oxocarbon dianions of the type (C_nO_n)^{m-} (m = 2, n = 3-6; m = 4, n = 6) can be regarded as a hub bearing a planar set of divergent hydrogen-bond acceptor sites, which may be matched with an appropriate set of convergent N-H donor sites provided by urea compounds, with quaternary ammonium ions playing an abetting role as guest templates. Besides these non-benzenoid aromatic systems and their thio derivatives, we shall focus on the synthesis and stabilization of a series of heretofore unknown sulfur-substituted six-membered ring and sulfur-bridged oxocarbon derivatives.

The rational design and assembly of extended arrays in one, two or three dimensions, based on preconceived cogwheel and rosette-tape structure motifs constructed from hydrogen-bonded molecular building blocks will be explored.

The present proposal is a logical sequel of three completed RGC-supported projects (CUHK 19/88, 456/95P and 4206/99P).

(CU03020)

Synthetic Studies of Amphiphilic Phthalocyanines Bearing Cationic Moieties

✉ NG Kee Pui Dennis

□ 1 August 2003

❖ Research Grants Council (Earmarked Grants)

Phthalocyanines represent an important class of functional dyes. Apart from their traditional use as industrial pigments, these materials have been actively exploited in various technological applications in the fields of materials science, medicine, and catalysis. Through design and manipulation of the molecules, chemists are able to tune the properties of these materials for different applications. This proposal seeks to secure funds to develop general synthetic pathways to unsymmetrical zinc(II) phthalocyanines bearing both hydrophilic and hydrophobic moieties. These novel macrocyclic compounds, having an amphiphilic character, are potentially useful as second-generation photosensitizers for photodynamic therapy (PDT), which is being actively investigated in many clinical applications. While anionic phthalocyanines have been studied extensively because of their promising photodynamic activity, relatively little is known about the cationic analogues. Special emphasis will therefore be placed on amphiphilic phthalocyanines with cationic moieties, in particular those which exist as a single isomer and are non-aggregated in aqueous media. All these features are desirable for efficient photosensitizers used in PDT. The proposed work involves the preparation and characterization of a series of these unsymmetrical phthalocyanines

together with the study of their aggregation behavior and photophysical properties.

(CU03021)

Pseudo-aminodisaccharides: Syntheses and Evaluation as Glycosidase Inhibitors

✉ SHING Kung Ming Tony

□ 1 November 2003

❖ CUHK Research Committee Funding (Direct Grants)

Glycosidases are biological catalysts (enzymes) responsible for splitting large sugar units into smaller ones and glycosidase inhibitors hinder the operation of glycosidases. The large sugar units can be sugar-protein of the viral cell envelope or can be starch, the main carbohydrate component of human food. Recent research efforts have confirmed the value of glycosidase inhibitors in halting the reproduction of human immunodeficiency virus (HIV), the etiologic agent for Acquired Immune Deficiency Syndrome (AIDS), and in the treatment of diseases related to disorders in sugar metabolism such as diabetes and obesity. Extensive research for the development of glycosidase inhibitors into useful medicines is underway.

Valienamine is a natural pseudo-aminomonosaccharide and an important component of the powerful α -D-glucosidase inhibitor acarbose. Acarbose, an oral-active antidiabetic medicine, delays the digestion and absorption of starch and sucrose. Acarbose is a pseudo-aminotetrasaccharide because it contains three monosaccharides and one valienamine unit linked together. On the basis of its bioactivity and medicinal value, this research programme proposes to prepare, from quinic acid, valienamine-containing pseudo-aminodisaccharides that will be tested for

glycosidase inhibitory activities. Chemical preparation (synthesis) of pseudo-aminodisaccharides will give substances (structurally related to acarbose) for biological evaluation as a means of providing improved drugs and novel structure-inhibitory activity relationship. Continued testing of synthetic compounds that may lead to useful medicines is essential to continuing progress in AIDS and diabetes chemotherapy and therein lies the significance of this project.

(PS03677)

The Folding of Individual Copolymer Chains in Dilute Solution

✉ WU Chi

□ 1 September 2003

❖ Research Grants Council (Earmarked Grants)

Linear homopolymer chains can undergo a coil-to-globule conformation transition in dilute solution as the quality of solvent changes from good to poor. Such a transition leads to a random-packing of chain segments inside the globule. In contrast, the folding of protein chains with specific distributions of hydrophobic, hydrophilic and/or charged amino acid residues often results in complicate bioactive structures. Different theories have been proposed, but the protein folding still remains a mystery. Recently, computer simulation was used to construct copolymers with a specific comonomer distribution to imitate proteins. The folding of such chains could remember their parent state in which they were formed. In this project, we propose to synthesize a range of copolymers with relatively defined comonomer distributions and study their folding in dilute solution. As expected, the folding of these copolymer chains in solution will be in a more ordered fashion than their count-parts, random

copolymer chains, with a similar length and comonomer composition. A combination of laser light scattering, microcalorimetry and fluorescence spectroscopy will be used to study how the folding of a copolymer chain depends on its composition and comonomer distribution. This study will lead us one step forward to the understanding of protein folding.

(CU03029)

Preparation of Multi-block Copolymers by Self-assembly Assisted Polymerization (SAAP)

✉ WU Chi

□ 1 January 2004

❖ CUHK Research Committee Funding (Direct Grants)

Recently, we proposed a novel synthetic approach of using the so-called self-assembly assisted polymerization (SAAP) for the preparation of long linear multi-block copolymer chains with an ordered block sequence and controllable narrowly distributed block lengths. We have had a limited success because the yield is not high. This is because our laboratory does not have a high-vacuum facility and experience of using high vacuum system for polymerization. In this proposal, we intend to establish a high vacuum line with a diffusion pump and a mechanical pump and hire an experienced research associate to perfect this novel method and train our postgraduate students. The principle of SAAP is as follows. It has been well-known that using ionic or living free radical polymerization or attaching each end of polymer blocks with a reactive functional group, one can only prepare copolymer chains with *few* long blocks, such as diblock and triblock copolymers. Alternatively, one could couple different polymer blocks with two reactive ends. However, the reactive ends are wrapped and

hidden inside the chain coiled in solution and the end concentration is low. The key problem is how to organize and concentrate the chain ends so that they can be effectively coupled together to form long multi-block copolymer chains. Using a selective solvent, we can assemble block copolymer chains into core-shell-like micelles with the insoluble block as the core and the soluble block as the shell. The self-assembly forces the soluble chain ends to expose and concentrate on the periphery so that the coupling can be greatly promoted.

(PS03610)

The Chemistry of a New Class of Early Transition Metal Carborane Complexes Bearing ansa-Carborane-Cyclopentadienyl Ligands

✉ XIE Zuwei

□ 1 December 2003

❖ Research Grants Council (Earmarked Grants)

Fourteen electron, d⁰ bent-metallocene alkyl cations of general type (C₅R₅)₂M(R')⁺ exhibit a rich insertion, olefin polymerization, and C-H activation chemistry which is highly sensitive to the structural and electronic properties of the (C₅R₅)₂M fragment, the presence or absence of Lewis base, and counterion/cocatalyst properties. Replacement of a uninegative C₅R₅⁻ ligand of (C₅R₅)₂M(R')⁺ by the isolobal, dinegative dicarbollide ligand (C₂B₉H₁₁²⁻) reduces the overall charge by one unit but leaves the gross structural and metal frontier orbital properties unchanged. The resulting neutral mixed metallacarborane sandwich complexes [(C₅Me₅)(C₂B₉H₁₁)]M(R') show a variety of reactions characteristics of electrophilic metal alkyls. It can also catalyze the polymerization of ethylene with a moderate activity in the absence of any cocatalysts, which is a significant progress in the

field of Ziegler-Natta catalysis. How to increase the catalytic activity of this type of neutral mixed metallacarboranes is the focus of this research. Many factors including steric/electronic effects and dual active centers will be systematically examined using new structurally well-defined mixed metallacarboranes. This process is of great scientific and technological interests since it can avoid using expensive MAO, thus eliminating possible contaminant of alumina in the polymeric materials.

(CU03031)

Multi-Sandwich Metallacarborane Oligomers and Polymers

✉ XIE Zuwei

□ 1 May 2004

❖ CUHK Research Committee Funding (Direct Grants)

It has been well-documented that *o*-carboranes (1,2-R₂C₂B₁₀H₁₀) can be reduced by group 1 metals to give *nido*-7,9-R₂C₂B₁₀H₁₀²⁻ in which the two cage carbon atoms are separated by at least one boron atom. The cage carbon-carbon bond is always broken without any exception. We have recently developed a new method to prepare a novel class of 'carbons-adjacent' *nido*- and *arachno*-carborane anions by introducing a short bridge between the two cage carbon atoms. Their group 1 metal salts are extremely useful synthons for the preparation of other metallacarboranes of s-, p-, d-, and f-block elements. Single-crystal X-ray analyses reveal that 'carbons-adjacent' *arachno*-carborane tetraanions consist of one open six-membered C₂B₄ face and one open five-membered C₂B₃ face that are capable of being η^6 - and η^5 -bonded to metal ions, respectively. Such a unique bonding feature can serve as π building blocks for the preparation of

multi-sandwich metallacarboranes. We propose here to explore the chemistry of this novel class of multi-sandwich metallacarborane oligomers and polymers which may have unique magnetic and electronic properties.

(PS03340)

Semiconductor-sensitized Photocatalysts for Pollution Treatment

✉ YU Jimmy C.

☐ 1 December 2003

❖ CUHK Research Committee Funding (Direct Grants)

Photocatalytic oxidation is a very attractive pollution treatment method. We have demonstrated successfully the degradation of many persistent pollutants using this technique. There is, however, a hurdle that must be overcome before photocatalysis is used for large-scale decontamination. Traditional titanium dioxide photocatalyst can only be activated by UV irradiation. This means that only about 3% of the energy from sunlight can be used.

The proposed research project will overcome this spectral limitation by sensitizing TiO₂ with a second semiconductor that can be activated by visible light. With careful matching of the band gap energies, it is possible to transfer the excited electrons from the second semiconductor to TiO₂ initiating the formation of a strong oxidizing agent. Special microemulsion-mediated solvothermal and photo-induced deposition methods will be developed for the coupling of TiO₂ to semiconductors such as CdS, MoS₂ and WS₂. These semiconductor-sensitized photocatalysts should have great potential for commercial applications.

(PS03747)

Please refer to previous issues of this publication for more details of the following ongoing research at the department:

Edition	Title/Investigators
1994-95	Asymmetric Catalysis by Metal Complexes of Chiral Pyridyl Phenols and Their Derivatives (PS94010) ✉ CHAN Kin Shing
2001-02	1,2 Rearrangements of Beta-Aminoalkyl Rhodium Porphyrins (PS01251) ✉ CHAN Kin Shing
2001-02	Catalytic Asymmetric Hydrogenation, Transfer Hydrogenation and Suzuki Cross Coupling Reactions (AoE Scheme - Institute of Molecular Technology for Drug Discovery & Synthesis) (PS01305) ✉ CHAN Kin Shing
2002-03	Transition Metal-catalyzed Phosphination (PS02544) ✉ CHAN Kin Shing
2000-01	High-resolution Spectroscopy of CH ₂ ⁺ and NH ₂ ⁺ : The Study of Rovibronic Interactions of Quasilinear Molecules (CU00272) ✉ CHAN Man Chor
2001-02	Double Resonance Spectroscopy of Solid Hydrogen: Studies of Vibrational Relaxation (PS01258) ✉ CHAN Man Chor

2002-03	Concentration-modulated Cavity-enhanced Absorption Spectroscopy in Gaseous Plasmas (PS02864) ✍ CHAN Man Chor	2001-02	Micrometallurgy in the Electroplated Bumps for Flip-chip Applications (PS01583) ✍ KWOK Wai Man Raymund
2000-01	Dissociation of Large Ions in a Fourier-transform Ion-Cyclotron-Resonance Mass Spectrometer (CU00274) ✍ CHAN Tak Wah Dominic	2001-02	Structures and Dynamics of Mismatches in Trinucleotide Repeats (PS01255) ✍ LAM Sik Lok
2000-01	Artificial Globular Proteins: Synthesis and Characterization of alpha-Amino Acid-based Peptide Dendrimers (CU00273) ✍ CHOW Hak Fun	2001-02	Correlation of Sequence Dependent Chemical Shifts and Local Structures of Deoxyribonucleic Acids (PS01877) ✍ LAM Sik Lok
2001-02	Synthesis and Properties of a Dendritic Analog of Poly(olefins) (PS01249) ✍ CHOW Hak Fun	2002-03	Base Pair Selectivity of Low-Fidelity DNA Polymerases - Structural and Dynamics Perspectives (CU02047) ✍ LAM Sik Lok
2001-02	Asymmetric Synthesis Using Chiral Dendritic Catalysts (AoE Scheme - Institute of Molecular Technology for Drug Discovery & Synthesis) (PS01402) ✍ CHOW Hak Fun	2001-02	Synthetic and Structural Studies of Lanthanide Metal Amides (PS01946) ✍ LEE Hung Kay
2002-03	Self Assembling Properties of 1, 3, 5-Triaminobenzene Derivatives (PS02667) ✍ CHOW Hak Fun	2002-03	Group 4 Metal Chemistry Involving Amides and Amidinates (PS02783) ✍ LEE Hung Kay
2000-01	A Novel Technique for the Analyses of Depth Distributions of Chemical States and Compositions in Semiconductor Materials with Sub-nanometer Resolution (CU00230) ✍ KWOK Wai Man Raymund	1990-91	Synthesis of Novel Transition-Metal Alkyls (BP90039) ✍ LEUNG Wing Por Kevin
		1990-91	Synthesis of Organometallic Compounds of Alkali Metals (BP90040) ✍ LEUNG Wing Por Kevin
		2002-03	Metal Phosphoranimine Complexes; Synthesis, Structure and Reactivity (CU02023)

	✍ LEUNG Wing Por Kevin		Systems for Phthalocyanine-Based Photosensitizers in Photodynamic Therapy (PS02686)
2000-01	Gaussian-3 Study on the Structures, Reactions, and Energetics of Some Interesting Chemical Systems (CU00275)		✍ NG Kee Pui Dennis • XUE Jinping*
	✍ LI Wai Kee	2002-03	Glycoconjugated Phthalocyanines – A Novel Class of Photosensitizers for Photodynamic Therapy (PS02342)
2000-01	Theoretical Study on Solvation Dynamics and Intracluster Reactions for $Al^+(H_2O)_n$ Ion Clusters (CU00276)		✍ NG Kee Pui Dennis
	✍ LIU Zhifeng • TSE John S.*	2001-02	The Study of Uloses in Asymmetric Epoxidation (PS01617)
2001-02	Computational Studies on the Adsorption and Reaction of Small Molecules on Arrays of Carbon Nanotubes (PS01252)		✍ SHING Kung Ming Tony
	✍ LIU Zhifeng • GONG Xin Gao*	1989-90	Synthesis of Novel Aromatic Compounds (BP83001)
			✍ WONG Nai Ching Henry
2002-03	Exploring Mechanisms for the Thermal Dissociation and Desorption of Small Molecules adsorbed on Surfaces from First Principles (CU02022)	2000-01	The Construction of Chiral 3-Dimensional Molecular Scaffolds Using Tetraphenylenols as Building Blocks (CU00264)
	✍ LIU Zhifeng		✍ WONG Nai Ching Henry • MAK Thomas Chung Wai
1989-90	X-Ray Analysis of Crystal Structures (BP72001)		
	✍ MAK Thomas Chung Wai	2000-01	Synthesis of Compounds by Solution Phase Chemistry (PS20007)
1989-90	Metal Coordination by Betaines (BP88025)		✍ WONG Nai Ching Henry
	✍ MAK Thomas Chung Wai	2001-02	Biomimetic Total Synthesis of Novel Diterpenes from Liverwort <i>Pallavicinia subciliata</i> (PS01250)
2000-01	Studies on the Coordination Chemistry of Acetylenediide and Pseudohalide Anions (CU00268)		✍ WONG Nai Ching Henry
	✍ MAK Thomas Chung Wai	2000-01	Phase Transitions of Novel Polymer Brushes (CU00266)
2002-03	Conjugation of Phthalocyanines with Biodegradable Polymers, Development of Efficient Delivery and Release		✍ WU Chi

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|---------|---|---------|---|
| 2001-02 | The Mesoglobular Phase of Dilute Heteropolymer Solutions (PS01257)
✉ WU Chi | 2002-03 | Novel Catalysts for Polymerization of Olefins and Polar Monomers (PS02757)
✉ XIE Zuowei • OKUDA Jun* |
| 2002-03 | Controllable and Reversible Aggregation of Soft Particles in Dispersion (CU02025)
✉ WU Chi | 2002-03 | Novel Catalysts for C-C/C=C Bond-forming Reactions and Fine Chemistry (PS02866)
✉ XIE Zuowei • Pierre H DIXNEUF* |
| 2000-01 | Group 4 Metal Carborane Complexes: Synthesis, Structure, and Reactivity (CU00267)
✉ XIE Zuowei | 2000-01 | Applications and Mechanisms of Photochemical Oxidation of Persistent Organic Pollutants (CU00033N)
✉ YU Jimmy C. • ZHAO Jincai* |
| 2001-02 | A New Class of Metallacarboranes Incorporating the n7-Carboranyl Ligand (PS01254)
✉ XIE Zuowei | 2001-02 | Development of Advanced Photocatalytic Nano-coating Technologies for Environmental and Health Industries (PS01871)
✉ YU Jimmy C. • WONG Po Keung (Dept of Biology) |
| 2001-02 | Novel Ruthenium Catalysts for Fine Chemistry (PS01513)
✉ XIE Zuowei • Pierre H DIXNEUF* | 2002-03 | Sonochemical Preparation of Mesoporous Metal Oxide Catalysts for Environmental Applications (CU02027)
✉ YU Jimmy C. |
| 2002-03 | The Chemistry of Novel Carbons-Adjacent Carborane Anions of C ₂ B ₁₀ System (CU02026)
✉ XIE Zuowei | | |

RESEARCH PROJECTS

Collection of Herb Samples and Herbarium Specimens

✉ CHE Chun Tao

☐ 27 October 2003

❖ Dept of Health, HKSAR Government

This project aims to collect and supply a number of authenticated Chinese herbal drugs, and to support the research programme of the Hong Kong Chinese Materia Medica Standards.

(BL03692)

Anti-Tuberculosis Ingredients from Chinese Medicines

✉ CHE Chun Tao • CHAN Chiu Yeung Raphael (Dept of Microbiology) • LAU Bik San Clara (School of Pharmacy) • LIANG Songming

☐ 1 December 2003

❖ Research Grants Council (Earmarked Grants)

The major goal of the project is to identify Chinese medicinal herbs as potential agents for the treatment of tuberculosis. The work is designed to generate sufficient data to serve as the basis of more definitive studies. Five medicinal herbs of high priority for study have been pre-selected on the basis of reported pharmacological and clinical results. They include *Hedysarum polbotrys*, *Ardisia japonica*, *Chenopodium ambrosioides*, *Inula helenium*, and *Ottelia alismoides*. These plant extracts will be subjected to *in vitro* anti-TB assay protocols using the standard drug sensitive *M. tuberculosis* H37Rv strain and a clinical isolate. Active ingredients from the

active plants will be purified and the biological activities are further determined using *in vitro* and *in vivo* anti-TB assays. This project also includes other Chinese medicinal herbs for anti-tuberculosis testing.

(CU03316)

Research and Laboratory Work on the Chinese Medicinal Herb, Namely Radix Paeoniae Alba

✉ CHE Chun Tao • KWAN Hoi Shan (Dept of Biology)

☐ 6 January 2004

❖ Dept of Health, HKSAR Government

This project aims at setting analytical and identification standards for the Chinese medicinal herb, Radix Paeoniae alba. The work includes macroscopic and microscopic characterization of the herbal drug, physical and chemical testing, chromatographic and spectroscopic identification methods, assays for contaminants such as foreign matters, heavy metals, residual pesticides, and microbial toxins determination of ash, water, and extractive contents, as well as chromatographic fingerprints.

(BL03755)

Research and Laboratory Work on the Chinese Medicinal Herb, Namely Radix Aucklandiae

✉ CHE Chun Tao • KWAN Hoi Shan (Dept of Biology)

☐ 6 January 2004

❖ Dept of Health, HKSAR Government

This project aims at setting analytical and identification standards for the Chinese medicinal herb, Radix Aucklandiae. The work includes

macroscopic and microscopic characterization of the herbal drug, physical and chemical testing, chromatographic and spectroscopic identification methods, assays for contaminants such as foreign matters, heavy metals, residual pesticides, and microbial toxins, determination of ash, water, and extractive contents, as well as chromatographic fingerprints.

(BL03844)

Research and Laboratory Work on the Chinese Medicinal Herb, Namely Radix Paeoniae Rubra

✍ CHE Chun Tao • KWAN Hoi Shan (Dept of Biology)

□ 6 January 2004

❖ Dept of Health, HKSAR Government

This project aims at setting analytical and identification standards for the Chinese medicinal herb, Radix Paeoniae rubra. The work includes macroscopic and microscopic characterization of the herbal drug, physical and chemical testing, chromatographic and spectroscopic identification methods, assays for contaminants such as foreign matters, heavy metals, residual pesticides, and microbial toxins, determination of ash, water, and extractive contents, as well as chromatographic fingerprints.

(BL03862)

Research and Laboratory Work on the Chinese Medicinal Herb, Namely Rhizoma Coptidis

✍ CHE Chun Tao • LEUNG Po Sing (Dept of Physiology)

□ 12 January 2004

❖ Dept of Health, HKSAR Government

This project aims at setting analytical and identification standards for the Chinese medicinal herb, Rhizoma coptis. The work includes macroscopic and microscopic characterization of the herbal drug, physical and chemical testing, chromatographic and spectroscopic identification methods, assays for contaminants such as foreign matters, heavy metals, residual pesticides, and microbial toxins, determination of ash, water, and extractive contents, as well as chromatographic fingerprints.

(BL03523)

Research and Laboratory Work on the Chinese Medicinal Herb, Namely Herba Desmodii Styracifolii

✍ CHE Chun Tao • LEUNG Po Sing (Dept of Physiology)

□ 12 January 2004

❖ Dept of Health, HKSAR Government

This project aims at setting analytical and identification standards for the Chinese medicinal herb, Herba Desmodii styracifolii. The work includes macroscopic and microscopic characterization of the herbal drug, physical and chemical testing, chromatographic and spectroscopic identification methods, assays for contaminants such as foreign matters, heavy metals, residual pesticides, and microbial toxins, determination of ash, water, and extractive contents, as well as chromatographic fingerprints.

(BL03626)

Research and Laboratory Work on the Chinese Medicinal Herb, Namely Radix Saposhnikovia

✉ CHE Chun Tao • LEUNG Po Sing (Dept of Physiology)

☐ 12 January 2004

❖ Dept of Health, HKSAR Government

This project aims at setting analytical and identification standards for the Chinese medicinal herb, *Radix Saposhnikoviae*. The work includes macroscopic and microscopic characterization of the herbal drug, physical and chemical testing, chromatographic and spectroscopic identification methods, assays for contaminants such as foreign matters, heavy metals, residual pesticides, and microbial toxins, determination of ash, water, and extractive contents, as well as chromatographic fingerprints.

(BL03840)

Research and Laboratory Work on the Chinese Medicinal Herb, Namely *Radix Achyranthis Bidentatae*

✉ CHE Chun Tao • LEUNG Po Sing (Dept of Physiology)

☐ 16 January 2004

❖ Dept of Health, HKSAR Government

This project aims at setting analytical and identification standards for the Chinese medicinal herb, *Radix Achyranthis bidentatae*. The work includes macroscopic and microscopic characterization of the herbal drug, physical and chemical testing, chromatographic and spectroscopic identification methods, assays for contaminants such as foreign matters, heavy metals, residual pesticides, and microbial toxins, determination of ash, water, and extractive contents, as well as chromatographic fingerprints.

(BL03514)

Research and Laboratory Work on the Chinese Medicinal Herb, Namely *Rhizoma Cimicifugae*

✉ CHE Chun Tao • KWAN Hoi Shan (Dept of Biology)

☐ 16 January 2004

❖ Dept of Health, HKSAR Government

This project aims at setting analytical and identification standards for the Chinese medicinal herb, *Rhizoma Cimicifugae*. The work includes macroscopic and microscopic characterization of the herbal drug, physical and chemical testing, chromatographic and spectroscopic identification methods, assays for contaminants such as foreign matters, heavy metals, residual pesticides, and microbial toxins, determination of ash, water, and extractive contents, as well as chromatographic fingerprints.

(BL03772)

HPLC Analysis of *Luo-Han-Guo* (*Momordica grosvenorii* Fruits)

✉ LIANG Songming • CHE Chun Tao

☐ 1 December 2003

❖ CUHK Research Committee Funding (Direct Grants)

Luo-Han-Guo (*Momordica grosvenorii* fruit) is used in Chinese medicine to relieve cough and reduce sputum. It is a reputed medicine for nourishing the lung, and has great potential for the development of dietary supplements. The plant material contains triterpene glycosides, some of which possess significant sweetening effect. In this application, we propose to establish a reliable chemical assay method for the analysis of *Luo-Han-Guo* extracts

using high-performance liquid chromatography (HPLG), and to determine a fingerprint chromatogram for quality control purpose. The work will be accompanied by bioassays and phytochemical studies which do not require financial support from the Direct Grant programme.

(BL03715)

Chinese Herbal Medicine in Asthma: A Randomized, Double-blind, Placebo-Controlled Clinical Trial

✉ LIN Zhixiu • CHE Chun Tao • LIN Lin*

□ 15 January 2004

❖ CUHK Research Committee Funding (Direct Grants)

Asthma is a chronic inflammatory disorder of the airway characterized by reversible airflow obstruction causing cough, wheeze, chest tightness and shortness of breath. The proposed project aims to evaluate whether Chinese herbal preparation has a genuine benefit on asthma using a well designed clinical trial with appropriate control and sufficient power. 120 newly diagnosed asthma patients that meet the entry criteria of the trial are randomly assigned into one of the three groups: individualized Chinese herbal formulations, a standard Chinese herbal formulation, or placebo. Patients will receive 5 capsules 3 times daily for a total of 12 weeks and are evaluated regularly by a traditional Chinese herbalist and by a lung specialist. Patients, herbalist and lung specialist are all blinded to treatment group. Main outcome measurements include global improvement assessed by patients and lung specialist, and change in the degree of interference in life caused by asthmatic symptoms assessed by patients. Clinical investigations such as forced expiratory volume in one second (FEV₁), vital capacity (VC)

and peak expiratory flow (PEF) are also measured. The results are statistically compared among the three groups. The trial would provide convincing evidence on whether Chinese herbal preparations have any beneficial effects on the management of asthma.

(BL03836)

應用分子功能影像技術研究針灸治療心絞痛的原

✉ 孫外主 SUN Waizhu • JIA Shaoci* • ZHOU Gao* • CUN Wang*

□ 1 January 2004

❖ CUHK Research Committee Funding (Direct Grants)

在人體生理條件下，採用分子功能影像技術，在視覺化的條件下，直接進行人體研究。觀察對電針治療的技術參數、俞穴選擇和俞穴治療不同部分室壁心肌缺血的效應關係。進一步證實針灸改善心肌血供、降低氧耗量、減少缺血性心肌細胞損害及保護損傷心肌細胞的原理。它是從基礎到臨床，從動物實驗到人體的深入研究，它是針刺療效的人體傳導規律和原理的創新性研究工作。本研究物件為 60 例心絞痛患者，擬隨機分為二組，第一組為對照組，第二組為針灸即時治療效應研究組。所獲得的針刺研究資料，具有可視性、比較性和定量化，可採用多種數學模型、粗糙級和神經網路電腦進行資料挖掘和再計算，有可能對針灸治療原理做出更深入的解釋。

(BL03797)

Please refer to previous issues of this publication for more details of the following ongoing research at the department:

Edition Title/Investigators

- 2001-02 Cancer Drugs Active against Signal Transduction Targets (BL01514)
 ✎ CHE Chun Tao
 ✎ CHE Chun Tao • KWAN Hoi Shan (Dept of Biology) • HU Shiu Ying • IP Siu Po
- 2002-03 Research and Laboratory Work on the Chinese Herb, namely CORTEX MOUTAN (*Paeonia Suffruticosa* Andr.) (BL02892)
 ✎ CHE Chun Tao • KWAN Hoi Shan (Dept of Biology) • HU Shiu Ying • IP Siu Po
- 2002-03 Research and Laboratory Work on the Chinese Herb, namely Radix Astragali (BL02546)
 ✎ CHE Chun Tao • KWAN Hoi Shan (Dept of Biology) • HU Shiu Ying • IP Siu Po
- 2002-03 Research and Laboratory Work on the Chinese Medicinal herb, namely Cortex Phellodentri (BL02498)
- 2002-03 Research and Laboratory Work on the Chinese Medicinal Herb, namely Rhizoma Alismatis (*Alisma orientalis* (Sam.) Juzep.) (BL02991)
 ✎ CHE Chun Tao • KWAN Hoi Shan (Dept of Biology) • HU Shiu Ying • IP Siu Po
- 2002-03 Research on Traditional Chinese Medicines and Botanical Dietary Supplements (BL02503)
 ✎ CHE Chun Tao
- 2002-03 Hepatoprotective Effects of Wu-zi-yan-song-wan Formulation (BL02799)
 ✎ CHE Chun Tao • LIANG Songming

RESEARCH PROJECTS

The Study of Mahler Measure of Knots

✉ AU Kwok Keung Thomas • LIN Xiao Song*

□ 1 June 2004

❖ CUHK Research Committee Funding (Direct Grants)

Mahler measure has been always a way to understand complex polynomials. It can be expressed in terms of logarithms of the roots. It also has an integral form by the Jensen's formula. There is a natural way to define Mahler measure for Laurent polynomials.

On the other hand, a powerful tool of studying knots is the Jones polynomial, which is a Laurent polynomial with special properties. There are evidences that the Mahler measure of the Jones polynomial of a knot reflects some properties of the knot. Yet, the exact phenomenon about these properties is still unclear.

It is the aim of this project to study and analyze these properties and to provide certain descriptions of the Mahler measure arisen from the Jones polynomial of a knot, especially in terms well-known invariants of knots.

(PS03969)

Enrichment Programme for Young Mathematics Talents

✉ AU Kwok Keung Thomas • LAU Ka Sing • CHEUNG Ka Luen

□ 1 July 2004

❖ Quality Education Fund, HKSAR Government

This is a mathematics programme for the pre-university students who are good mathematics and sciences. The programme offers three courses at summer, autumn, spring each year. Students who had completed a yearlong programme should have mathematics abilities comparable to first year students in major universities in the world including the Ivy League. The programme is overseen by an advisory committee formed by leading mathematicians from all over the world. Many of them have served as Presidents, Deans, and Department Chairpersons in famous universities.

In each course, the basic lectures comprise the university credited course. In addition, there will be small group discussions and guest lectures. Guest lectures are delivered by members of the advisory board or other specialists. The aim of guest lectures is to broaden the exposure of the students and enlighten them by the multifarious applications of mathematics.

(PS04504)

Wavelet Algorithms for High-Resolution Multichannel Images

✉ CHAN Hon Fu Raymond • CHAN Tony* • SHEN Zuowei*

□ 1 September 2003

❖ Research Grants Council (Earmarked Grants)

High-resolution image reconstruction refers to the generation of high-resolution images from multiple low-resolution, shifted, degraded samples of a true image. These problems arise in a variety of scientific, medical and engineering applications: from the daily-life TV broadcasting to the sophisticated satellite remote sensing. The resulting systems are usually very ill-conditioned. Tikhonov regularization approach is traditionally used and the systems can be

solved efficiently by fast iterative methods such as the preconditioned conjugate gradient method. In this proposal, however, we analyze this problem from the wavelet point of view. For gray-level images, we have derived fast wavelet iterative algorithms that decompose the images obtained from the previous iteration into different frequency components in the wavelet domain and denoise them before adding them back into the new iterate to improve the results. The reconstructed images from our wavelet algorithms are better than that from the Tikhonov approach. The purpose of this research is to develop and implement this wavelet method for color/multispectral image reconstruction. We will apply wavelet and partial differential equation techniques to alleviate the ill-conditioning of the problem and to adapt our method to the spatially variant case where the low-resolution frames are not aligned properly.

(CU03005)

Inexact Methods for Inverse Eigenvalue and Singular Value Problems

✉ CHAN Hon Fu Raymond • XU Shu Fang* • MORINI Benedetta*

☐ 1 November 2003

❖ CUHK Research Committee Funding (Direct Grants)

Inverse eigenvalue (respectively singular value) problems refer to the problem of finding a matrix with a given structure that has the eigenvalues (respectively singular values) equal to the pre-assigned set of eigenvalues (respectively singular values). One of the effective methods is to use the Cayley transform method coupled with Newton's iteration. This requires an inner and outer iterations. The method is an improvement over previous

methods where the inverse power method is used in the inner iterations. In this proposal, we consider using an inexact Cayley transform method for solving the inverse eigenvalue problem and inverse singular value problem. This method can avoid the oversolving problem of the inner iterations and hence improve the efficiency of the overall outer iterations. Using our previous results and knowledge for the convergence of the inverse power method, we will analyze the convergence of the method for both inverse eigenvalue problem and inverse singular value problems. We will also consider the extension of our method to inexact homotopy techniques which are more versatile in the sense that they depend less on the initial guess than Newton's method.

(PS03706)

On the Laplacians on fractals and application to some diffusion models

✉ LAU Ka Sing • ANH Vo Van*

☐ 31 December 2003

❖ Research Grants Council (Earmarked Grants)

The consideration of diffusion in fractal media (e.g. porous rock, non-crystalline material) was proposed in the 80's in physics. Recently this idea has also been used in biological sciences such as diffusion and transport of macromolecules in living tissues, diffusion of protein in an energy landscape.

In mathematics there is a surge of interest in these studies. It has been observed that the classical laws do not follow and lead to many anomalous physical properties. Unlike the applied sciences, a rigorous mathematical theory is still in the developing stage. While there are basic understanding of diffusion on simple fractal domains like the Sierpinski gasket and

the Sierpinski carpet, many questions remain unsettled.

This proposal has two goals. The first is to investigate the Laplacian and the Riesz potential defined on fractal sets, and the associated spectral dimension, walk dimension, function spaces, heat kernel and diffusion. As these notions are fundamental in this context, they will lead to a solid foundation of the theory. Our second goal is to formulate stochastic evolution models in terms of pseudo-differential equations on domains with fractal geometry. The results of these diffusion processes will be used to model protein dynamics in a fractal energy landscape and to determine the folding and function of a protein.

(CU03012)

Self-affine Tiles and Spectral Sets

✉ LAU Ka Sing • HE Xing Gang* • WANG Xiang-Yang* • RAO Hui*

□ 1 February 2004

❖ CUHK Research Committee Funding (Direct Grants)

Tiling is an arrangement of congruent geometric objects (tiles) to fill up the plane or the space with repeated patterns and allows no overlap or gap. The art of designing tiles and patterns is as old as human history. On the other hand a precise mathematical investigation only come up very recently and many parts of the subject remain unexplored. The major motivation of this development is due to the creation of the Penrose tiling in the seventies, the discovery of quasicrystals in solid state sciences in the eighties, and the advance of the diffraction geometry and tomography. Our study further linked up the topic with fractal geometry and wavelet theory.

My concentration is on the self-affine tiles which are generated by certain affine iterated function systems. Typically this class of tiles have fractal like boundaries, and the corresponding tilings are often aperiodic, making both the tiles and the tilings interesting mathematically. In the recent investigation, it was found that such theory are closely linked to the study of wavelets. In fact, both of them are governed by the functional equations called refinement equations. The two fields hence share many common techniques and open problems. In addition I will consider the relation of the self-affine tiles and the spectral sets, and the spectral measures that are related to the function spaces on fractal sets. These topics are in the confluence of analysis, algebra, geometry and tiling. Analysis, in particular harmonic analysis, provides a powerful tool in this development, which has just started to be used in the theory of tilings. There are a few breakthroughs in these directions recently and we expect that this investigation will bring in new initiatives.

(PS03326)

Harmonic maps between non-compact manifolds and its applications

✉ WAN Yau Heng Tom

□ 1 September 2003

❖ Research Grants Council (Earmarked Grants)

The objective of this project is to study various problems of harmonic maps between complete non-compact manifolds and its applications to different fields of mathematics. We are particularly interested in the studies of the geometric and analytic structures of certain moduli spaces of harmonic maps, harmonic maps from surfaces into symmetric spaces of non-compact type, and the relationships of

two-dimensional harmonic maps and classical complex analysis.
(CU03024)

Mathematical Analysis of Localized Solutions in Elliptic Systems

✉ WEI Juncheng

□ 29 December 2003

❖ Research Grants Council (Earmarked Grants)

The purpose of this project is to study reaction-diffusion equations and related systems with particular emphasis on problems with solutions that exhibit transition phenomena. There are two main types of transition phenomena depending on the nature of the nonlinearity: spike-type behavior and transition layer behavior. Spike-type solutions occur when the solution concentrates at certain isolated points in the domain and it occurs in most models of biological morphogenesis such as Gierer-Meinhardt system, in chemical response in biology, and in pulse-replication phenomena in chemical reaction models, including the Gray-Scott model. Transition layer behavior occurs when the solution exhibits a rapid variation across a smooth surface in the domain. Such solutions are very common in the broad field of materials science including block copolymer problems. All of these localization phenomena have been observed in experimental situations.

In recent years, there has been considerable progress in both the modeling and the mathematical analysis of localization behavior. Our primary goal of this project is to give a unified and rigorous mathematical analysis on the existence and stability of localized solutions. In particular, we shall concentrate on two particular systems: Gierer-Meinhardt system (spikes) and Block Copolymer Models (transitional layers), in the hope of leading to the development and

application of improved analytical tools for studying these and related localization problems and explaining many interesting biological and physical phenomenon and discovering some new patterns. This is a new and very active area and has a wide range of applications in mathematics, biology, chemistry, and physics.
(CU03025)

Mathematical Analysis of Diblock Copolymer Problem

✉ WEI Juncheng

□ 20 February 2004

❖ CUHK Research Committee Funding (Direct Grants)

In recent years, block copolymer problems have attracted a lot of attentions, due to experimental results and increasingly applications. The mathematical model of diblock polymer takes the form:

$$F(u) = \int_{\Omega} \left[\frac{\epsilon^1}{2} |\nabla u|^2 + \frac{1}{4} (u^2 - 1)^2 + \frac{\sigma}{2} \left| (-\Delta)^{-\frac{1}{2}} (u - m) \right|^2 \right] dx$$

Where m is the mass and u is the density of one monomer. The two different monomer unit are represented by $u = -1$ and $u = 1$ respectively. The connectivity of the two monomer units leads to the

long range interaction term $\frac{\sigma}{2} \left| (-\Delta)^{-\frac{1}{2}} (u - m) \right|^2$ in the free energy. In this proposal, we shall give a rigorous mathematical analysis on the existence and stability of several observed patterns: stripes, spots, annuli, hexagonal and lamellar patterns, nucleations.

(PS03372)

Detonation Models in Two-phase Flows: Mathematical Analysis

✉ XIN Zhouping • WEI Juncheng •
ROQUEJOFFRE Jean-Michael* • DOMELEVO
Komla*

□ 1 January 2004

❖ France/Hong Kong Joint Research Scheme

Two-phase flow combustion is a widely used process with numerous applications such as the propulsion of engines, cars, planes and rockets. The modelling of such phenomena gives rise to systems of nonlinear partial differential equations that pose quite challenging mathematical questions. There are two basic types of models: the Eulerian models and the Kinetic models. The Eulerian models are nonlinear systems of hyperbolic or parabolic-hyperbolic type. While the Kinetic models are the full reactive Navier-Stokes equations, coupled to a Vlasov or Fokker-Planck type equation. The main objective of the project is to investigate the existence and multiplicity of travelling front solutions to the one-dimensional versions of the Eulerian and Kinetic models, and to study the links between the two models. We would like to classify the travelling combustion fronts into two classes: slow fronts with moderate pressure gradients and fast fronts with high pressure gradients just as the classical Chapman-Jouguet diagram for the classical gaseous combustion. We propose to attack this problem by a combination of techniques coming from the theory of reaction-diffusion systems, dynamical systems, geometric singular perturbation theory and nonlinear hyperbolic systems.

(PS03931)

**Mathematical and Numerical Study of a
Nonlinear Kinematic Dynamo Problem**

✉ ZOU Jun

□ 1 November 2003

❖ Research Grants Council (Earmarked Grants)

Magnetic field generation by alpha effects has been at the heart of modern dynamo theory. A spherical kinematic alpha dynamo simulates magnetic field generation through a prescribed alpha in a sphere in association with a turbulent flow. The kinematic problem provides valuable insight into the fundamental magnetic field generation mechanism.

This project is to study a nonlinear kinematic alpha dynamo problem mathematically and numerically. Little mathematical study has been done on such dynamo system in the literature, although there exists a vast literature on numerical simulations. In this project, we make the first attempt to investigate the existence, uniqueness, stability and regularity of the solutions to the kinematic dynamo problem, and study the equivalence between the weak formulation of the dynamo system and the saddle-point like variational formulation. The latter is more convenient for numerical approximations.

No numerical analysis exists to justify the reliability and accuracy of the existing methods for dynamo problems. So the second task of the project is to analyse the convergence, accuracy and stability of our newly proposed fully discrete finite element method for solving the saddle-point like variational problem of the dynamo system.

The mathematical theory and numerical analysis for the kinematic dynamo system will be finally extended to a solar interface dynamo problem.

(CU03034)

**Please refer to previous issues of this publication
for more details of the following ongoing research
at the department:**

Edition Title/Investigators

2001-02	New Applications of Iterative Toeplitz Solvers (PS01243) ✉ CHAN Hon Fu Raymond • NG Kwok Po*	2002-03	On Regularities and Constraint Qualifications in Mathematical Programming (PS02616) ✉ NG Kung Fu • YE Jane* • LI Chong* • HUANG L R*
2000-01	Topics in Curvature Flows (CU00294) ✉ CHOU Kai Seng	2002-03	Analytic Problems on Riemannian and Kähler Manifolds (CU02032) ✉ TAM Luen Fai
2002-03	The Thin Film Equation: Rupture, Blow-up and Regularity (CU02028) ✉ CHOU Kai Seng	2000-01	Analysis on Complete Manifolds (CU00291) ✉ WAN Yau Heng Tom • LI Wai Kwong Peter*
2001-02	On Some Problems in Tilings (PS01240) ✉ LAU Ka Sing • WANG Yang*	2001-02	Existence and Stability of Multiple Spikes (PS01238) ✉ WEI Juncheng
2002-03	Harmonic Analysis of Fractal Measures (CU02030) ✉ LAU Ka Sing	2000-01	Analysis of Some Problems for Incompressible Euler and Navier-Stokes Equations (CU00279) ✉ XIN Zhouping
2002-03	C*-uniqueness of Locally Compact Groups (PS02862) ✉ LEUNG Chi Wai • NG Chi Keung*	2002-03	Mathematical Theory of Boundary Layers and the Prandtl's System (CU02040) ✉ XIN Zhouping
2000-01	Explicit Construction and Decoding Algorithms of Algebraic-geometric Codes (CU00295) ✉ LUK Hing Sun • YAU Shing Toung Stephen*	2000-01	A Finite Element Method for Nonlinear Convection Problems in Rapidly Rotating Spherical Shells with Applications to Planetary Fluid Systems (CU00292) ✉ ZOU Jun • ZHANG Keke*
2002-03	Geometry of CR Manifolds and Applications (CU02033) ✉ LUK Hing Sun • YAU Shing Toung Stephen*	2001-02	Simultaneous Reconstruction of Initial Temperature Distributions and Heat Radiative Coefficients (PS01244) ✉ ZOU Jun
2002-03	Error Bounds in Mathematical Programming (CU02029) ✉ NG Kung Fu • PANG Jong Shi*		

2001-02	Numerical Reconstruction of Initial Temperature Distributions (PS01811)	2002-03	Efficient Numerical Methods for Solving Electromagnetic Maxwell's Systems (CU02048)
	✉ ZOU Jun • HU Qiya* • HUANG Jianguo*		✉ ZOU Jun

RESEARCH PROJECTS

Probing the Early Universe with Cosmic Microwave Background Anisotropies

✉ CHU Ming Chung

☐ 1 December 2003

❖ Research Grants Council (Earmarked Grants)

The cosmic microwave photons are believed to be remnants of radiations produced in the hot early universe and carry information about the state of the universe during the recombination epoch, when the photon cross section is drastically reduced due to the formation of neutral atoms. In particular, the acoustic oscillations of the cosmic fireball during this epoch produced the Cosmic Microwave Background Anisotropies (CMBA), which were frozen in the subsequent expansion of the universe. It is therefore possible to put tight constraints on cosmological theories using high precision CMBA data.

We propose two theoretical projects to study the CMBA. First, we investigate the effects of the softening of the equation of state and the reheating of matter during the recombination process on the CMBA spectra. These effects have been ignored in the standard CMBA calculation, which represents the matter content of the universe by an adiabatic monatomic ideal gas. In view of the unprecedented precision of the upcoming CMBA data, it is important to test the validity of such an approximation. Second, we propose a systematic study of how changes in various fundamental ‘constants’ - such as the speed of light - over cosmological time scale affect the CMBA spectra. We therefore study the feasibility of using the CMBA

data to constrain possible variations of these ‘constants’.

(CU03008)

Effects of Phase Transitions on the Expansion of the Universe

✉ CHU Ming Chung

☐ 1 December 2003

❖ CUHK Research Committee Funding (Direct Grants)

The standard theory of modern cosmology describes a Universe whose space-time scale changes with time according to the Friedmann equation. In this theory, the expansion rate of the universe, characterized by the Hubble parameter, depends on several cosmological parameters including the average density of matter, vacuum energy density, and the intrinsic curvature of space-time. Recent data indicates that the universe is flat, and the vacuum energy density dominates that of matter by a factor of two, leading to an accelerating universe. In order to solve the Friedmann equation, the matter equation of state (EOS) – the relation between density and pressure – is needed. To good approximation, one can simplify the calculation by assuming a simplified EOS describing a mixture of photons and non-relativistic matter, the density of each changes according to the Friedmann equation itself. This approach yields also the time dependence of the temperature, which is an essential ingredient of the theory of cosmic microwave anisotropies.

In view of recent advances in observational cosmology yielding unprecedented precision on the cosmological parameters, a critical examination of the standard calculation of various cosmological observables is in order. Simplifying assumptions used previously should be scrutinized carefully. We

propose to incorporate several phase transitions known to exist in the solution of Friedmann equation and study their effects. These include the QCD phase transition (from quark-gluons to hadrons), the recombination of protons and electrons to hydrogen, and the transition of neutrino EOS from a relativistic to non-relativistic one.

(PS03999)

Micro-Raman Scattering Studies of Nanostructures

✉ HARK Sui Kong • ZHANG, Shu-ling*

□ 1 October 2003

❖ Research Grants Council (Earmarked Grants)

We propose to use size selective resonant micro-Raman technique to study individual nanostructures in the forms of highly oriented carbon nanotubes, semiconductor and metallic quantum dots. The size, shape and structure of the various nanostructures, fabricated either by us or by our collaborators, will be characterized by TEM and AFM prior to spectroscopic studies. Using tunable lasers as the excitation light sources in a high throughput confocal micro-Raman spectrograph and a CCD capable of single photon detection, we aim to single out, from an assembly that contain many, a nanostructure for detailed studies. Cryogenic cooling of the nanostructure enhances and sharpens the resonance of photons with its electronic levels, allowing the normally very weak Raman signal to be detectable. Polarized Raman studies will also be carried out in several scattering configurations to determine the symmetry of the scattering mechanisms involved. The signatures of the effects of confinement, as manifested in the obtained Raman spectra, will be analyzed according to the latest theoretical models. Through our joint effort and the

combined resources of CUHK and Peking University we think we can contribute to the understanding of the electron and phonon interactions in nanostructures.

(CU03010)

Complex Fluoride Crystals of Alkali and Rare-earth Elements for TL Dosimetry and VUV/Deep UV Up-conversion

✉ KUI Hin Wing • LO Yam Kuen Dennis

□ 31 December 2003

❖ Research Grants Council (Earmarked Grants)

Fluoride crystals are widely used as phosphors in thermoluminescence dosimetry (TL) and in vacuum ultra-violet emission. TL detectors of radiation are broadly utilized in personnel, environmental, clinical and high dose dosimetry. Since each of these fields has its own distinct requirements, there is an increasing interest in developing various types of novel materials attractive for thermoluminescence dosimetry (TLD). Although TL properties for quite a number of different chemical compositions have been thoroughly investigated, there are only a very limited number of materials which can be used for TLD. The only way to find high sensitive TL materials as well as to discover novel properties of materials which have high sensitivity is a systematic experimental study of some series of materials whose chemical compositions could change with certain regularity. VUV/deep up-conversion is of interest because near UV radiation can be up-converted into radiation in the 200nm spectral region useful for sub-micro photolithography. We aim to synthesize and characterize novel complex fluoride crystals using the hydrothermal method and the Bridgman method. As a result of this investigation, quantitative data on optical, luminescent and physical

characteristics for a number of new promising thermoluminescence and VUV/deep UV emitting phosphors will be obtained and systematized on the base of crystal chemical peculiarities of fluoride hosts.

(CU03234)

Time of Flight Scattering and Recoiling Spectroscopy of Ferroelectrics

✉ LAU Leo Woon Ming • CHAN Helen L. W.* • LIU Zhifeng (Dept of Chemistry)

☐ 1 October 2003

❖ Research Grants Council (Earmarked Grants)

Time-of-flight scattering and recoiling spectroscopy (TOF-SARS) is a powerful surface science tool that gives atomic composition and atomic spatial coordinates of the top few atomic layers of a crystal, by irradiating the sample with a very low dosage of low energy ions and monitoring the corresponding collision events. In addition, it gives information on the electronic structure of the surface and the charge exchange between the surface and all incoming/outgoing particles. The proposed project is a surface science study of ferroelectrics with TOF-SARS. Although ferroelectrics are smart materials with vast industrial applications, most applications only make use of their bulk properties and leave surface properties as unexploited resources. In the 3-year project period, we will use the readily available LiTaO₃ as a model ferroelectric and study the following properties and their interrelationships: surface composition and crystallography, hydrogen-lithium exchange reactions, and ion-induced electron and negative ion emission. More importantly, effects of changes in bulk spontaneous polarization on these properties and relevant surface charge dynamics will be examined.

In preparation, we have already built a TOF-SARS facility and collected some encouraging data in this topic. We are thus confident that we will unearth some interesting surface physics and chemistry of ferroelectrics.

(CU03013)

Quantum Entanglement in Nonclassical Light Sources

✉ LEUNG Pui Tang

☐ 1 September 2003

❖ Research Grants Council (Earmarked Grants)

Entanglement is a fundamental quantum property responsible for major applications in quantum communication. As photons are ideal carriers of quantum information, it is crucial to understand how entangled photon states can be generated and controlled. In this project we propose an extensive theoretical investigation of quantum entanglement created by two fundamental electromagnetic interaction schemes: (A) Cavity quantum electrodynamical photon pistol and (B) Parametric downconversion. Our main focus is placed on the photonic continuous degree of freedom where rich information can be encoded. We will determine how these two interactions can lead to entanglement, and provide quantification and characterization. In addition, we shall develop basic models of entanglement transfer and storage. We expect our research will bring new insights of the nature of photons that are entangled in the continuous physical variables.

(CU03016)

Gravitational Wave Spectra of Neutron Stars

✉ LEUNG Pui Tang

□ 1 October 2003

❖ CUHK Research Committee Funding (Direct Grants)

Gravitational waves emitted from a neutron star are often studied in terms of its quasi-normal modes (QNM's), which are outgoing wave solutions of a system of partial differential equations that describe the scattering of gravitational waves by the geometry of the spacetime and the fluid motion of the star. The characteristics of these QNM's that can be observed by gravitational wave detectors in the future are likely to provide useful information about the internal structure of neutron stars. In this project, we propose to study the spectra of gravitational waves emitted from a neutron star and infer the internal structure of the star from the spectra.

(PS03829)

Fabrication, Microstructure and Mechanical Properties of Aligned Nanorod/Matrix Composite Coatings

✉ LI Quan

□ 1 November 2003

❖ CUHK Research Committee Funding (Direct Grants)

It is always desirable to have a 'multifunctional' coating - with its electrical, magnetic or optical properties satisfying the requirements of specific applications, while having sufficient mechanical strength to serve the purpose of protection. It is well known that almost defect-free whisker materials have been widely used in bulk fiber-strengthened composites materials. These whiskers are mechanically strong and can take a large percentage of the applied load in the composite. It is also discovered that local inhomogeneties such as grain

boundaries and composition modulations could lead to strengthening, as these inhomogeneties can act as barriers against dislocation motion. Recently, it was demonstrated that nanorods of various materials can be readily synthesized. The nanorod is a nanoscale whisker. Its smaller size further minimizes the occurrence of defects, resulting in higher strength. Incorporating these nanorods into thin films by deliberately growing the nanorods perpendicular to the substrate leads to aligned nanorod/matrix composite coatings, where the nanorods may act as the strengthening 'bone structure'. The resulting nanorod/matrix interfaces may restrict dislocation motion, which further contributes to the film strengthening. To date, very little work is done based on the aligned nanorod/matrix composite film configuration, let alone any systematic study in understanding the relations between the designed film microstructure and its mechanical properties. We therefore propose in this project to carry out a comprehensive study on the fabrication of aligned nanorod/matrix composite films and their mechanical properties. We will focus on several aspects that may have strong influence on the mechanical properties of these composite films, and investigate the mechanisms behind it.

(PS03366)

A Finite Temperature Study of the Magnetic Properties of the Periodic Anderson Model

✉ LIN Hai Qing • GUBERNATIS J E*

□ 1 September 2003

❖ Research Grants Council (Earmarked Grants)

We will assess the experimental relevance of the periodic Anderson model (PAM) to f-electron materials by performing finite temperature quantum Monte Carlo calculations of the PAMs magnetic

properties. Both ferromagnetic and anti-ferromagnetic behavior will be studied. In particular, we will investigate whether such unusual phenomena, seen in some f-electron materials, such as an initial increase in the ferromagnetism with temperature, follows from the PAM. Because the more commonly occurring phenomena of anti-ferromagnetism is only seen in the model under special circumstances, we will search for the proper combination of parameters so that an extended version of the model is anti-ferromagnetic. Taking advantage of the efficiency offered by the parallelization of a new algorithm to perform the finite temperature quantum Monte Carlo simulations, we will perform the simulations not only in two but also in three-dimensional systems. The finite temperature and three-dimensional results will connect the PAM more firmly with experiments. (CU03017)

Studies of Multi-band Hubbard Model

✉ LIN Hai Qing • TIAN G S* • GONG C. D.* • WANG H L*

□ 1 March 2004

❖ CUHK Research Committee Funding (Direct Grants)

We propose to study the existence of the ordered phase and the quantum phase transition in strongly correlated multi-orbital electron models, such as multi-band Hubbard model, spin-orbital coupling model and multi-orbital Falicov-Kimball model. The main issues we want to address are the regions and conditions for the existence of magnetic ordering and orbital ordering in the spin-orbital model and the possibility of electronic phase separation in the multi-orbital Falicov-Kimball model. Using numerical methods such as unrestricted Hartree-Fock

approach and the special symmetry and commutation relation of the Hamiltonian, we expect to provide some rigid qualitative analysis as well as quantitatively phase diagram.

(PS03833)

Tunable Multi-wavelength Sol-gel Glass Distributed Feedback Waveguide Lasers for Communications and Sensors

✉ LO Yam Kuen Dennis

□ 1 October 2003

❖ Research Grants Council (Earmarked Grants)

Lasers with multi-wavelength output have found application in sensors and lidars for environmental monitoring. For lidar applications, dye lasers are often fitted with intra-cavity dispersion elements (e.g. prism or grating) to provide separate feedback paths for dual wavelength operation. With the recent up-surge of interest in wavelength division multiplexing (WDM) optical fiber system for communications, lasers with multi-wavelength output have drawn increased attention as the coherent light source in WDM network. For short-haul communications, plastic optical fiber (POF) system (e.g. polymethyl methacrylate (PMMA), deuterated PMMA etc.) is more advantageous than silica fiber in terms of cost and flexibility. The absolute minimum due to transmission loss of PMMA is near 560 nm with additional local minima around 640 nm and 760 nm. A multi-wavelength laser emitting near these wavelengths thus are useful in WDM applications. In this proposed research we propose the fabrication of organic or inorganic-doped sol-gel glass DFB waveguide laser leading to the demonstration of simultaneous tuning of multiple lasing modes. Zirconia or zirconia hybrid will be used as the guiding film because of the wide transparency and

absence of catalytic photo-degradation. The number of output wavelength and the separation of the output wavelengths are determined by the waveguide parameters (viz. the refractive indices of the substrate and the guiding film, the film thickness and the pump wavelength), alleviating the need of wavelength dispersive element or the use of multiple lasers in obtaining multi-wavelength output.

(CU03233)

Fabrication and Characterization of In-situ Formed Nanometer-sized Sialon Whiskers

✍ NG Hang Leung Dickon

□ 1 January 2004

❖ CUHK Research Committee Funding (Direct Grants)

Silicon nitride (Si_3N_4) provides outstanding oxidation resistance at temperature even above the melting point of steel. Sialon is formed when silicon and nitrogen in Si_3N_4 are partially replaced by aluminum and oxygen at high temperature ($> 1600^\circ\text{C}$). The general form of sialon is $\text{Si}_{6-z}\text{Al}_z\text{O}_z\text{N}_{8-z}$. It is a lightweight ceramic having high thermal shock resistance and corrosion resistance. A new technique is developed to produce high quality sialon at a moderate temperature below 1600°C . The process involves sintering of powder mixture of Al and SiO_2 in an N_2 atmosphere. In this development, we find that nm-sized whiskers that contain Si, Al, O, and N are formed. Detailed investigation shows that when Al and SiO_2 are allowed to react at 1000°C in argon, Al_2O_3 nm-sized whiskers are readily formed. Further sintering of these Al_2O_3 whiskers at higher temperatures in N_2 can transform them to nm-sized sialon whiskers. So far, there has been no report on the sighting of sialon in the form of nano-whiskers or nano-fibers. The process of producing these

whiskers is a new invention. It is simple, and time, energy and cost effective. We expect the nm-sized sialon whiskers to have superior mechanical properties than the commonly used Al_2O_3 and SiC whiskers. They can be used as strengtheners in parts and components being operated at high temperature because of their high elastic modulus and their thermal and chemical stabilities.

(PS03828)

The Study of Light Emissions in Polycrystalline Superlattices

✍ ONG Hock Chun Daniel

□ 1 January 2004

❖ CUHK Research Committee Funding (Direct Grants)

Short wavelength light emitting materials are being actively studied due to their potential applications in display technology, telecommunication and data storage. ZnO, which emits light in blue-UV region, is of great interest because it prevails strong luminescence and low turn-on threshold at a wide range of operational temperature. In addition, by using the nanotechnology, such as low-dimensional quantum wells and dots, both the luminescence as well as turn-on threshold can be further improved. To date, most of the low dimensional quantum heterostructures are based on single crystalline semiconductors. However, the making of single crystalline materials is a costly and difficult task. This proposal arises from our preliminary results that polycrystalline MgZnO/ZnO superlattices exhibit a sign of quantum size effect. Whether the quantum size effect arises primarily from the presence of quantum dot-like nanostructures or from polycrystalline quantum wells remains as an open question. Therefore, it is worthwhile to investigate

the underlying microstructures and light emission mechanism of the material system so that further optimization can be achieved. We believe the outcomes of the project will shed light on our basic understanding of the optical and structural properties of ZnO-based systems, in particular the low-dimensional nanostructures.

(PS03697)

Development of a Course Module "Astronomy" for S4-6 Students in Hong Kong

✉ TONG Shiu Sing Dominic

□ 12 March 2004

❖ Education & Manpower Bureau, HKSAR Government

The project involves the development of a trial course module "Astronomy" for S4-6 physics students in Hong Kong. The course module should be designed to enhance students' understanding of concepts and processes in Astronomy through interactive learning strategies, and to provide teachers with a collection of teaching resources. The package should include the aims and objectives, course outline and course content of about 30 hours, learning activities and supporting resources.

(ED03793)

Production of Web-based Education Kit on Energy Efficiency for Secondary Schools in Hong Kong

✉ TONG Shiu Sing Dominic • LEE Kwok San • POON Sai Chiu • PUN Pui Yung Sara • YAM Henry

□ 30 April 2004

❖ The Hongkong Electric Company & CLP Power Hong Kong Ltd.

The project aims at constructing a web-based education kit on the theme of Energy Efficiency. About 40 learning and teaching hours of learning and teaching materials will be produced. The project provides teaching resources for teachers as well as a self-learning package for students on selected topics of Energy Efficiency. Contextual approach will be adopted in the design. The package will be divided into many modules, each serving a real-life context in which students can explore. Context story, theory, information and data based on real situations in Hong Kong, are provided in each module. The learning activities in each module are packaged with detailed procedure, worksheets, discussion questions, and teachers' guides to help students experience the process of scientific investigation. The presentation of the learning activities are enhanced by a wide range of multimedia tools including photos, illustrations, Flash animations and video clips. Online interactive quizzes are in place to test students' understanding of the scientific contents. The education kit will be supported by an e-learning platform in HKEdCity. The website is bilingual in English and Chinese. Two versions of teaching materials will be designed, namely, S1-3 Integrated Science and S4-5 Physics. Tryout classes will be conducted in secondary schools and the results will be evaluated.

(ED03348)

Extraordinary Low-field Magnetoresistance in Manganite Multilayers

✉ WONG Hong Kuen

□ 1 November 2003

❖ Research Grants Council (Earmarked Grants)

(La,Ca)MnO₃ and related perovskite oxides have attracted renewed interest because of the recently discovered colossal magnetoresistance (CMR) effects. The main shortcoming of the manganites is the fact that they manifest the CMR only at high magnetic field strength, and thus not suitable for applications such as magnetic sensors in recording heads. Previous approaches to achieve enhanced low-field magnetoresistance (LFMR) including superlattices and junctions are successful only at very low temperatures. We have demonstrated that great enhancement in magnetoresistance at low field (< 500Oe) and at reasonably high temperature (~220K) can be achieved in high quality manganite multilayers. We propose to further explore different manganite multilayers and try to reveal the essential parameters responsible for the enhanced LFMR effects. It is hoped that the experiments can help clarify the CMR mechanism.

(CU03027)

De-doping of Poly(3,4-ethylene dioxythiophene) in Polymeric Electroluminescence Devices by Indium Diffusion and Its Prevention Using Self-assembly Monolayers

✉ WONG King Young • LAU Leo Woon Ming • WONG Ka Wai

☐ 1 September 2003

❖ Research Grants Council (Earmarked Grants)

Poly(3,4-ethylene dioxythiophenes), PEDOT, is one of the most widely studied conducting polymers due to its relatively high stability and processibility. PEDOT, doped with poly(styrene sulphonate), PSS, is commonly used for charge carrier (hole) injection and transport in polymeric light emitting devices (PLEDs). However, recently we found that severe indium contamination of the polymer occurs when

PEDOT:PSS is coated on indium-tin oxide (a typical electrode of PLED). We also found that such contamination detrimentally "de-dopes" the PEDOT and thereby degrades its electrical properties. In the present proposal, we will study and clarify such "de-doping" and degradation mechanisms. In addition, we will extend our preliminary work on using the self-assembly monolayer (SAM) approach for encapsulating the indium-tin oxide prior to the polymer coating, and examine the correlation between the molecular design in SAM and the effects on preventing indium contamination, enhancing adhesion, and modifying charge injection. An ultrahigh vacuum processing and analysis facility integrated with a glove box for polymer coating has already been built. Our team is experienced with surface and interface research, and polymer synthesis and characterization. We believe that the proposed work will lead to both basic understanding of conducting polymers and new techniques for PLED fabrication.

(CU03028)

Turbulent Mixing of Active and Passive Scalars in a Convective System

✉ XIA Keqing

☐ 31 December 2003

❖ Research Grants Council (Earmarked Grants)

An experimental study of the statistical properties of thermal plumes in turbulent thermal convection is proposed. Both "natural" and "artificial" plumes will be studied. The artificial plumes are generated by heaters placed inside the convection cell and their properties at "birth" are predetermined. Thus when these plumes are measured and analyzed in some "downstream" locations, we will be able to know how the plumes and the flow field interact and how

the plumes interact with each other in a turbulent environment. To investigate how the plumes influence the flow field itself, measurements of the velocity field will be synchronized with the emission of the artificial plumes, which will tell us how plumes drive or otherwise affect the velocity field. Results from this study will provide us detailed knowledge about how plumes transport heat and are advected in the convection cell.

The second part of the proposed project aims at studying the advection and mixing of a passive scalar in turbulent convection. The result will tell us how the statistical properties of the passive scalar are similar to or different from those of an active scalar advected by the same velocity field (itself under the influenced of the active one).

(CU03030)

Electrokinetic Behavior of Suspensions under AC Applied Fields

✉ YU Kin Wah

☐ 1 August 2003

❖ Research Grants Council (Earmarked Grants)

Suspension of dielectric particles dispersed in fluids is an important substance in nature. Typical materials in living systems are also suspensions. Both the suspended particles and the host fluid are dielectric material with a frequency-dependent (ac) response to applied fields. As a composite system of particles and host fluid, a suspension can have a complicated ac response. Namely, the particles in a suspension may undergo rotational motions in a rotating electric field. The dielectrophoresis is used to describe the motion of the suspended particles caused by the electric polarization in a nonuniform field. The hydrodynamic interaction between the particles can also change the ac response and the dispersion

spectrum of a suspension. In this proposal, we aim at investigating the ac electrokinetic behavior of a suspension, and study the effects of the particle motion and the hydrodynamic interaction among the particles on the ac response.

(CU03033)

Please refer to previous issues of this publication for more details of the following ongoing research at the department:

Edition	Title/Investigators
2000-01	Velocity and Temperature Statistics in Turbulent Convection (CU00286) ✉ CHING Shuk Chi Emily
2002-03	Turbulent Convection: Statistics, Large-scale Circulating Wind, and Heat Transport (CU02046) ✉ CHING Shuk Chi Emily
2001-02	Dynamics of a Driven Bose-Einstein Condensate: Coherent Structures and Control (PS01237) ✉ CHU Ming Chung • LEUNG Pui Tang
2001-02	Optical Properties of Wide Band Gap II-VI Semiconductor Quantum Dots (PS01247) ✉ HARK Sui Kong • LAU Leo Woon Ming
2002-03	Resonant Raman Scattering of Semiconductor Nanostructures (PS02817) ✉ HARK Sui Kong

2001-02	Physics of Adaptive Behaviour in a Population of Competing Agents (PS01241) ✉ HUI Pak Ming	2001-02	Fabricaton of Zn-based One-dimensional Nanostructures and Their Optical Properties (PS01746) ✉ LI Quan
1989-90	Microstructure of Undercooled Ge and Si (BP87003) ✉ KUI Hin Wing	2002-03	Synthesis of Uniform II-VI One Dimensional Nanostructures and Their Growth Mechanism Study (PS02431) ✉ LI Quan
1989-90	The Viscosity of Easy Glass Formers (BP87004) ✉ KUI Hin Wing	2001-02	Exact Diagnoalization Studies of Quantum Spin Models (PS01246) ✉ LIN Hai Qing • BETTS Donald D*
2000-01	Mechanical Behavior of Bulk Nanostructured Alloys Synthesized by Rapid Solidification (CU00170) ✉ KUI Hin Wing	2002-03	A Parallel Quantum Monte Carlo Study of Magnetic and Electronic Properties of Strongly Correlated Electron Materials (CU02037) ✉ LIN Hai Qing • GUBERNATIS J E*
2001-02	Thermal Stability of Nanostructured Alloys Prepared by Metastable Liquid Spindoad Decomposition and the Search for High-temperature Nanostructures (MP01184) ✉ KUI Hin Wing	2002-03	Estimation of Default Probability by Three-factor Structural Model (PS02932) ✉ LO Chi Fai • HUI Cho Hoi*
2002-03	Spatial Solitions in Photovoltaic Photorefractive Crystals and Their Interactions (CU02035) ✉ LEE Wing Kee	2001-02	Compact Long-pulse Vacuum Ultra-violet Source for Micro-fabrications (EE01218) ✉ LO Yam Kuen Dennis
2000-01	Applications of Quasinormal-Mode Expansion in Open Wave Systems (CU00282) ✉ LEUNG Pui Tang	2002-03	Correlative Study of Thermoluminescence and Surface Analytical Techniques in the Provenance Determination of Ancient Ceramics (PS02857) ✉ LO Yam Kuen Dennis
2001-02	Mie's Scattering from Imperfect Spheres (PS01910) ✉ LEUNG Pui Tang	2001-02	Fabrication and Characterization of Alumina Whiskers and Intermetallics

	Reinforced Aluminum-based Metal Matrix Composites (MP01235) ✍ NG Hang Leung Dickon • CHAN Lap Ip Sammy*	2002-03	Video Bank for Secondary-school Physics Teaching (PS01882) ✍ WONG Wing Hung • MAK Se Yuen (Dept of Curriculum & Instruction)
2001-02	The Study of ZnO Doped with Erbium and Its Electroluminescent Applications (EE01648) ✍ ONG Hock Chun Daniel • XU Jianbin (Dept of Electronic Engineering) • LUO Enzhou (Dept of Electronic Engineering)#	1993-94	Study of Statistical Nature of Particle Motion in Fluids (BP00101) ✍ XIA Keqing
		1994-95	Experimental Studies of Turbulent Convection (PS94012) ✍ XIA Keqing
2000-01	Production a Web-based Self-Learning Package for Secondary School Teachers in Hong Kong: Using Contextual Themes in the Teaching of Physics in Secondary Schools (ED20020) ✍ TONG Shiu Sing Dominic • WONG Wing Hung • LAU Leo Woon Ming	2001-02	Turbulent Thermal Convection in Low and High Prandtl Number Fluids over Rough Surfaces (PS01242) ✍ XIA Keqing • TONG Penger*
		2001-02	Experimental Investigation of Chaotic Modes in Turbulent Rayleigh-Benard Convection (PS01447) ✍ XIA Keqing
2002-03	Production of IT-based Resource Materials for Physics (ED02849) ✍ TONG Shiu Sing Dominic • LEE Kwok San • YAM Henry • POON Sai Chiu • PUN Pui Yung Sara	2001-02	First-principles Approach to Dielectric Dispersion of Nonspherical Cells (PS01245) ✍ YU Kin Wah
2001-02	Technology and Materials Innovations in Using Electrically Luminous Plastics in the Display Industry (PS01645) ✍ WONG King Young • CHOW Hak Fun (Dept of Chemistry) • XU Jianbin (Dept of Electronic Engineering) • LAU Leo Woon Ming • WONG Sai Peng Joseph (Dept of Electronic Engineering) • HARK Sui Kong • ONG Hock Chun Daniel	2001-02	Computer Simulation of Electrorheological Fluids in the Dipole-Induced-Dipole Model (PS01705) ✍ YU Kin Wah
		2002-03	Field-induced Structural Transformation of Self-assembled Colloids (PS02545) ✍ YU Kin Wah

RESEARCH PROJECTS

Fractional Black-scholes Models and Malliavin Calculus

✉ CHAN Ngai Hang

□ 1 June 2004

❖ CUHK Research Committee Funding (Direct Grants)

This proposal aims at developing a class of long-memory Black-Scholes models by means of fractional Brownian motion. Since it is well known that fractional Brownian motion is not a semi-martingale, the corresponding Black-Scholes model will not be arbitrage free. In order to preserve the arbitrage free condition, a new class of stochastic calculus, namely, Malliavin calculus, has been developed. By means of the Malliavin calculus and Wick product, Black-Scholes formulae for contingent claims can be established. In this project, we propose to pursue this idea in regard to volatility estimation. In particular, it will be shown that a corresponding Black-Scholes formula for the constant elasticity of volatility model can be established. Furthermore, application of the formula to real-life data reveals the volatility skewness phenomenon reported in empirical literature. Results of this project not only provide valuable conceptual advances to long-memory financial modeling, but also practical computational tools to model financial data.

(PS03375)

Multiple Comparisons with a Control in Two-way Designs with Directional-mixed Families

✉ CHEUNG Siu Hung

□ 1 January 2004

❖ CUHK Research Committee Funding (Direct Grants)

Multiple Comparison Procedures (MCP) is a powerful tool for comparing different treatments in an experiment. It is widely used in medicine, agriculture, etc. In many circumstances, it is desirable to include a control in the experiment in the form of a dummy treatment, to measure the magnitude of the experimental response without any treatments. Thus we can compare whether a certain treatment is better with respect to the control treatment.

Cheung and Holland (91, *biometrics*; 94, *Statistics in Medicine*) extended the well-known Dunnett procedure for simultaneous comparison of the mean of all active treatments with the control mean to the case where one wishes to conduct such comparisons simultaneously in each of several groups. However, their procedures mainly deal with particular families of inferences in which all hypotheses are either one-sided or two-sided. In this article, we seek to develop a procedure, which copes with a more general testing environment in which the family of inferences is composed of a mixture of one-sided and two-sided hypotheses. The proposed procedure, which incorporates the prior directional information of some treatments, provides a more flexible and powerful tool than the existing method.

(PS03403)

Statistical Analyses of Structural Equation Models with Missing Data

✉ LEE Sik Yum

□ 1 November 2003

❖ Research Grants Council (Earmarked Grants)

Latent variables that cannot be measured directly by a single measurement are very common in behavioral, educational, psychological and social research. Structural equation models (SEMs) are well-recognized as important techniques with which to explore the relationships among latent and manifest variables in establishing plausible models. In recent years, the growth of SEMs for analyzing fully observed data has been very rapid. To cope with the strong demands in various fields, more than a dozen of standard SEMs packages have been developed, and complex SEMs have been established on the basis of more advanced statistical methods. Comparatively, contributions to analyze SEMs with missing data (MD) are very limited. Even for standard models and data structures, existing methods in treating MD have theoretical and computational deficiencies, whilst for complex models and data, very little results have been achieved. However, in practice, MD are frequently encountered in more than ninety percents of the data sets. Moreover, a lot of publications have indicated that the commonly used 'Listwise deletion' approach gives inaccurate and theoretically inferior estimates. More importantly, incorrect treatment of MD may result in selection of a wrong model in the model selection and give very misleading conclusions. Hence, developing sound statistical methods for handling MD has become very important. The main objective of this project is to develop theoretically rigorous and computationally efficient methods for analyzing MD in SEMs. In addition to the standard SEM, more sophisticated models will be investigated that have wider scope of applicability, in the context of more complex data structures in reality. Both Bayesian and maximum likelihood approaches for estimation, hypothesis testing, and model comparison/selection, will be

investigated. Efficient algorithms for computing the estimates and the Bayes factor (or BIC) for model comparison/selection will be developed using the advanced powerful tools in statistical computing; for example the Monte Carlo EM algorithms, Markov chain Monte Carlo methods, bridge sampling and path sampling. The newly developed methodologies will be very useful in practical applications of SEMs to substantive research with missing data.

(CU03243)

Maximum Likelihood and Influence Analysis of a Unified Model for Ranking Data

✍ POON Wai Yin • LEE Sik Yum

□ 1 October 2003

❖ Research Grants Council (Earmarked Grants)

When a research involves a list of alternatives/items/objects/variables, ranking can be an easy, quick and natural method to elicit useful information. In collecting ranking data, each subject/judge is required to order the set of alternatives according to a particular criterion, such as acceptability, desirability or quality. For example, citizens may be asked to rank 4 public policies, with the most preferred policy being labeled as 1, second preferred as 2, and accordingly, least preferred as 4. Ranking data has unique characteristics. For example, the sum of rankings made by each individual respondent is equal to a constant; thereby introducing dependency among the set of ranked items. As a result, it is necessary to develop statistical techniques designated for analyzing ranking data. A number of approaches have been developed and the Thurstonian approach has been confirmed as being useful for research in a wide range of disciplines. However, due to the well-known computational burden that arises

from computing multi-dimensional integrals, Thurstonian ranking models discussed in the literature are comprised of some specific simple structures. A unified and general model that allows modeling ranking data in a flexible way is not available, hindering the development of substantive researches based on ranking data. The objective of this project is to develop efficient, reliable and convenient statistical techniques that will enable researchers in various disciplines to model and analyze ranking data. A unified and general model will be built for the purpose of modeling ranking data. An efficient procedure to produce parameter estimates with optimal statistical properties will be developed. Influence analysis procedures, which will accompany the estimation method for assessing influence of minor perturbation of a hypothesized model, will be derived.

(CU03242)

A Structural Model of Credit Migrations

✍ WONG Hoi Ying

□ 1 September 2003

❖ Research Grants Council (Earmarked Grants)

This project aims at building a structural model for credit migration. We propose a firm specific model depending on the Distance to Default and migrating signal durations of a given firm. The Distance to Default is the number of standard deviation of logarithmic asset-to-liability ratio to asset value volatility, modeled by a Brownian motion, and the migrating signal durations are modeled by occupation time variables. By measuring the duration of a firm's upgrading signals and downgrading signals, it is possible to describe the "general" credit performance of a firm in a specific horizon. The proposed model not only satisfies an empirical observations that there

are overlaps in default probabilities across different credit ratings, but also explains why this empirical observations reflect market reputations of rated companies. A closed-form solution of credit transition probability is also derived. The proposed model can be used with historical transition matrices to filter out the subjective assessments of rating agencies.

(CU03026)

Valuing General American Style Options with Sub-replication and Replenishing Premium Approach

✍ WONG Hoi Ying

□ 1 March 2004

❖ CUHK Research Committee Funding (Direct Grants)

This research project studies the model-free valuation of American style options, including path dependent contracts. By considering a series of sub-replicating portfolios approaching the underlying American options, the option price is decomposed into a sum of the price of its European counterpart and an early exercise premium. It results at obtaining a model-free representation for the early exercise premium under the risk-neutral probability measure. Then, we attempt to verify that the model-free representation for prices of American call, American put and American path dependent options with continuous sample path agrees with the findings of the literature. The verification is also made for jump-diffusion models in pricing vanilla American put. This result may add new insights to the development of nonparametric estimation for American options.

(PS03495)

Please refer to previous issues of this publication for more details of the following ongoing research at the department:

Edition Title/Investigators

		1989-90	Analysis of Continuous and Polytomous Variables (CS85001) ✉ LEE Sik Yum • POON Wai Yin
		1989-90	Analysis of Incomplete Data (CS88002) ✉ LEE Sik Yum • POON Wai Yin
2002-03	Long-memory Time Series Analysis for Bursty Data in I/O Performance and Finance (CU02043) ✉ CHAN Ngai Hang	1989-90	Analysis of Structural Equation Models with Correlated Data (CS89006) ✉ LEE Sik Yum • POON Wai Yin
2000-01	Testing Equivalence in Paired-sample Design: An Exact Unconditional Approach (CU00261) ✉ CHAN Ping Shing Ben • CHAN Siu Fung Ivan* • TANG Man Lai#	2000-01	Influence Diagnostics for Statistical Models with Missing Data and Their Applications to Models with Latent Variables (CU00356) ✉ LEE Sik Yum
2002-03	Test of Fit for the Log-gamma Distribution (PS02986) ✉ CHAN Ping Shing Ben	2001-02	Development of a General Model Selection Procedure for Complex Structural Equation Models (SS01346) ✉ LEE Sik Yum
2001-02	Multiple Comparisons and Bioequivalence Studies in Two-way Designs (PS01561) ✉ CHEUNG Siu Hung • WU Ka Ho Eden	2002-03	Development of Statistical Methods and Computer Programs for a Two-level Nonlinear Structural Equation Model with Fixed Covariates and Binary, Ordinal Categorical and Continuous Variables (CU02243) ✉ LEE Sik Yum
2002-03	Sensitivity Analysis of Family Selection in Multiple Inferences (CU02042) ✉ CHEUNG Siu Hung • WU Ka Ho Eden	2002-03	Maximum Likelihood Analysis of Mixture of Structural Equation Models (PS02917) ✉ LEE Sik Yum
2002-03	Inference for General Non-Linear Random Effects Models with MCMC Stochastic Approximation (CU02041) ✉ GU Ming Gao	2001-02	Sampling Correlated Varieties from Partially-specified Distributions (PS01989) ✉ LI Kim Hung

1989-90	Analysis of Fuzzy Data (CS89005) ✍ POON Wai Yin • LEE Sik Yum • LEUNG Y P*	2001-02	Multiple Forecasts with Autoregressive Time Series Models (PS01414) ✍ WU Ka Ho Eden • CHEUNG Siu Hung
2001-02	Practice and Influence Analysis of Structural Equation Modeling with Ordinal Data (SS01347) ✍ POON Wai Yin	2002-03	Benchmarking Socio-economic Time Series with Survey Error Modelling (CU02314) ✍ WU Ka Ho Eden • CHEN Zhao Guo* • CHEUNG Siu Hung
2002-03	Analysis of Ranking Data with Structural Equation Modeling (PS02911) ✍ POON Wai Yin		