

RESEARCH PROJECTS

Formation Theory of Finite Groups and Algebras

✉ SHUM Kar Ping

☐ 21 September 2002

❖ Research Grants Council (Earmarked Grants)

The theory of finite solvable groups forms a remarkable subclass of the class of finite groups. The theory of formation of finite groups was introduced by Gaschütz in 1963. In recent years, fruitful results on finite groups have been obtained by using the theory of formation.

In this project, we will concentrate on local formation theory of finite groups and universal algebras. We will develop the method of Gaschütz and apply the theory to semigroups and universal algebras. It is expected that some interesting results on groups, semigroups, general algebras and formation operators can be obtained. Formation theory related to table algebras will also be considered.

(CU02031)

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

| <u>Edition</u> | <u>Title/Investigators</u> |
|----------------|---|
| 1999-00 | Semigroups and Combinatorics Applications (CU99216) ✉ SHUM Kar Ping |
| 2001-02 | Representations and Structures of Regular Semigroups, Regular Rings and Related Topics (PS01260) ✉ SHUM Kar Ping |
| 2001-02 | Fuzzy Mathematics with Applications in Algebra and Automata (PS01477) ✉ SHUM Kar Ping • WU Congxin* • SEN M K* |

RESEARCH PROJECTS

Biochemical Analysis of Dribble, a Single KH Domain-containing Protein

✉ CHAN Ho Yin Edwin • NGAI Sai Ming (Dept of Biology)

☐ 1 January 2003

❖ CUHK Research Committee Funding (Direct Grants)

The K homology (KH) domain is a short module of approximately 70-100 amino acids commonly found in RNA-binding proteins. Depending on the number of KH domains that a protein carries, KH domain-containing proteins are classified into two classes. The *Drosophila* Dribble (DBE) protein belongs to novel protein sub-group of a single KH domain protein class. DBE represents an evolutionarily conserved protein family and is homologous to the human HIV-1 Rev binding protein 2 (HRB2). One suggested role of HRB2 is in the nuclear trafficking of HIV-1 RNAs. Consistent with this view, DBE has been shown to localize to the nucleolus. Previous characterization of DBE revealed a role in ribosomal RNA metabolism. Analysis of proteins from other groups of KH domain-containing proteins indicates that they interact with each other to form dimmers. More interestingly, dimer formation of some KH domain-containing proteins requires the presence of cellular RNAs. Point mutation found in the KH domain region of the *fragile X mental retardation (fmr)* gene affects RNA binding of the FMR protein, and causes Fragile X syndrome in humans. Using biochemical techniques, we sought to investigate (1) the dimerization potential (homo-dimerization) and

(2) protein interacting partners (hetero-oligomerization) of DBE. Through studying this newly identified KH protein family, the proposed work will shed light on the biochemical properties of this and other classes of KH domain-containing proteins.

(BL02693)

Antioxidant and Vasorelaxative Properties of Green Tea Catechin Epimers

✉ CHEN Zhenyu • HUANG Yu (Dept of Physiology) • LEUNG Lai Kwok (Biochemistry)

☐ 1 November 2002

❖ CUHK Research Committee Funding (Direct Grants)

The proposed project is to study the antioxidant and vasorelaxative activities of four epimers of green tea catechins (GTCs). In green tea, GTCs are the principal components and contains mainly four epicatechin derivatives namely (-)-epicatechin (EC), (-)-epicatechin gallate (ECG), (-)-epigallocatechin (EGC) and (-)-epigallocatechin gallate (EGCG). GTCs have been shown to be anticarcinogenic, antioxidative and hypolipidemic. Our recent study has demonstrated that GTCs are probably antihypertensive because it can relax the rat isolated mesenteric artery. In another study, we found that canned or bottled tea drinks were relatively low in GTCs partially because of thermal degradation. It is also known that canned or bottled tea drinks contain epimers of GTC because heat treatment during tea brewing or sterilization causes epimerization of EGCG to (-)-gallocatechin gallate (GCG); EGC to (-)-gallocatechin (GC); ECG to (-)-catechin gallate (CG); and EC to (-)-catechin (C). To date, there are no studies that have examined the biological activity of four epimers, GCG, GC, CG and C. The

objectives of the present studies that have examined the biological activity of four epimers, GCG, GC, CG and C. The objectives of the present study are therefore to (1) study the factors that influence the epimerization of GTC; (2) compare the relative antioxidant activity of these epimers with that of EGCG, EGC, ECG and EC; (3) test the vasorelaxative properties of the four epimers; and (4) identify the decomposing products of GTC during heat treatment under various processing conditions.

(BL02638)

Isolation and Characterization of a Protein with Trypsin-inhibitory and Antifungal Activities from Wampee (*clausena lansium*) Seeds

✉ FONG Wing Ping • NG Tzi Bun (Biochemistry)

□ 1 November 2002

❖ CUHK Research Committee Funding (Direct Grants)

Preliminary experiments revealed the presence of potent trypsin-inhibitory and antifungal activities in the seed extract of wampee (*clausena lansium*) which is a popular edible fruit. The intent of the study is to isolate and characterize the protein or proteins in the seed extract which exhibit trypsin-inhibitory and antifungal activities. Recently there have been reports that some types of protease inhibitors exhibit antifungal activity. The isolated protein will be characterized with regard to its substrate (trypsin/chymotrypsin) specificity, specificity of antifungal activity toward different fungal species, and antiproliferative activity toward tumor cell lines. Its molecular weight, subunit nature, and amino acid sequence will be ascertained. The isolated protein will be compared with known proteins with respect to its structure and functions.

(BL02467)

Biochemical Characterization of Newly-identified UGT 1A8 in Rats

✉ HO Wing Shing John

□ 1 November 2002

❖ CUHK Research Committee Funding (Direct Grants)

Glucuronidation is one of the major conjugation reactions occurring in most species with a wide variety of substrates. The enzyme catalyzing the conjugation reaction, UDP-glucuronosyl transferase (UGTs), exists in four or more forms with different substrate specificities. The expression and regulation of UGTs play an important role in detoxification of xenobiotics. Different isozymes have been identified. However, the biochemical properties of these enzymes remain sketchy. The present study is planned to characterize the gene expression of UDP-transferases in the rat after treatment with 3-methylcholanthrene. In particular, UGT1A8, which has recently been identified in rat hepatoma cells will be studied. The mRNA levels in the rat will be determined using RT-PCR. The results will be confirmed by Northern blot analysis. The substrate specificity of UGT1A8 will be studied and compared with the other UGTs in the rats. The study will allow us to study the expression of UGT1A8 and its functional role in detoxification reaction in the rat. The methodology of the present study will be valuable tools for screening natural products for study of enzyme induction. The study will have a wide range of applications that may include profiling differential gene expression, and discovering potential natural products with therapeutic benefits for the liver.

(BL02543)

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

□ 1 December 2002

❖ CUHK Research Committee Funding (Direct 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_α by lipid-like chemicals, such as Wy-14,643, results in liver cancer. It is known that PPAR_α mediates its action via modulations of gene expressions. PPAR_α regulates its target genes by forming heterodimer with retinoid X receptor (RXR_α) and binds to a DNA consensus sequence named as the peroxisome proliferator response element (PPRE) on its target genes. Many PPAR_α target genes have been identified, however the whole spectrum of PPAR_α regulating genes involved in maintaining lipid homeostasis during energy deprivation, and peroxisome proliferator chemicals-induced liver cancer is still not fully known. The long-term goal of our laboratory is to unrevealing the molecular mechanism of PPAR_α mediating effects, such as lipid metabolism during fasting and Wy-14,643-induced liver cancer formation. In one of our previously funded RGC projects aiming to isolate novel PPAR_α target genes involved in lipid metabolism during energy deprivation, we identified a novel and putative PPAR_α 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_α 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. Identification of new PPAR_α regulating gene might increase our understanding on how PPAR controlling the battery of genes involved in maintaining lipid homeostasis during high demand of lipid metabolism, such as during diabetes, liver dysfunction, fasting, and mitochondrial fatty acids disorders.

(BL02732)

An Investigation on the Effects of 18β-Glycyrrhetic Acid on the Proliferation, Differentiation and Apoptosis of Myeloid Leukemia Cells *In Vitro*

✉ LEUNG Kwok Nam

□ 1 December 2002

❖ CUHK Research Committee Funding (Direct Grants)

Leukemia is a heterogeneous group of disorder resulting from an uncoupling of the proliferation and differentiation of blood cells at various stages of development. Conventional anti-leukemia drugs have several limitations such as relatively high cost, significant toxicity and adverse side effects. Differentiation therapy and induction of apoptosis are two new approaches for the treatment of leukemia.

Our earlier work and that of others have shown that myeloid leukemia cells will stop to proliferate and are induced to differentiate in response to a wide variety of agents, including cytokines, vitamin analogs and phytochemicals isolated from many species of Chinese medicinal herbs. The traditional Chinese medicine Gancào (甘草) or licorice has widely been used in China and Asia for decades in the treatment of hepatitis, hepatocellular carcinoma, melanoma, inflammatory diseases, gastric ulcer and several viral diseases. The major active constituent of licorice is glycyrrhizin (GL), a water-soluble triterpenoid saponin glycoside that accounts for much of the sweetness of licorice. It is metabolized into the aglycone 18 β -glycyrrhetic acid (18 β -GA) after oral administration in humans. Earlier studies by others have shown that 18 β -GA exhibits hepatoprotective, immunomodulatory, anti-allergic, anti-carcinogenic and anti-tumor activities. However, the direct anti-leukemic activity and the modulatory effects of 18 β -GA on the growth, differentiation and apoptosis of leukemia cells remain poorly understood. Therefore, the main objective of this project is to investigate the effects of 18 β -GA on inhibiting the proliferation, inducing leukemic cell apoptosis and in triggering the terminal differentiation of the myeloid leukemia cells. Moreover, attempts will be made to identify the genes that may be involved in the 18 β -GA-induced myeloid leukemic cell differentiation and growth arrest. It is anticipated that this study will lead to a better understanding of the biological and pharmacological properties of 18 β -GA and its potential application in the differentiation therapy of leukemia.

(BL02967)

Optimization of Enzymes: Development of Novel Methodology for New Applications

✍ WANG Jun

☐ 1 August 2002

- ❖ GeneHarbor (Hong Kong) Technologies Limited
 - University-Industry Collaboration Prog.: Matching Grant for Joint Research, ITF, Innovation & Tech. Commission

The project targets at three tangible goals: (1) to develop a novel methodology for more efficient *in vitro* recombination; (2) to integrate the novel methodology with a number of existing key technologies of proteomics to generate a platform technology for optimization of proteins/enzymes; and (3) to apply the platform technology to improve biochemical properties of a number of enzymes of eminent commercial values. The deliverables include improved catalytic and thermostability for these enzymes and the IP rights associated.

(BL02320)

Structural Basis of Thermostability of Proteins - Protein Engineering of a Thermophilic Protein from a Hyperthermophilic Archaea *Thermococcus celer*

✍ WONG Kam Bo

☐ 31 December 2002

- ❖ Research Grants Council (Earmarked Grants)

How some proteins remain stable at high temperatures is an unresolved issue. *Thermococcus celer* is a hyperthermophilic archaeon growing at an optimal temperature of 85°C. The ribosomal protein L30e from *T. celer* is highly thermostable, which resists unfolding at over 90°C, while the mesophilic yeast L30e protein undergoes irreversible unfolding at 45°C. We propose to use the L30e proteins as a model system to delineate the structural basis of thermostability of proteins. We will measure and

compare the thermodynamics parameters (ΔG_u , T_m , ΔH_m , ΔC_p) of the mesophilic/thermophilic L30e. The contribution of individual residues to the thermostability will be probed by the protein engineering approach. The effect of mutation on thermostability will be quantified by thermodynamics parameters such as melting temperature and free energy of unfolding. Thermodynamics parameters obtained will be compared to those predicted by theoretical models. Results obtained on the L30e model will provide lessons of how to engineer a heat labile protein to a thermostable one.
(CU02254)

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*

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 Serine Protease Inhibitors from Cucurbitaceous Seeds (BL01816)

✉ FONG Wing Ping • NG Tzi Bun (Biochemistry)

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*

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)

2000-01 Induction of UDP-glucuronyltransferase and Its Regulation in Rats by Licorice Extracts (BL00746)

✉ HO Wing Shing John

1999-00 Identification of Peroxisome Proliferator-activated Receptor- α (PPAR α)-dependent Genes Involved in Peroxisome Proliferator-induced Hepatomegaly and Hepatocarcinogenesis (CU99157)

✉ LEE Sau Tuen Susanna • CHAN Wood Yee (Dept of Anatomy)

2000-01 Identification of Peroxisome Proliferator-activated Receptor- α (PPAR α)-dependent Genes Involved in Hepatic Lipid Metabolism (CU00241)

✉ LEE Sau Tuen Susanna

2001-02 Identification of Genes Involved in Carbon Tetrachloride-induced Liver

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|---------|--|---------|---|
| | Injury: A Model for Chemical Toxicity-mediated by Free Radicals (BL01135) ✉ LEE Sau Tuen Susanna | 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) |
| 2001-02 | Mechanistic Actions of Antiviral Compounds Isolated from Chinese Herbs Banlangen (MD00947) ✉ LEUNG Kwok Nam | | |
| 1999-00 | Structure-function Relationship Study of M.EcoHK31I, a C5-cytosine Methyltransferase with Two Polypeptides (CU99177) ✉ SHAW Pang Chui • LEE Kai Fai* | 2000-01 | Second Messenger Mediating the Interaction between Tumor Necrosis Factor- α and β -adrenergic Mechanism in C6 Glioma Cells (BL00734) ✉ TSANG David Sau Cheuk |
| 2001-02 | Technology Development for Assessing Chinese Medicinal Materials for Treating Alzheimer's Disease (BL01490) ✉ SHAW Pang Chui • FUNG Kwok Pui (Biochemistry) • WAN Chi Cheong David (Biochemistry) • FISCUS Ronald Ray (Dept of Physiology) • CHEUNG Chun Yung Thomas* | 2001-02 | Interactions between Tumor Necrosis Factor-alpha and Beta-adrenergic Mechanism in Cultured Rat Astrocytes (BL01139) ✉ TSANG David Sau Cheuk • LEUNG Kwok Nam |
| 2001-02 | Interaction of Ribosomal Proteins P0 and P1 with Trichosanthin (BL01145) ✉ SHAW Pang Chui • SZE Kong Hung* • WONG Kam Bo • ZHU Guang* | 2000-01 | Biochemical Engineering of New Pathways for Antibiotics Production (BL00736) ✉ WANG Jun |
| 2001-02 | Screening of Chinese Medicinal Materials for Lowering the Accumulation of Amyloid-beta Peptide (BL01565) ✉ SHAW Pang Chui • LEE Wing Cheung# | 2001-02 | Efficient, Economical and Environmentally-friendly Production of Key Intermediates of Major Antibiotics (BL01619) ✉ WANG Jun |

2000-01 Structure-function of a Novel RNA-binding Motif-structure Determination of a Ribosomal Protein L30e from *Thermococcus Celer* by Multi-dimensional NMR Spectroscopy (CU00243)
✍ WONG Kam Bo

2001-02 Structural Basis of Thermostability of a Protein from a Hyperthermophilic Archaea *Thermococcus Celer* - Protein Engineering and High Resolution Structure by Crystallography (BL01645)
✍ WONG Kam Bo

RESEARCH PROJECTS

Provision of Services - Biological Monitoring in Tung Ping Chau Marine Park

✍ ANG Put Jr.

☐ 15 August 2002

❖ Agriculture, Fisheries & Conservation Dept,
HKSAR Government

Tung Ping Chau, located on the northeastern part of New Territories, Hong Kong, was designed as the fourth Hong Kong marine parks in Nov, 2001. This project aims to examine the fish, coral and algal diversities of designated areas around the island in order to monitor for any changes that may occur after the area around the island has been designated as a marine park. As recreational fishing is allowed in two designated areas around the island, this project will also monitor the number of fishers, the fish they catch, and possibly the sizes of fish being caught. Results from this project will help formulate future management programme for this marine park.

(BL02560)

Provision of Services for a Study on Establishing a Reference Collection and Field Guides for Hong Kong Scleractinian Coral

✍ ANG Put Jr.

☐ 15 August 2002

❖ Agriculture, Fisheries & Conservation Dept,
HKSAR Government

Scleractinian corals form extensive coral formation, especially in the eastern shore of Hong Kong shallow water environment. The taxonomic identity of these

corals, however, remains to be systematically clarified. This project aims to clarify the species identity of Scleractinian corals found in Hong Kong corals and to build a reference collection for these corals. A general guide book on the identity and distribution of Hong Kong corals will also be produced.

(BL02784)

Coral Mapping in Tung Ping Chau

✍ ANG Put Jr.

☐ 15 August 2002

❖ Civil Engineering Department, HKSAR
Government

Tung Ping Chau was declared as the fourth Marine Park in Hong Kong in Nov., 2001. Since then, the number of people visiting Tung Ping Chau has increased tremendously. The present public pier is old and dilapidated and needs to be reconstructed in order to ensure the safety of the public using it. There are many corals living around the pier. In order to ensure that the reconstruction of a new pier will not impose a great impact on the coral communities, a detailed mapping is carried out to locate the position of every coral colony within a 120m X 120m area around the pier. A corridor with the least number of coral colonies and with the lowest percentage of coral could then be selected and identified as the working area for the barge and for setting up of the temporary pier.

(BL02810)

Recovery of Corals form Lesion and Injuries

✍ ANG Put Jr.

☐ 1 January 2003

- ❖ CUHK Research Committee Funding (Direct Grants)

Scleractinian corals form extensive coral formation, especially in the eastern shore of Hong Kong shallow water environment. They are, however, subject to extensive damage from human activities like swimming and anchorage or from other natural phenomena like predation, bleaching and fouling by other invertebrates and algae. This study examines the ability of corals to recover from various types of injuries brought about by both human activities and natural phenomena. Selected species of corals, representing different growth forms, will be examined and their rate of recovery compared.

(BL02430)

Provision of Services on Marine Flora Studies in Hoi Ha Wan Marine Park

- ✉ ANG Put Jr.

□ 15 June 2003

- ❖ Agriculture, Fisheries & Conservation Dept, HKSAR Government

Seagrasses were recently discovered in Hoi Ha Wan Marine Park. This project aims at monitoring the seasonality, growth, reproduction and associated fauna of this seagrass bed as well as changes in the abundance of seaweed flora around the Marine Park. A list of seagrass and seaweed species found in the marine park will be compiled.

(BL02515)

A Mechanistic Study of the Immunopotentiating and Antitumor Effects of Native and Chemically Modified Nonstarch Polysaccharides [(1 → 3)-β-D-glucans] from Mushroom Sclerotia

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

□ 1 October 2002

- ❖ Research Grants Council (Earmarked Grants)

For centuries, mushrooms have been valued as flavorful foods and as medicinal substances. They are widely sold as nutritional supplements having health benefits. Mushrooms are claimed to have various medicinal effects including antiviral, antibiotic, anti-inflammatory, hypocholesterolemic, hypotensive, and hypoglycemic activities. However, the most detailed investigated medicinal effect of mushrooms is their antitumor activity and enhancement of the immune system in mice and in humans. Among the different bioactive substances identified in mushrooms, nonstarch polysaccharides (NSPs) especially the (1→3)-β-D-glucans are found to be the most potent antitumor-active compounds. These mushroom polysaccharides are conventionally isolated from the fruiting bodies, mycelia and the culture media of mushrooms. They are generally considered as a kind of biological response modifiers which are able to restore or enhance various immune responses which result in the inhibition of the growth of tumor cells, exertion of carcinostatic action and though to a lesser extent direct cytotoxic effects on cancer cells. Our previous studies have shown that mushroom sclerotia, a compact solid mass of fungal hypha, were extremely rich in NSPs, particularly (1→3)-β-D-glucans that had antitumor activities from experiments using mouse models and tumor cell cultures. This project will aim at investigating the *in vivo* cellular mechanisms by which these sclerotial mushroom polysaccharides modulate the immune system and potentially exert antitumor effects. This project also aims at exploring the potential development of some structurally well-defined native and chemically modified polysaccharides obtained

from mushroom sclerotia as novel immunopotentiating as well as antitumor agents.

(CU02255)

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

✉ CHEUNG Chi Keung Peter

□ 1 December 2002

❖ CUHK Research Committee Funding (Direct Grants)

High fiber diets have been used in the successful treatment of diabetics. Edible mushrooms are regarded as a health food for diabetic patients because of its high fiber (non-starch polysaccharides [NSP]) content with low levels of fat and digestible carbohydrate. A number of NSP has been isolated from the fruiting bodies and spores of some common edible and medicinal mushrooms such as *Tremella fuciformis*, *Tremella aurantia*, *Auricularia auricula*, *Ganoderma lucidum*, *Hericium erinaceum*, etc.; they significantly decrease the blood glucose level of chemically-induced as well as genetically diabetic mice. It has been postulated that viscous water-soluble NSPs decrease the digestion and absorption of carbohydrate, resulting in the lowering of blood glucose levels. However, the detailed structural relationships between the mushroom NSPs and their hypoglycemic effect are still not well understood. The present proposal will aim at studying the antidiabetic effect of some structurally well-characterized mushroom NSPs. The research will expect to give insights into the hypoglycemic mechanisms of mushroom NSPs and lead to potential development of antidiabetic nutraceuticals.

(BL02308)

Quantitative Analysis for Antiviral Activity of *Prunella vulgaris* and Related Medicinal Herbs with Flow Cytometry

✉ CHIU Chi Ming Lawrence • OOI Vincent Eng Choon

□ 1 January 2003

❖ CUHK Research Committee Funding (Direct Grants)

Cytopathic effect and plaque reduction assays are conventional methods for identifying viruses in clinical isolates and for antiviral drug susceptibility assay. A drawback of these methods is that they are very labor intensive and usually take days to complete. However, the most important drawback is that these methods are not very quantitative, and depend on an expertise for assessing subjectively the proportion of cells with the viral infection. Recently, our laboratory has developed a flow cytometric method for determining quantitatively the infections of different viruses in their host cells. Using this method, we have determined the kinetics of infections of different strains of herpes simplex viruses (HSV) in Vero cells. Significant levels of the viral antigens were detected inside the host cells as early as 2 h after the infections. Proportions of the infected cells then increased gradually, and plateau levels were observed after 12 h when >92% of the cells were positive for the viral antigens. *Prunella vulgaris*, a perennial plant commonly found in China and Europe, has long been used as a folk medicine to cure ailments and its antiviral properties have been reported recently. In this study, we propose to investigate the anti-herpetic effects and mechanisms of the polysaccharides isolated and characterized from *P. vulgaris* and other related medicinal herbs using our novel flow cytometric system. With the emergence of drug-resistant

strains of HSV, new antiviral agents, especially those with a different mode of action from the recent drug-of-choice, acyclovir, are urgently needed.

(BL02597)

Development of an Animal Model of Shrimp Allergy

✉ CHU Ka Hou • CHIANG Bor Luen* • FUNG Ming Chiu • LEUNG Sai Cheong Patrick*

☐ 1 November 2002

❖ Research Grants Council (Earmarked Grants)

Hypersensitive reactions to seafood are one of the most common food allergies. Previous studies in our laboratory have demonstrated the muscle protein tropomyosin as the major, cross-reactive allergen in edible crustaceans and mollusks. To further elucidate the physiological and molecular mechanisms of seafood allergies, we propose to develop an animal model of shrimp allergy. Mice immunized with shrimp extracts/recombinant allergen will be challenged orally and observed for signs of allergic responses/anaphylaxis. Immunophysiological parameters such as vascular leakage, plasma histamine levels, cytokine profiles, antigen specific IgE and T cell responses will be examined to determine the validity of the animal model. Furthermore, B cell responses such as antigen specific IgE and their epitopes against shrimp tropomyosin as well as IgE cross-reactivity with other seafood allergens will be studied and compared with established human subjects data available in our data bank. We will also determine the antigen specific T cell responses against shrimp tropomyosin by T cell proliferation assay, cytokine profile determination and epitope analysis. Our goal is to develop an animal model that closely mimics the human hypersensitive responses in shrimp allergy,

which would allow future studies of the molecular mechanisms involved in food allergy and design of therapeutic modalities.

(CU02256)

DNA Strand Breaks in Crustaceans as a Pollution Indicator in Marine Environment

✉ CHU Ka Hou

☐ 1 February 2003

❖ CUHK Research Committee Funding (Direct Grants)

The extent of DNA strand breaks has been developed as a sensitive biomarker in a number of organisms for environmental assessment. The present study explores the use of comet assay in estimating DNA strand breaks in crustaceans as a tool for monitoring genotoxicants in the marine environment. This assay will be developed in the local marine amphipod, *Hyale crassicornis*. The responses of DNA strand breaks to reference toxicants and environmental samples will be determined. A time series experiment will be performed for the development of a standardized reliable bioassay. The goal is to apply the comet assay of amphipod as a routine tool for monitoring pollution in the local marine ecosystem.

(BL02819)

Ecotoxicity of Herbicide Glyphosate

✉ CHU Lee Man

☐ 1 November 2002

❖ CUHK Research Committee Funding (Direct Grants)

Herbicide glyphosates are widely used in the environment among which Roundup® is the most

popular formulation. However, their aquatic toxicity data are relatively incomplete. Previous studies usually employed organisms of higher level of organization (e.g. invertebrates, fishes and amphibians) for aquatic toxicity, and toxicity data on bacteria and protozoa are lacking. Most toxicity tests were carried out in the absence of sediment particles, and the route of exposure to the organism was mainly through dissolved glyphosate. Therefore, the sediment-associated toxicity of glyphosate-based formulations is not fully understood. In addition, the effect of environmental factors such as pH and temperature on glyphosate toxicity were mostly studied with more than one variable at a time, making it difficult to generalize their effects. There is also a paucity of information on the bioavailability of metal-glyphosate complexes in water. This proposed project therefore examines the relative toxicity contribution of IPA salt of glyphosate and POEA to Roundup® to different groups of aquatic organisms with the emphasis on microorganisms, assess the sediment toxicity of Roundup® and Roundup® Biactive via porewater exposure and the effect of sediment organic carbon on the bioavailability and toxicity of these surfactant-containing herbicides, and study the influences of various environmental factors on the toxicity of Roundup®.

(BL02633)

Characterization of Plain Sufu Extract Prepared by Supercritical Fluid Extraction

✉ CHUNG Hau Yin

☐ 15 February 2003

❖ CUHK Research Committee Funding (Direct Grants)

In our previous investigations on the volatile constituents of sufus using simultaneous steam distillation and solvent extraction, we found substantial amounts of different ethyl esters and other components contributing to the volatile composition of plain sufus. And we have suggested that the esters were important contributors to the overall impression of the plain sufu based on the observations. However, our recent analysis of the headspace in plain sufus, we found much less number of esters than before. And this leads us to believe that the extraction methods may cause the difference in our observation. In order to find an explanation to the present results, we will use the method of supercritical fluid extraction to produce more comprehensive profiles of plain sufus for our evaluation.

(BL02767)

Phosphatidylinositol Glycan (PIG-N) a Potential Target to Combat *Schistosoma*

✉ FUNG Ming Chiu

☐ 1 February 2003

❖ CUHK Research Committee Funding (Direct Grants)

Schistosomiasis, 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 12 provinces in China. Toxic drugs are used to cure this disease. The currently use drug, Praziquantel, is only effective to kill the worm within the first 2 days of infection and drug resistant strains of *S. haematobium* and *S. mansoni* are developed. Recently, artemether is introduced to cure schistosomiasis. It can kill schistosomula over the first 21 days after infection. A low dose and long term administration of this drug

in the areas of malaria has a high risk of developing drug resistant malaria strains. GPI-anchor proteins associated with the cell membrane, are important major antigens of the schistosome and other parasites. Although the enzyme used to synthesize GPI-anchor is very conserved from human to yeast, the inhibitors that can block the enzyme function is species specific. In 1999, selective inhibitors that only block the GPI synthetic pathway in the trypanosome, a protozoan parasite, but not in human cells are identified. Recently, we have isolated a gene of the schistosome parasite that is a homologue of the mouse and human PIG-N, an essential enzyme for synthesis of the GPI-anchor. It is the first PIG-N gene of the parasite being cloned. We propose to study the expression profile of this gene, the biochemical properties of the encoded enzyme, and the immunogenicity of this PIC-N protein. Our results may lead to develop a vaccine candidate and a better drug to cure schistosomiasis.

(BL02348)

Epidermal Growth Factor (EGF) in the Ovary of Zebrafish - How is It Related to the Ovarian Activin System in Controlling Oocyte Development?

✉ GE Wei

📅 31 December 2002

❖ Research Grants Council (Earmarked Grants)

The development and function of vertebrate ovary are among the most dynamic and complex physiological processes, and the regulation of the ovarian function involves numerous extrinsic hormones and intrinsic ovarian factors. During the past two decades, peptide growth factors in the ovary have attracted tremendous attention in this regard. Although the biological activities of various growth factors in the

ovary have been extensively studied in mammals, their interactive relationships have not yet been well documented. Using zebrafish as a model, the present proposed study aims at addressing this issue with the emphasis on epidermal growth factor (EGF) and activin, the two well-studied ovarian growth factors. Since EGF has not yet been cloned in any non-mammalian vertebrates, the first part of the project will be to clone zebrafish EGF and its receptor (EGFR) followed by the localization of their expression in the ovary. We will then further examine the expression profiles of EGF and EGFR during the ovarian follicle development, and investigate the regulation of their gene expression. The last part of the project will be focusing on elucidating the regulatory relationship of ovarian EGF and activin systems to reveal how the local *EGF-activin axis* we demonstrated recently fits into the generally *pituitary gonadotropin-ovarian activin axis* model that we have proposed.

(CU02258)

Molecular Cloning and Functional Characterization of Pituitary Adenylate Cyclase-activating Polypeptide (PACAP) in the Zebrafish Ovary

✉ GE Wei

📅 1 March 2003

❖ CUHK Research Committee Funding (Direct Grants)

Pituitary adenylate cyclase-activating polypeptide (PACAP) is a neuropeptide first identified in the pituitary. However, evidence has accumulated during the past few years that PACAP is also expressed in a variety of extrapituitary tissues including the ovary and exerts local paracrine actions. PACAP functions by activating the adenylate cyclase

to increase the intracellular cAMP level. The peptide has been cloned in several teleost species including the goldfish and its expression has also been demonstrated in multiple tissues such as the ovary. Despite the consistent evidence from fish to mammals for the existence of PACAP in the ovary, little information is available about the physiological roles of PACAP in the ovary. The present study aims at cloning the peptide from the zebrafish and investigating its potential roles in the ovary. Considering that cAMP as a critical role in vertebrate oocyte maturation, we will examine the effect of PACAP on the rate of final oocyte maturation in the zebrafish. We will also investigate if the peptide has any effect on the expression of follistatin (the binding protein for activin) which has been demonstrated to be dependent on cAMP.

(BL02574)

Production and Characterization of Antibodies for Plant Vacuolar Sorting Receptor Proteins

✉ JIANG Liwen

□ 31 December 2002

❖ CUHK Research Committee Funding (Direct Grants)

BP-80 is a type I integral membrane protein that belongs to a family of plant vacuolar sorting receptor (VSR) protein that are responsible for sorting certain soluble proteins from the Golgi apparatus to the lytic prevacuolar compartment. To further study role of VSR in protein sorting, here we propose to produce antibodies specific for VSR proteins. Both recombinant VSR proteins derived *E. coli* and synthetic peptides will be used as antigens to inject rabbits for antibody production. These antibodies will be affinity-purified and used for subcellular

localization of VSR proteins using both confocal immunofluorescence and immunoEM.

(BL02399)

Molecular Characterization of Plant Prevacuolar Compartments

✉ JIANG Liwen

□ 31 December 2002

❖ Research Grants Council (Earmarked Grants)

Plant cells contain two functionally distinct vacuoles: a lytic vacuole and a protein storage vacuole. Two distinct vesicular transport pathways, represented by BP-80 (a vacuolar sorting receptor, VSR) and RMR (a receptor-like protein), are responsible for sorting proteins from the Golgi apparatus to lytic vacuole and protein storage vacuole. Prevacuolar compartments (PVCs) are membrane-bound organelles that mediate protein traffic between Golgi and vacuoles in the plant secretory pathway. However, the nature of the PVCs remains unclear because no unambiguous markers have been generated for identifying and defining PVCs morphologically and functionally in plant cells. Markers for PVCs will provide valuable tools for plant cell biologists to dissect the functions and sorting mechanisms of PVCs in the plant secretory pathway. As a first step to characterize the PVCs, we have recently developed markers to define PVCs in plant cells using confocal immunofluorescence and demonstrated that VSR proteins are predominantly concentrated on the lytic PVCs. Here we propose to further characterize the plant PVCs using molecular and biochemical approaches. We will develop an *in vivo* transgenic tobacco cell system that expresses different GFP (green fluorescent protein) or RFP (red fluorescent protein) reporter proteins. Using this system, we will test the hypothesis that two distinct PVCs exist

in the same plant cells and study the dynamic relationship between Golgi and PVCs. Using subcellular fractionation, we will purify PVCs or fractions enriched in PVCs and identify the major protein components within PVCs. Our long-term goal is to elucidate the molecular mechanisms by which proteins are sorted away from the Golgi into different vesicular pathways leading to PVCs, to identify and characterize the plant PVCs morphologically and functionally.

(CU02260)

Molecular Mechanism of Plant Prevacuolar Compartments

✉ JIANG Liwen

☐ 1 January 2003

❖ France/Hong Kong Joint Research Scheme

Prevacuolar compartments are defined as organelles that receive cargo from transport vesicles and subsequently deliver that cargo to the vacuole by fusion with the tonoplast. Here we propose the hypothesis that two functionally distinct prevacuolar compartments exist in plant cells that are responsible for sorting protein into lytic vacuole and protein storage vacuole respectively. We will develop molecular markers for these two prevacuolar compartments and study their dynamics using molecular and immunocytochemical approaches.

(BL02622)

Identification of Ultrastructural Components of the Secretory Pathway for Endoglucanase in the Edible Mushroom, *Volvariella volvacea*

✉ JIANG Liwen • BUSWELL John Anthony

☐ 1 February 2003

❖ CUHK Research Committee Funding (Direct Grants)

Volvariella volvacea, the edible straw mushroom, is cultivated on high-cellulose-containing cotton waste “composts.” In order to degrade the composts, the mushroom produces a family of cellulolytic enzymes in order to hydrolyse the cellulose to produce nutrients for fungal growth. Since the cellulose polymer is too large to enter the fungal hypha, the cellulolytic enzymes have to be secreted to the external environment. In yeast, mammalian and plant systems, protein secretion occurs via a polarised process involving several intracellular organelles including the endoplasmic reticulum, the Golgi apparatus, endosome (‘pre-vacuoles’), vacuoles, and secretory vesicles. However, the secretory pathway in filamentous fungi such as *V. volvacea* is much less well-defined. Therefore, it is proposed to study the ultrastructural components of the secretory pathway for one enzyme of the cellulase complex, endoglucanase, using an immunocytochemical approach involving various probes that are specific for both the endoglucanase protein and the documented components of known secretory pathways. A better understanding of the exocytic pathway in *V. volvacea* will facilitate the development of strategies aimed at more efficient secretion of the enzymes required for bioconversion of the cellulosic growth substrate and improved mushroom yields.

(BL02956)

Molecular Authentication of Traditional Chinese Medicinal Plants

✉ KWAN Hoi Shan

☐ 1 December 2002

- ❖ CUHK Research Committee Funding (Direct Grants)

Our laboratory aims to develop and apply molecular tools for the authentication of traditional Chinese medicinal plants (TCM plants). TCM plants have been traditionally authenticated by morphological and chemical methods which could be influenced by environmental and physiological variations. Molecular approaches can be used as a more definitive method. TCM plants will be collected from different localities. Samples will be extracted to obtain DNA from which specific segments will be amplified for sequencing and other DNA analysis. We will authenticate the plants at 3 levels, genus, species, and strains based on localities. The methods will be useful for the standardization of TCM plants.

(BL02977)

Gene Regulation in the Signal Transduction Pathways of Broad-Spectrum Bacterial Blight Resistance Loci in Rice

✉ LAM Hon Ming • LING Zhong Zhuan* • ZHANG Qi* • ZHAO Kai Jun*

□ 31 December 2002

- ❖ Research Grants Council (Earmarked Grants)

Rice is a monocot crop that provides staple food for nearly two-third of the world's population. Its production, however, is severely hampered by pathogens. Despite that several pathogen resistance (R) loci were identified and four R genes were cloned in rice, relatively little is known on the signal transduction pathway leading to the pathogen resistance. The study addresses the gene expression related to the signal transduction pathways of broad-spectrum bacterial blight resistance (Xa) loci in

rice. Using the unique genetic tools (including near-isogenic lines of several important Xa loci and a newly identified broad-spectrum R locus Xa23) constructed previously by this team and the availability of the state-of-the-art gene chip technology, we will perform systematic and comparative gene expression studies on Xa lines of different spectra of disease resistance.

(CU02273)

Characterization of a Purple Acid Phosphatase Gene in Soybean

✉ LAM Hon Ming

□ 1 April 2003

- ❖ CUHK Research Committee Funding (Direct Grants)

Phosphorus, a macronutrient that constitutes an essential component of nucleic acids, phospholipid, phosphoester, and inorganic phosphate in plant cells, is the third abundant element in higher plants. Induction of both extracellular and intracellular phosphatases is an important adaptive mechanism under phosphorus starvation. Previous biochemical analyses by others showed that acid phosphatase activities elevate in response to salt and drought stress. Our molecular studies also demonstrated that a purple acid phosphatase gene is strongly induced in soybean under salt stress. Since salt stress may affect phosphate uptake and/or phosphate metabolism in plant cells, we hypothesize that to cope with such a stress situation, the purple acid phosphate gene is induced and its gene product, an extracellular phosphatase will help to hydrolyze and mobilize the phosphorus in the soil for absorption into the plant cells. In this study, we will characterize the gene expression kinetics of this purple acid phosphate gene under different stress conditions. Our long-term

goal is to test if this purple acid phosphatase gene will confer stress tolerance to higher plants.

(BL02800)

Protein Characterization Studies on *Cordyceps*

✉ NGAI Sai Ming

□ 31 December 2002

❖ CUHK Research Committee Funding (Direct Grants)

A large-scale construction and compilation of Fungal (in particular: *Cordyceps*) Genomics/Proteomics Databases has been initiated in our laboratory (~40,000 DNA and Protein sequences). Our plan is to establish relational Chinese Medicinal Fungal databases of DNA and proteins with therapeutic values. The DNA/protein sequence of various Chinese Medicinal Fungi and their corresponding expression profiles will be investigated. My goals are to construct annotated in-house protein and peptide libraries from the process of Bioinformatics data mining in the Genebank via the Internet. These libraries will contain the DNA, protein and peptide databases that cover and provide the information on local and international genomic and proteomic data from areas of X-ray crystallizations, NMR, protein engineering and peptide design, protein threading and molecular dynamic calculation. Information generated will be anticipated to be valuable in future molecular biotechnology research and development. They also structure the basis of the new era of Proteomic research.

(BL02556)

In Vitro and In Vivo Anticancer Studies of Novel Polyunsaturated Fatty Acids (DHA, EPA) Purified and Characterized from Several Enriched Microalgae

✉ OOI Vincent Eng Choon • CHEN Feng Steven*
• CHEUNG Chi Keung Peter • CHIU Chi Ming
Lawrence

□ 1 October 2002

❖ Research Grants Council (Earmarked Grants)

Long-chain polyunsaturated fatty acids (PUFAs) from fish oils, such as docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), have long been considered as important components in human nutrition and nutraceuticals with anticancer and therapeutic potentials. However, there are several drawbacks in the satisfactory exploitation of this source. Recently, cultured microalgae have been developed as alternative sources for highly purified DHA and EPA, which are free from environmental pollutants and devoid of cross-contamination. Nevertheless, studies on anticancer properties of algal PUFAs are somehow only limited. In this study, we plan to extract and purify several novel PUFAs, particularly DHA and EPA, from some specific PUFA-enriched microalgae cultured in Hong Kong. The anticancer effects and mechanisms of these PUFAs against human leukemia, breast and colon cancer cells will be investigated *in vitro*. We will examine by using flow cytometry the effects of these algal PUFAs on cell-cycle progression and apoptosis of cancer cells as well as their mechanistic action on the regulatory protein expression. Furthermore, we will also investigate the *in vivo* antiproliferative and cytotoxic actions of these algal PUFAs on growth and development of human breast cancer in nude mice. We believe that this study will provide scientific information for better understanding and solid foundation for potential commercial development of algal oils as dietary supplements with proven anticancer and other therapeutic properties.

(CU02261)

Nursery Functions of Mangrove Habitats for Marine Fishes

✍ WONG Chong Kim

☐ 1 February 2003

❖ CUHK Research Committee Funding (Direct Grants)

Mangrove habitats provide important foraging and resting grounds for numerous marine organisms. However, the role of mangroves as nursery habitats for marine fishes is relatively unclear. In Hong Kong, about 75% of the original mangrove habitats have been lost to urban development and aquaculture. The impacts of habitat destruction on local fish communities have not been fully assessed. Field sampling will be launched to provide quantitative data on seasonality, composition and abundance of fishes, especially larvae and juveniles. The aim of the project is to determine the role of mangroves as nursery habitats for marine fishes.

(BL02478)

A Novel Process for Removing and Recovery of Metal Contaminants Using Integrated Biosorption and Electrodeposition

✍ WONG Po Keung • CHUA Hong* • LO Wai Hung Thomas*

☐ 1 December 2000

❖ Research Grants Council (Coll. with PolyU ERG)

This project is to develop an innovative multi-stage process which could remove and recover metals from industrial effluents in a more effective, economical and environmentally friendly fashion. Metals are among the most common industrial pollutants.

Metal-contaminated effluents are discharged daily and in large quantity from the factories of battery, electroplating and printed circuit board in both Hong Kong and South China. Many metals, if present at higher than normal concentration, can pose a serious threat to environment, animals and humans. Thus it is imperative to remove metals from the industrial effluents before they are discharged into the sewage system or into aquatic environment. Current technologies for metal removal such as chemical precipitation, ion exchange and electro dialysis provide only partially effective treatment, yet at high capital and operational costs, especially when the metal concentration is relatively low. These technologies may also result in the generation of secondary hazardous wastes and create additional treatment and disposal problems, such as a large quantity of sludge generated by precipitation processes.

An alternative green and economical technology for removing metals is to employ microbial biomass, a waste byproduct generated from large-scale industrial fermentation, as a metal biosorbent. Metal bound to the biomass can be concentrated through a desorption step, followed by electrodeposition to recover the metal. The conversion of biomass waste into a useful metal biosorbent would remarkably reduce not only the production cost of biosorbent and the disposal cost of the biomass, but also recovers value from the metal waste. This proposed process is therefore capable of achieving very effective and inexpensive metal removal and produces only clean water and solid metal for reuse. As a result, water is conserved, waste is minimized and a commercially useful product is produced.

(BL00417)

Polychlorinated-dibenzo-dioxins (PCDDs) in Marine Sediment

✍ WONG Po Keung

☐ 1 November 2001

❖ Lee Hysan Foundation Research Grant (under United College) CUHK

Due to highly toxic nature of PCDDs, trace amount of PCDDs will cause toxicity to living organisms. Although there are many methods developed to detect PCDDs in environmental samples, there have been reported that the precision of the measurement is highly dependent on efficiency of extraction of PCDDs from environmental samples. In order to tackle the pollution problem of PCDDs, a monitoring programme to continuously measure the levels of PCDDs in environmental samples is urgently needed. The objective of the present study is to assess various available extraction methods of PCDDs from solid environmental samples (i.e. contaminated marine sediments). The comparison of the efficiency of these methods will provide a precise protocol to measure PCDDs in sediment samples.

(BL01986)

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

✍ WONG Po Keung

☐ 1 February 2003

❖ CUHK Research Committee Funding (Direct Grants)

Polychlorinated dibenzo-dioxins (PCDD/Fs) such as 2,3,7,8-TeCDD are extremely toxic and mutagenic compounds that adsorbed onto solid matrices such as

sediment in the environment. PCDD/Fs can be degraded by photochemical or biological methods, but the degradation rates of PCDD/Fs in sediment are low mainly due to the hydrophobic and highly chlorinated properties of PCDD/Fs. To solve these problems, a novel treatment scheme to integrate several proven technologies is attempted: to use a surfactant to desorb PCDD/Fs from sediment, pre-treated with a short-term photocatalytic oxidation (S-PCO) to partially degrade desorbed PCDD/Fs into simpler compounds that will be suitable for further treatment, and then further degrade the partially treated PCDD/Fs by a prolonged-PCO (P-PCO_ or biodegradation.

Due to the complex matrix of contaminated sediment, the feasibility of proposed treatment scheme will be tested and optimized using selected pure PCDD/Fs spiked onto a clean reference sediment. Throughout each above-mentioned step, the profiles and toxicities of PCDD/Fs and the selected surfactant, and their degradation products(s) will be monitored by GC-MS and a sensitive bioassay, respectively.

(BL02775)

Isolation and Characterization of Flavonoid Antioxidants in *Vigna sinensis* Seeds

✍ WONG Yum Shing • CHUNG Hau Yin

☐ 1 November 2002

❖ Research Grants Council (Earmarked Grants)

Epidemiological studies support a beneficial role for dietary flavonoids against coronary heart disease, cancer and other chronic diseases. It is suggested that the health-beneficial properties of flavonoids are associated with their antioxidant activities. Flavonoids are polyphenolic compounds that occur ubiquitously in plants. In our previous study, the seeds of a pigmented cultivar of *Vigna sinensis*

exhibited very high total antioxidant activity among twenty five legume species/cultivars examined. The method extract of *V. sinensis* seeds showed protective effects on hydrogen peroxide-induced DNA damage in rat blood cells. In this project, the putative flavonoid antioxidants in *V. sinensis* seeds will be isolated and characterized. The antioxidant activities, DNA protection properties and mutagenicity of these dietary flavonoids will be evaluated.

(CU02263)

Study on the Biological Activities of Narciclasine

✉ WONG Yum Shing

☐ 1 February 2003

❖ CUHK Research Committee Funding (Direct Grants)

Narciclasine (NCS) is a plant alkaloid from the bulbs of *Narcissus tazetta* L. It exhibits a wide range of inhibitory effects on various processes in plant growth and development including seed germination, radicle elongation, cotyledon expansion and chlorophyll biosynthesis. This alkaloid was shown to have antiviral, antimitotic and anti-cancer properties. It has also been reported as feeding deterrent of insect larvae. Limited information is available on its biological activities and physiological role in the *Narcissus* plant. This research focuses on the elucidation of the mode of action of NCS as a eukaryotic cell protein synthesis inhibitor using both *in vitro* and *in vivo* systems. The allelopathic properties of NCS is also studied by examining the effects of NCS on the growth of selected high plants in cell culture system.

(BL02437)

Growth Hormone and Insulin-like Growth Factor-I as Anti-apoptotic Factors via Modulated HSP70 Expression in Seabream

✉ WOO Norman Ying Shiu

☐ 1 December 2002

❖ Research Grants Council (Earmarked Grants)

The relationship between environmental stress, hormones and cell molecular responses needs to be fully understood in order to develop strategies for proper management of fish culture practices. Over the past few years the PI has accumulated much evidence on the effect of environmental stress and hormonal status and a clearer picture has emerged whereby manipulation of environmental culture conditions (e.g. iso-osmotic salinity) stimulates the growth hormone (GH) – insulin-like growth factor I (IGF-I) axis in parallel with lowered stress, enhanced immunity and increased growth in sea bream. At the cellular molecular level, two key processes which can occur upon exposure to stress are changes in levels of heat shock protein (HSP70), affording protection and survival and/or induction of a series of coordinated processes eventually leading to apoptotic cell death. Whilst the signals which control HSP70 expression and apoptosis represent two distinct molecular pathways, much evidence exists as to direct regulatory role of HSP70 on apoptosis and in addition a number of key hormones (including GH and IGF-I) have been demonstrated to either suppress or enhance stress induced apoptosis, dependent upon cell type and stress type. Preliminary evidence from the PI's laboratory has demonstrated that GH and IGF-I treatment downregulates HSP70 and protects against apoptosis in non-immune cells but upregulates HSP70 and also protects against apoptosis in immune cells. Whilst it is clear that apoptosis can be regulated via GH or IGF-I in sea

breast cells, a number of outstanding unanswered questions remain: (1) Does GH work through IGF-I stimulation? (2) What are the molecular processes responsible for HSP70 expression upon hormone exposure in immune and non-immune cells? (3) Can GH and IGF-I protect cells against stress induced apoptosis? (4) Is hormonal protection against apoptosis mediated via HSP70 expression? and (5) Can we manipulate fish culture conditions to protect against pathogen-induced apoptosis? In the proposed study these questions will be addressed using molecular and biochemical approaches and the results gained will provide new insight into how fish respond to stress and how we can formulate optimal fish culture practices.

(CU02264)

Effects of Steroid Hormones on Seabream Macrophages

✉ WOO Norman Ying Shiu • NG Tzi Bun (Biochemistry)

☐ 1 February 2003

❖ CUHK Research Committee Funding (Direct Grants)

Prolactin, growth hormone and lectin have been shown to stimulate the phagocytic activity of seabream macrophages. However, the possibility of an effect of steroid including cortisol, the oocyte-maturational steroids including 17α -hydroxyprogesterone and 17α , 20β -dihydroxyprogesterone and the male steroid 11-ketotestosterone has not been investigated. 11-ketotestosterone and 17α , 20β -dihydroxyprogesterone are steroids found only teleosts. Cortisol exerts an immunosuppressive effect and the androgen dehydroepiandrosterone exhibits an immunoenhancing effect in mammals.

Since the immune system is responsible for defence against pathogenic organisms, an understanding of the hormonal regulation of macrophage function in teleosts is important. The objective of the present study is to examine the effects of (1) male steroids including testosterone and 11-ketotestosterone (2) female and oocyte-maturational steroids including estrogen, 17α -hydroxyprogesterone and 17α , 20β -dihydroxyprogesterone and (3) the glucocorticoid and mineralocorticoid cortisol on phagocytic activity of seabream macrophages.

(BL02640)

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

| <u>Edition</u> | <u>Title/Investigators</u> |
|----------------|--|
| 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 |
| 2000-01 | Resource Assessment of Marine Alga <i>Hypnea charoides</i> in Hong Kong (BL00425) ✉ ANG Put Jr. |
| 2001-02 | Biodiversity of Marine Algae in Hong Kong (BL01416) ✉ ANG Put Jr. |
| 1999-00 | Novel Anti-herpes Agent from Natural Product (CU99171) |

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| | <p>✍ BUT Pui Hay Paul • XU Hongxi (Institute of Chinese Medicine)# • OOI Vincent Eng Choon</p> | 1999-00 | Evolutionary and Population Genetics of Mitten Crabs, <i>Eriocheir</i> spp. (CU99162) |
| 2001-02 | <p>A Web-based Database and Training for Hong Kong Flora and Vegetation (ED01912)</p> | | ✍ CHU Ka Hou • CHAN Tin Yam* • SHEN Qi* |
| | <p>✍ BUT Pui Hay Paul • CHIU Siu Wai • WONG Yum Shing • ANG Put Jr. • HU Shiu Ying (School of Chinese Medicine) • CHANG Michael (Dept of Information Engineering)</p> | 2000-01 | Isolation, Characterization, and Molecular Cloning of the Androgenic Hormone of the Mud Crab <i>Scylla</i> spp.: Development of Monosex Crab Aquaculture (CU00254) |
| 2000-01 | <p>Nutritional Evaluation of Edible Mushrooms (BL00678)</p> | | ✍ CHU Ka Hou • SUN Piera S* • LIU Hong* |
| | <p>✍ CHEUNG Chi Keung Peter • HUANG Nian Lai*</p> | 2000-01 | Morphological and Molecular Variations Among Populations of the Brown Alga <i>Sargassum hemiphylum</i> (BL00537) |
| 2001-02 | <p>Dietary Fiber from Mushroom: An Evaluation of Their Biochemical, Physico-chemical, Nutritional, Toxicological, and Sensory Properties (BL01322)</p> | | ✍ CHU Ka Hou • ANG Put Jr. |
| | <p>✍ CHEUNG Chi Keung Peter • MASUYAMA Ritsuko*</p> | 2001-02 | Population Genetics of the Pearl Oyster <i>Pinctada Fucata</i> in Southern China (BL02919) |
| | | | ✍ CHU Ka Hou |
| 2001-02 | <p>Toxicity of Cadmium-Contaminated Soil towards Wheat and Cleanup by Splent Mushroom Compost of <i>Pleurotus Pulmonarius</i> (BL01623)</p> | 2001-02 | Molecular Population Structure of Penaeid Shrimp in the Indo-West Pacific (BL01157) |
| | <p>✍ CHIU Siu Wai • NG Tzi Bun (Biochemistry)</p> | | ✍ CHU Ka Hou |
| 2001-02 | <p>Biotechnological Improvement of a Microbial Cultivar and Evidence-based Diversification of Microbial Products (BL01812)</p> | 2000-01 | Revegetation of Newly Restored Landfills: Site Environmental Conditions and the Role of Native Species (CU00250) |
| | <p>✍ CHIU Siu Wai • NG Tzi Bun (Biochemistry)</p> | | ✍ CHU Lee Man |
| | | 2001-02 | Value of Water Storage Ash Lagoon for Wildlife Conservation (BL01794) |
| | | | ✍ CHU Lee Man |

- 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
- 2001-02 Preliminary Characterization of Exudate from Fungal Mass (BL01383)
 ✎ CHUNG Hau Yin
- 2001-02 Cercariae Stage Sepecific and Immunogenic Antigen of Schistosoma japonicum (BL01154)
 ✎ FUNG Ming Chiu • CHEN Xiao Guang*
- 2001-02 Interferon Alpha Subtypes and Antiviral Drugs (BL01885)
 ✎ FUNG Ming Chiu
- 1999-00 Transcriptional Regulation of Gonadotropin-I & II (GTH-I & II) β Genes in the Goldfish by Activin - Functional Analysis of Cis-acting Elements that Mediate Activin Stimulation of GTH-I β & Inhibition of GTH-II β Expression in the Goldfish, *Carassius auratus* (CU99176)
 ✎ GE Wei
- 2001-02 Expression of Genes Encoding for Cellulolytic Enzymes and Laccase in *Volvariella volvacea* during Substrate Colonisation and Fruit Body Morphogenesis (BL01163)
 ✎ GE Wei • BUSWELL John Anthony
- 2001-02 Activin System in the Pituitary: How Important is It in the Differential Expression of Fish FSH and LH? (BL01150)
 ✎ GE Wei
- 2001-02 Sorting of Proteins to the Protein Storage Vacuole in Plant Cells (BL01156)
 ✎ JIANG Liwen • SUN Sai Ming Samuel
- 2001-02 Dynamic Localization of a Plant Vacuolar Sorting Receptor (BL01307)
 ✎ JIANG Liwen
- 2001-02 Protein Sorting in the Plant Golgi (BL01648)
 ✎ JIANG Liwen • ROBINSON David G*
- 1999-00 Germplasm Bank, Chemical and Molecular Characterization of Chinese Medicinal Plants Commonly Used in Hong Kong (BL99004)
 ✎ KWAN Hoi Shan • CHE Chun Tao (School of Chinese Medicine) • WONG Yum Shing
- 2000-01 Isolation and Differential Expression Analysis of Hydrophobin Genes of Shitake Mushroom *Lentinula edodes* (BL00642)
 ✎ KWAN Hoi Shan
- 2001-02 Identification and Characterization of Genes Differentially Expressed in Dikaryotic Mycelium of Shiitake

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|---------|---|---------|---|
| | Mushroom <i>Lentinula edodes</i> by cDNA Microarray Hybridization (BL01147) ✍ KWAN Hoi Shan | | ✍ OOI Vincent Eng Choon • SUN Sai Ming Samuel |
| 1998-99 | Asparagine Synthetase Genes: Their Roles in Plant Growth and Development (CU98292) ✍ LAM Hon Ming | 2000-01 | Flow Cytometric Studies on Anticancer and Immunomodulatory Activities of Microalgal DHA and EPA (BL00540) ✍ OOI Vincent Eng Choon • CHIU Chi Ming Lawrence |
| 1999-00 | Molecular and Biochemical Characterization of a Salt-tolerant Soybean Variety (CU99180) ✍ LAM Hon Ming • SHAO Gui Hua* | 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 |
| 2000-01 | Sink-Source Relationship During Seed Development in <i>Arabidopsis thaliana</i> - Molecular Regulation of Aspartate Family Amino Acids (CU00263) ✍ LAM Hon Ming • SUN Sai Ming Samuel | 2001-02 | Agents Against Dermatophytes from Traditional Chinese Medicine (TCM) (BL01632) ✍ OOI Vincent Eng Choon • OOI Shiou Mei Linda |
| 2001-02 | Molecular Regulation of Sugar Transportation During Flowering of Soybean (BL01803) ✍ LAM Hon Ming | 1998-99 | Engineering the Brazil Nut Met-rich Protein for Reduced Allergenic Activity (CU98351) ✍ SUN Sai Ming Samuel • LAM Wai Kei Christopher (Dept of Chemical Pathology) |
| 1999-00 | Development of Two Potent Novel Antiviral Drugs from Traditional Chinese Medicines (BL99001) ✍ OOI Vincent Eng Choon • BUT Pui Hay Paul • XU Hongxi (Institute of Chinese Medicine)# • CHAN Kay Sheung Paul (Dept of Microbiology) | 2001-02 | The Croucher Foundation - Advanced Study Institute "Biotechnology and Crop Improvement: Recent Development and Impacts on Developing World" (BL01517) ✍ SUN Sai Ming Samuel • LAM Hon Ming • LIU Pui Shan Lucia • ZHANG J H* • CHYE M L* • ROCK C* |
| 1999-00 | Expression of cDNA Encoding a Mannose-binding Lectin (NTL) from <i>Narcissus tazetta</i> in Transgenic Tobacco Plant (CU99182) | | |

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|---|---|
| <p>2000-01 Development of a Rapid Toxicity Screening Test Based on the Filtering Behaviour of the Green Mussel <i>Perna viridis</i> (BL00330) ✍ WONG Chong Kim</p> | <p>2000-01 Removal of Pentachlorophenol by Adsorption by Chitin from Shrimp Shell Waste (BL00518) ✍ WONG Po Keung</p> |
| <p>2000-01 Water Quality Monitoring in Marine Park and Marine Reserve (BL00633) ✍ WONG Chong Kim • CHU Lee Man • WONG Po Keung • CHU Ka Hou</p> | <p>2001-02 Degradation of Pentachlorophenol by Photocatalytic Oxidation (BL00824) ✍ WONG Po Keung</p> |
| <p>2001-02 Study of Benthic Faunal Species in Marine Sediment Monitoring for SSDS Stage one (BL01595) ✍ WONG Chong Kim • WONG Po Keung</p> | <p>2001-02 Bioactive Substances from Marine Bacteria (BL01535) ✍ WONG Po Keung • QIAN P Y*</p> |
| <p>2001-02 Heavy Metal Concentrations in Tilapia Collected from Hong Kong Rivers (BL01616) ✍ WONG Chong Kim</p> | <p>2001-02 Polycyclic Aromatic Hydrocarbons (PAHs) in Marine Sediment (BL01436) ✍ WONG Po Keung</p> |
| <p>2001-02 Provision of Services on Water Quality Monitoring in Marine Parks, Marine Reserve & Other Ecological Significant Areas (BL01892) ✍ WONG Chong Kim • CHU Lee Man • WONG Po Keung • CHU Ka Hou</p> | <p>1995-96 A Study of the Nutritional Quality and Potential Food Use of Some Underutilized Legumes (BL95043) ✍ WONG Yum Shing</p> |
| <p>1999-00 Integrated Chemical-Biological Treatment of Dye-Containing Effluent of Textile and Dyeing Industry (CU99174) ✍ WONG Po Keung • YU Jimmy C. (Dept of Chemistry)</p> | <p>2000-01 The Effects of Narciclasine on the Greening of Etiolated Wheat Leaves (BL00656) ✍ WONG Yum Shing</p> |
| | <p>2001-02 Evaluation of Castanea Mollissima Pigment as Natural Food Additive (BL01654) ✍ WONG Yum Shing</p> |
| | <p>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</p> |

- 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)
- 2000-01 Modulation of Gill $\text{Na}^+\text{-K}^+\text{-ATPase}$ Expression by Salinity and Hormonal Factors in the Sea Bream, *Sparus sarba* (CU00252)
 ✉ WOO Norman Ying Shiu
- 2000-01 An Investigation into the Effects of Growth Hormone, Prolactin and Cortisol on Branchial HSP90, HSP70 and HSP60
- Expression in Silver Sea Bream (BL00859)
 ✉ WOO Norman Ying Shiu • DEANE Eddie Edward
- 2001-02 Stimulation of Glucose-6-Phosphate Dehydrogenase Activity in Sea Bream: Metabolic Significance and Potential Applications (BL01146)
 ✉ WOO Norman Ying Shiu
- 2001-02 Effect of Grass Carp Lectin on Teleost Macrophages and Lymphocytes (BL01353)
 ✉ WOO Norman Ying Shiu • NG Tzi Bun (Biochemistry)

RESEARCH PROJECTS

Transition Metal-catalyzed Phosphination

✉ CHAN Kin Shing

☐ 1 December 2002

❖ CUHK Research Committee Funding (Direct Grants)

Phospines are important chemical compounds for agricultural uses and as ligands for organometallic catalysis. The preparation of phosphines usually requires highly air-sensitive reagents. Functional group tolerance is therefore limited. A mild, neutral and catalytic method for converting aryl halides, triflates and tosylates into optically active phosphines will be developed using transition metal complexes. This method aims to be economical, functional group tolerant, user-friendly, environmentally benign and stereoselective. The preparation of optically active phosphine polymers and their preliminary application in asymmetric carbon-carbon bond forming reactions will be investigated.

(PS02544)

Concentration-modulated Cavity-enhanced Absorption Spectroscopy in Gaseous Plasmas

✉ CHAN Man Chor

☐ 1 January 2003

❖ CUHK Research Committee Funding (Direct Grants)

Research proposed here aims at developing a new detection scheme for ultrahigh sensitivity laser spectroscopy of ions and radicals generated in gaseous plasmas. The new detection scheme

combines several novel techniques including cavity enhanced absorption spectroscopy, concentration-modulated phase sensitive detection, and heterodyne detection. If successful, a sensitivity approaching the shot-noise limit is expected. The performance of the proposed detection scheme will be tested using the near infrared electronic spectra of C_2 radicals. Studies of other ionic species such as HN_2^+ , CH_2^+ , NH_2^+ , and HO_2^+ will also be attempted. The spectroscopic information of radicals and ions may also be used for *in situ* studies of the dynamics of weakly ionized plasmas, which are of great importance in a variety of research disciplines. This project forms an integral part of our developing research program on experimental Chemical Physics in the Department of Chemistry. We have no doubt that there are unforeseeable difficulties at this stage and this is by no means a short-term project. We plan to initiate the work with presently available instruments to test some crucial points and obtain some preliminary results so that further funding from outside agency can be requested in the future.

(PS02864)

Self Assembling Properties of 1, 3, 5-Triaminobenzene Derivatives

✉ CHOW Hak Fun

☐ 1 April 2003

❖ CUHK Research Committee Funding (Direct Grants)

The self assembly of small molecules into large nanoscopic and mesoscopic systems has proved to be one of the most efficient ways to prepare large supramolecular systems. This project aims to investigate the self assembly properties of some amide derivatives of 1, 3, 5-triaminobenzene. The

structurally related 3, 5-diaminobenzoic acid derived species have been shown to self-assemble in non-polar solvents via a combination of hydrogen bonding and π - π stacking interactions in our laboratory. Despite its symmetrical structure, the 1, 3, 5-triaminobenzene system is less studied. We plan to synthesis a number of its triamide derivatives and investigate their self-assembly behavior in non-polar solvents using NMR spectroscopy. The potential these compounds to form reversible physical gels will also be studied using electron microscopic techniques.

(PS02667)

Base Pair Selectivity of Low-Fidelity DNA Polymerases - Structural and Dynamics Perspectives

✉ LAM Sik Lok

□ 1 December 2002

❖ Research Grants Council (Earmarked Grants)

DNA polymerase is responsible for catalyzing DNA synthesis during DNA replication. The high fidelity of DNA synthesis observed in this replication process has recently been overwhelmed by the discovery of specific base pair mismatches synthesized by low-fidelity DNA polymerases. The factors dictating the synthesis of specific mismatches or Watson-Crick base pairs during DNA replication remains unclear. Several protein-DNA binding studies have indicated that the protein-DNA recognition process is related to DNA flexibility, thus leading to the hypothesis that DNA dynamics determines the selectivity of specific base pairs in the low-fidelity DNA polymerase synthesis process. *In order to investigate the effect of DNA dynamics on the base pair selectivity of low-fidelity DNA polymerases, I propose to use high resolution NMR*

spectroscopy method to study the structures and dynamics of the primer-template duplexes which mimic the intermediate products that a mismatched nucleotide has been inserted onto the 3'-end of the primer strand during DNA replication. Twelve mismatches and four Watson-Crick base pairs will be studied in order to examine the structural and dynamics effects on the base pair selectivity of low-fidelity DNA polymerases.

(CU02047)

Group 4 Metal Chemistry Involving Amides and Amidinates

✉ LEE Hung Kay

□ 1 April 2003

❖ CUHK Research Committee Funding (Direct Grants)

The chemistry of Group 4 metal amides has attracted considerable attention due to their potential applications as polymerization catalysts. In this study, a series of Group 4 metal (IV) amides and amidinates, based on the amido ligand $[N(\text{SiBu}^1\text{Me}_2)(2\text{-C}_5\text{H}_3\text{N-6-Me})]$ (L^1) and the amidinate ligands $[\text{RC}(\text{NsiMe}_3)(\text{Nar})]^-$ ($R = \text{Me}$ (L^2), Bu^1 (L^3), Ph (L^4); $\text{Ar} = 2, 6\text{-Me}_2\text{C}_6\text{H}_3$), respectively, are to be synthesized by direct reaction of $\text{MCl}_4(\text{THF})_2$ ($M = \text{Ti, Zr, Hf}$) with the corresponding lithium reagents $[\text{LiL}^n(\text{TMEDA})]$ ($n = 1\text{-}4$; $\text{TMEDA} = N,N,N',N'$ -tetramethylethylenediamine) in various stoichiometric ratios. Besides, Ti(II) and Ti(III) amido and amidinato compounds will also be prepared by treatment of $\text{TiCl}_2(\text{TMEDA})_2$ and $\text{TiCl}_3(\text{THF})_3$, with $[\text{LiL}^n(\text{TMEDA})]$. The structure of all compounds will be characterized by various spectroscopic techniques, in addition to single-crystal X-ray diffraction studies. Moreover, their reactivities towards polymerization of olefins will

also be investigated. The results of this work may provide insights and guide future design of polymerization catalysts for special uses.

(PS02783)

Metal Phosphoranimine Complexes; Synthesis, Structure and Reactivity

✉ LEUNG Wing Por Kevin

□ 1 October 2002

❖ Research Grants Council (Earmarked Grants)

This project is to develop the synthesis of a series of metal complexes based on a new class of phosphoranimine ligands and to study their structures and reactivities. This ligand system featuring a bulky phosphoranimine group – $R_2P=N(SiMe_3)$ and pyridine-functionalised group is capable of bonding to metals in different modes. It can either act as a N, N'-chelating ligand and/or as a bulky alkyl or carbene group *via* deprotonation of the methylene protons. The structures, reactivities and physical properties of the metal complexes derived from these ligands will be investigated. It is anticipated that the main group metal phosphoranimine complexes derived from these ligands may gain access to the synthesis of new class of group 14 metal analogues of carbenes, ketenes, vinylidenes and small rings.

(CU02023)

Exploring Mechanisms for the Thermal Dissociation and Desorption of Small Molecules adsorbed on Surfaces from First Principles

✉ LIU Zhifeng

□ 1 October 2002

❖ Research Grants Council (Earmarked Grants)

In the proposed project, we plan to test a new theoretical approach to the study of the mechanisms for the thermal dissociation and desorption of organic molecules adsorbed on surfaces. The elementary reaction channels are first sampled by real time simulation at finite temperature, using the *ab initio* molecular dynamics (AIMD) method based on density functional theory with a planewave basis set and pseudopotentials. Each type of reaction channels would then be further studied at a higher accuracy level to locate the transition structure and the reaction barrier. Since it does not rely on any prior experimental knowledge or intuitive assumptions, the approach is very powerful in exploring the complex manifolds of the potential surface to identify reaction channels and their relative importance, as illustrated in our previous experiment with the studies on gas phase unimolecular dissociation mechanisms. It should have great potentials for the computational studies on surface reactions, since such reaction are complex by nature as they often involve adsorption, dissociation and desorption of molecules on surfaces and the coupling among these processes. Two systems, azomethane ($CH_3N=NCH_3$) on metal surfaces, and ethylene/acetylene on Si surfaces will be used as models to test this approach.

(CU02022)

Conjugation of Phthalocyanines with Biodegradable Polymers, Development of Efficient Delivery and Release Systems for Phthalocyanine-Based Photosensitizers in Photodynamic Therapy

✉ NG Kee Pui Dennis • XUE Jinping*

□ 1 January 2003

❖ 福建省科學技術廳

This project aims to develop polymer-based delivery and release systems for phthalocyanines used as photosensitizers in photodynamic therapy. The proposed works include (1) preparation of a series of amphiphilic metallophthalocyanines linked to biocompatible and biodegradable polymers; (2) study of their aggregation and photophysical properties in aqueous media and in the form of nanoparticles; and (3) evaluation of their *in vitro* and *in vivo* photodynamic efficiency with special emphasis on their structure-property relationship.

(PS02686)

Glycoconjugated Phthalocyanines – A Novel Class of Photosensitizers for Photodynamic Therapy

✉ NG Kee Pui Dennis

□ 1 February 2003

❖ CUHK Research Committee Funding (Direct Grants)

Photodynamic therapy (PDT), which was first developed for cancer treatment, is being actively exploited in many other applications, such as the treatment of age-related macular degeneration, hardening of arteries, sun-induced precancerous skin lesions, and infectious diseases. The treatment involves administration of a photo-sensitive drug which has a high affinity to malignant tissues and unleashes singlet oxygen as the predominant cytotoxic agent upon excitation. While a substantial number of photosensitizers have been prepared and evaluated, only a very few have been accepted for clinical use so far. There is certainly a strong demand for further development of superior photosensitizers specific for different applications. This proposal seeks to secure funds to develop novel and efficient phthalocyanine-based photosensitizers. Special emphasis will be placed on glycoconjugated

metallophthalocyanines substituted with heavy atoms. The biocompatible sugar moieties can not only enhance the solubility of these compounds in biological media, but also promote the cellular recognition and maintain the photoactivity of the phthalocyanine core by preventing the molecular aggregation. The heavy atom substituents can increase the triplet population by promoting the intersystem crossing process, leading to a higher singlet oxygen quantum yield. These specially designed molecules, which fulfill most of the criteria for second-generation photosensitizers, should have a great potential in PDT.

(PS02342)

Controllable and Reversible Aggregation of Soft Particles in Dispersion

✉ WU Chi

□ 31 December 2002

❖ Research Grants Council (Earmarked Grants)

The aggregation of colloidal particles in dispersion has attracted much attention. This is partially due to their practical importance in colloid science (stability), metallurgy (phase separation), meteorology (rain formation), ecology (sedimentation) and biology (growth of tumors), to name but a few, and also partially due to our incomplete knowledge of such fascinating phenomena. In general, it has been realized that there exist two distinct regimes: namely, the reaction limited cluster aggregation (RLCA, slow) and the diffusion limited cluster aggregation (DLCA, fast). Hard particles (inorganic clusters or polymeric latexes) were often used and the aggregation was normally induced by the addition of salts to vary the ionic strength. The major disadvantage of such systems was that the aggregation was often *irreversible* and less

controllable. There remain three less-studied problems in this topic; namely, 1) the crossover region between RLCA and DLCA, 2) the fragmentation of the aggregates in the reversible process, and 3) the structural and kinetic difference between the aggregation of hard and soft particles. Recently, we have found that in the presence of divalent cations, an increase in the dispersion temperature can induce the aggregation of thermally sensitive soft microgels in water with a *controllable* rate via the cation/anion complexation. This is because the hydrophilicity of the microgel changes in the range 25-37 °C. Moreover, the process is *reversible*. Such aggregation of soft particles provides a much better imitation of the process inside a biological system. Using this microgel dispersion, we can continuously tune the softness of the particles by changing the crosslinking density and the sticking probability between two collided particles by varying the temperature, which enables us to launch an investigation of the three remaining problems.

(CU02025)

The Chemistry of Novel Carbons-Adjacent Carborane Anions of C₂B₁₀ System

✉ XIE Zuowei

☐ 31 December 2002

❖ Research Grants Council (Earmarked Grants)

It has been well-known that *o*-carboranes (*o*-R₂C₂B₁₀H₁₀) can be readily reduced by alkali metals to give ‘carbons-apart’ dianionic species [*nido*-R₂C₂B₁₀H₁₀]²⁻ in which the two cage carbon atoms are in *meta* positions. They can be further reduced to [*arachno*-R₂C₂B₁₀H₁₀]⁴⁻ tetraanions where the cage carbon atoms are further separated by at least two cage boron atoms. These anions are very useful versatile synthones for the production of

numerous metallacarboranes of s-, p-, d-, and f-elements. However, their isomers ‘carbons-adjacent’ carborane anions are virtually unknown. We propose in this research to generate this novel class of anions by introducing a short linkage between two cage carbon atoms of an *o*-carborane which would force them to remain adjacent in *ortho* positions during the reduction process leading to the formation of a novel class of ‘carbons-adjacent’ *nido*- and *arachno*-carborane anions. The chemistry of ‘carbons-apart’ and ‘carbons-adjacent’ carborane anions is expected to be different since they have different bonding faces and electronic and steric effects. It is anticipated that the chemistry of ‘carbons-adjacent’ carborane anions is extremely rich and varied.

(CU02026)

Novel Catalysts for Polymerization of Olefins and Polar Monomers

✉ XIE Zuowei • OKUDA Jun*

☐ 1 January 2003

❖ Germany/Hong Kong Joint Research Scheme

Polymerization catalysts based on well-characterized organometallic complexes are attracting worldwide academic and industrial interests as demand for inexpensive polymeric materials continues to grow. Ligand modifications have played a key role in developing new catalyst precursors for optimizing polymerization activity as well as polymer properties such as stereoregularity, molecular weight, bulky and polar comonomer incorporation, and microstructure. It has been documented that a ligand containing bifunctional groups often offers complexes with some additional advantage. Recently developed “constrained-geometry” ligands containing both mono (cyclopentadienyl) and σ-heteroatom

components have attracted considerable attention. Group 4 metallocenes derived from these ligands are very active catalysts (so-called constrained-geometry catalysts, CGC) for the copolymerization of ethylene with α -olefins due to the increased electron-deficiency and more open coordination environment of the central metal ions. We plan to systematically test the polymerization property of the novel catalysts developed in our lab towards homopolymerization of ethylene, styrene, methyl methacrylate as well as copolymerization of ethylene with styrene and methyl methacrylate as well as styrene with methyl methacrylate.

(PS02757)

Novel Catalysts for C-C/C=C Bond-forming Reactions and Fine Chemistry

✉ XIE Zuowei • Pierre H DIXNEUF*

□ 1 January 2003

❖ France/Hong Kong Joint Research Scheme

The development of chemical processes in industry is associated with the discovery of clean tolerance for the environment processes, and the combination of several simple substrates into one useful high value product under mild conditions, thus with energy and atom economy. In this direction of sustainable development *catalysis* is at the center of research and development for the large-scale production of chemicals and for the synthesis of high value intermediates for fine chemistry or health products including polymers. Modern catalysis requires both the discovery of catalytic systems performing new combinations of molecules with clean processes and atom economy, and the improvement of known catalyst efficiency to reduce metal residues and process cost. Consequently, the understanding of catalytic processes is now crucial for designing

significant modification and improvement of catalysts and new combinations of reagents. We plan to explore the chemistry of a novel class of modern ruthenium catalysts with mixed carboranyl-organic ligands developed in our group in the hope that these Ru complexes would have a very high catalytic efficiency in alkene metathesis and C-C bond forming process.

(PS02866)

Sonochemical Preparation of Mesoporous Metal Oxide Catalysts for Environmental Applications

✉ YU Jimmy C.

□ 1 September 2002

❖ Research Grants Council (Earmarked Grants)

Air Pollution is a very serious problem in Hong Kong. The city's high population density and reliance on fuel consumption put tremendous pressure on its environment. This proposal describes the development of highly effective mesoporous metal oxide catalysts for air pollution treatment. Traditional preparation methods for these catalysts often require toxic chemicals and solvents. Moreover, these processes are energy intensive. We have discovered recently that ultrasound could be used to enhance the formation of a mesoporous photocatalyst, titanium dioxide. This is due to the generation of localized high temperature and pressure regions by the sonochemical effect. We have preliminary evidence that highly active TiO₂, CuO and other kinds of metal oxides can be prepared by this novel route. This may be the simplest method for preparing fine catalytic powders on a nanometer scale and with homogeneous particle size distribution.

(CU02027)

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

| <u>Edition</u> | <u>Title/Investigators</u> | | |
|----------------|--|---------|--|
| | | | Interactions of Quasilinear Molecules (CU00272) ✍ CHAN Man Chor |
| 1994-95 | Asymmetric Catalysis by Metal Complexes of Chiral Pyridyl Phenols and Their Derivatives (PS94010) ✍ CHAN Kin Shing | 2001-02 | Double Resonance Spectroscopy of Solid Hydrogen: Studies of Vibrational Relaxation (PS01258) ✍ CHAN Man Chor |
| 1999-00 | Activation of Carbon-Carbon Bonds by Transition Metal Complexes (CU99202) ✍ CHAN Kin Shing | 2000-01 | Dissociation of Large Ions in a Fourier-transform Ion-Cyclotron-Resonance Mass Spectrometer (CU00274) ✍ CHAN Tak Wah Dominic |
| 2001-02 | 1,2 Rearrangements of Beta-Aminoalkyl Rhodium Porphyrins (PS01251) ✍ CHAN Kin Shing | 2001-02 | Development of Novel Electron Emitter for Electron Capture Dissociation of Biomolecules in a Fourier-transform Mass Spectrometer (PS01359) ✍ CHAN Tak Wah Dominic |
| 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 | 1999-00 | Synthesis and Characterization of Dendritic Networks (CU99201) ✍ CHOW Hak Fun |
| 1999-00 | Forbidden Transitions of H ₂ Studied by Cavity Ring Down Spectroscopy (PS99010) ✍ CHAN Man Chor | 2000-01 | Artificial Globular Proteins: Synthesis and Characterization of alpha-Amino Acid-based Peptide Dendrimers (CU00273) ✍ CHOW Hak Fun |
| 1999-00 | Structural and Dynamic Studies of van der Waals Molecules Using High Resolution Spectroscopy (PS99017) ✍ CHAN Man Chor | 2001-02 | Synthesis and Properties of a Dendritic Analog of Poly(olefins) (PS01249) ✍ CHOW Hak Fun |
| 2000-01 | High-resolution Spectroscopy of CH ₂ ⁺ and NH ₂ ⁺ : The Study of Rovibronic | 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) |
| 2000-01 | Development of Analysis Techniques for Deposits and Baths for the Electroplating Industry (PS20005) | | ✍ LEE Hung Kay |
| | ✍ KWOK Wai Man Raymond • HARK Sui Kong (Dept of Physics) | 1990-91 | Synthesis of Novel Transition-Metal Alkyls (BP90039) |
| | | | ✍ LEUNG Wing Por Kevin |
| 2000-01 | A Novel Technique for the Analyses of Depth Distributions of Chemical States and Compositions in Semiconductor Materials with Sub-nanometer Resolution (CU00230) | 1990-91 | Synthesis of Organometallic Compounds of Alkali Metals (BP90040) |
| | ✍ KWOK Wai Man Raymond | | ✍ LEUNG Wing Por Kevin |
| 2001-02 | Micrometallurgy in the Electroplated Bumps for Flip-chip Applications (PS01583) | 2000-01 | Metal Complexes of a Tridentate Diamide Ligand (CU00265) |
| | ✍ KWOK Wai Man Raymond | | ✍ LEUNG Wing Por Kevin |
| 2001-02 | R&D of New Process Chemicals for the Electronic Industry (PS01346) | 2000-01 | Gaussian-3 Study on the Structures, Reactions, and Energetics of Some Interesting Chemical Systems (CU00275) |
| | ✍ KWOK Wai Man Raymond | | ✍ LI Wai Kee |
| 2000-01 | Solution Structure Studies of Nuclear Localization Signals in Viral and Disease Proteins (PS00431) | 2000-01 | Theoretical Study on Solvation Dynamics and Intracluster Reactions for $Al^+(H_2O)_n$ Ion Clusters (CU00276) |
| | ✍ LAM Sik Lok | | ✍ LIU Zhifeng • TSE John S.* |
| 2001-02 | Structures and Dynamics of Mismatches in Trinucleotide Repeats (PS01255) | 2001-02 | Computational Studies on the Adsorption and Reaction of Small Molecules on Arrays of Carbon Nanotubes (PS01252) |
| | ✍ LAM Sik Lok | | ✍ LIU Zhifeng • GONG Xin Gao* |
| 2001-02 | Correlation of Sequence Dependent Chemical Shifts and Local Structures of Deoxyribonucleic Acids (PS01877) | 1989-90 | X-Ray Analysis of Crystal Structures (BP72001) |
| | ✍ LAM Sik Lok | | ✍ MAK Thomas Chung Wai |
| | | 1989-90 | Metal Coordination by Betaines (BP88025) |
| | | | ✍ MAK Thomas Chung Wai |

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|---------|--|--|
| 1999-00 | Studies in Supramolecular Chemistry (CU99206) ✍ MAK Thomas Chung Wai | ✍ WONG Nai Ching Henry • MAK Thomas Chung Wai |
| 2000-01 | Studies on the Coordination Chemistry of Acetylenediide and Pseudohalide Anions (CU00268) ✍ MAK Thomas Chung Wai | 2000-01 Synthesis of Compounds by Solution Phase Chemistry (PS20007) ✍ WONG Nai Ching Henry |
| 2000-01 | Bioconjugation of Phthalocyanines with Amino Acids and Peptides, Synthesis and Photophysical Properties in Micellar Systems (PS00397) ✍ NG Kee Pui Dennis | 2001-02 Biomimetic Total Synthesis of Novel Diterpenes from Liverwort <i>Pallavicinia subciliata</i> (PS01250) ✍ WONG Nai Ching Henry |
| 2001-02 | Dendritic Phthalocyanines with Cationic Surface Groups. Synthesis, Aggregation Behavior, and Photophysical Properties (PS01387) ✍ NG Kee Pui Dennis | 2000-01 Phase Transitions of Novel Polymer Brushes (CU00266) ✍ WU Chi |
| 2001-02 | The Study of Uloses in Asymmetric Epoxidation (PS01617) ✍ SHING Kung Ming Tony | 2001-02 The Self-assembly of Polymeric Surfactants in Water (PS01001) ✍ WU Chi • Avraham HALPESIN* |
| 1989-90 | Theoretical Studies of (a) Aluminium-Ethylene Complexes (b) CH_3SOH^+ (c) Ge Compounds (d) HPOH and HNOH (BP89048) ✍ SO Suk Ping | 2001-02 The Mesoglobular Phase of Dilute Heteropolymer Solutions (PS01257) ✍ WU Chi |
| 1989-90 | Synthesis of Novel Aromatic Compounds (BP83001) ✍ WONG Nai Ching Henry | 2001-02 The Orderly Folding of a Single Heteropolymer Chain in Solution (PS01912) ✍ WU Chi |
| 2000-01 | The Construction of Chiral 3-Dimensional Molecular Scaffolds Using Tetraphenylenols as Building Blocks (CU00264) | 1999-00 Organolanthanide Compounds with a New Class of Versatile Ligands (CU99210) ✍ XIE Zuwei |
| | | 2000-01 Group 4 Metal Carborane Complexes: Synthesis, Structure, and Reactivity (CU00267) ✍ XIE Zuwei |

- 2001-02 A New Class of Metallocarboranes
Incorporating the n7-Carboranyl Ligand
(PS01254)
✉ XIE Zuowei
- 2001-02 Novel Ruthenium Catalysts for Fine
Chemistry (PS01513)
✉ XIE Zuowei • Pierre H DIXNEUF*
- 2000-01 Applications and Mechanisms of
Photochemical Oxidation of Persistent
Organic Pollutants (CU00033N)
- 2001-02 Development of Advanced Photocatalytic
Nano-coating Technologies for
Environmental and Health Industries
(PS01871)
✉ YU Jimmy C. • WONG Po Keung
(Dept of Biology)

RESEARCH PROJECTS

Research and Laboratory Work on the Chinese Herb, namely CORTEX MOUTAN (*Paeonia Suffruticosa* Andr.)

✍ CHE Chun Tao • KWAN Hoi Shan (Dept of Biology) • HU Shiu Ying • IP Siu Po

☐ 1 September 2002

❖ Dept of Health, HKSAR Government

The overall objective of this project is to establish pharmaceutical standards for the Chinese herbal drug Cortex Moutan, as specified in the “Technical Guidelines for Research and Laboratory Work of the HKCMM Standards” provided by the Department of Health, the Hong Kong SAR Government. The work involves detailed description of technical procedures, method validation, and end point measurement of the standardization criteria.

(BL02892)

Research and Laboratory Work on the Chinese Herb, namely Radix Astragali

✍ CHE Chun Tao • KWAN Hoi Shan (Dept of Biology) • HU Shiu Ying • IP Siu Po

☐ 3 September 2002

❖ Dept of Health, HKSAR Government

The overall objective of this project is to establish pharmaceutical standards for the Chinese herbal drug Radix Astragali, as specified in the “Technical Guidelines for Research and Laboratory Work of the HKCMM Standards” provided by the Department of Health, the Hong Kong SAR Government. The work involves detailed description of technical

procedures, method validation, and end point measurement of the standardization criteria.

(BL02546)

Research and Laboratory Work on the Chinese Medicinal herb, namely Cortex Phellodendri

✍ CHE Chun Tao • KWAN Hoi Shan (Dept of Biology) • HU Shiu Ying • IP Siu Po

☐ 18 September 2002

❖ Dept of Health, HKSAR Government

The overall objective of this project is to establish pharmaceutical standards for the Chinese herbal drug Cortex Phellodendri, as specified in the “Technical Guidelines for Research and Laboratory Work of the HKCMM Standards” provided by the Department of Health, the Hong Kong SAR Government. The work involves detailed description of technical procedures, method validation, and end point measurement of the standardization criteria.

(BL02498)

Research and Laboratory Work on the Chinese Medicinal Herb, namely Rhizoma Alismatis (*Alisma orientalis* (Sam.) Juzep.)

✍ CHE Chun Tao • KWAN Hoi Shan (Dept of Biology) • HU Shiu Ying • IP Siu Po

☐ 18 September 2002

❖ Dept of Health, HKSAR Government

The overall objective of this project is to establish pharmaceutical standards for the Chinese medicinal herb Rhizoma Alismatis, as specified in the “Technical Guidelines for Research and Laboratory Work of the HKCMM Standards” provided by the Department of Health, the Hong Kong SAR Government. The work involves detailed

description of technical procedures, method validation, and end point measurement of the standardization criteria.

(BL02991)

Research on Traditional Chinese Medicines and Botanical Dietary Supplements

✉ CHE Chun Tao

☐ 15 November 2002

❖ University of Illinois at Chicago

As part of a collaborative research agreement between the University of Illinois at Chicago (UIC), USA and the Chinese University of Hong Kong (CUHK), the School of Chinese Medicine at CUHK is involved in the drug discovery and traditional Chinese/botanical dietary supplements research projects of the Program for Collaborative Research in the Pharmaceutical Sciences, College of Pharmacy, UIC. Research objectives include the acquisition of authenticated plant samples, quality standardization, validation of safety and efficacy, isolation of active ingredients, as well as enhancement of mutual technological advances through workshops, seminars, exchange visits and/or research training.

(BL02503)

Hepatoprotective Effects of Wu-zi-yan-song-wan Formulation

✉ CHE Chun Tao • LIANG Songming

☐ 1 December 2002

❖ CUHK Research Committee Funding (Direct Grants)

Wu-zi-yan-zong-wan is a Chinese medicinal formula which has a long history of use for its tonic effects. The formulation has also been found to display *in*

vitro antioxidant activities in cell-free tests as well as in cultured cell assays. Preliminary clinical observations conducted in the Mainland have suggested some extents of protective effect on liver functions when this prescription was applied to alcohol intoxicated patients. We propose to study and confirm the antihepatotoxic effects of this formulation by using *in vitro* and animal models. In this investigation, acute and chronic models will be set up to test for the preventive and therapeutic effects of the medicinal formula, including the *in vitro* t-BHP-induced hepatotoxicity assay and *in vivo* carbon tetrachloride-induced liver toxicity model. In particular, a chronic liver toxicity model will be established using rats with liquid diet containing alcohol.

(BL02799)

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

| <u>Edition</u> | <u>Title/Investigators</u> |
|----------------|--|
| 1999-00 | Cytotoxic and Potential Anti-Tumour Compounds from the Chinese Drug "Lang-Du" and Their Mechanisms of Action (CU99169) ✉ CHE Chun Tao • KONG Yun Cheung# • LIU Wing Keung Ken (Dept of Anatomy) |
| 2001-02 | Cancer Drugs Active against Signal Transduction Targets (BL01514) ✉ CHE Chun Tao |
| 2001-02 | Chemical and Molecular Analyses of Rhubarb (BL99851) |

✍ CHE Chun Tao

RESEARCH PROJECTS

The Thin Film Equation: Rupture, Blow-up and Regularity

✉ CHOU Kai Seng

☐ 1 December 2002

❖ Research Grants Council (Earmarked Grants)

The thin film equation describes the motion of a viscous fluid on a surface when its height is small. It is a commonly accepted approximation to the full motion. Due to its potential applications in fluid mechanics, biophysics and coating industries, this equation has been studied intensively in recent years. Many numerical and analytic results have been found. In this project we will study the rupture (dewetting), blow-up and long time behavior of the thin film. In particular, some numerical findings will be confirmed. From a theoretic point of view, this equation is a degenerate fourth-order parabolic equation. Nowadays people know a lot about second-order parabolic equations. Our study will contribute to the understanding of higher order equations.

(CU02028)

Harmonic Analysis of Fractal Measures

✉ LAU Ka Sing

☐ 31 December 2002

❖ Research Grants Council (Earmarked Grants)

Fractals was introduced in the 70's by Mandelbrot as a general framework to understand certain chaotic phenomena. The topic has great impact in mathematics and in the last thirty years, it has influenced almost every branch of mathematics

research. In analysis, while there is a large amount of literature concerning the geometric, dimensional, and dynamical aspects of the fractals, there are relatively few results in the direction of harmonic analysis.

In this proposal we will concentrate on harmonic analysis of fractal measures. Some of the basic setups for Fourier analysis have already been laid down by Strichartz, Jorgensen and Petersen and the Pl. Along that direction we will investigate the functional analytic properties, Fourier asymptotics and the spectral structure of such measures. We will bring in the techniques of maximal averages and the singular integral theory, the so-call real variable methods, to study the fractal measures and the associated function spaces. We plan to use this new approach to consider the convolution operators defined by such measures and to answer certain open problems such as the L^p -improving property.

(CU02030)

C*-uniqueness of Locally Compact Groups

✉ LEUNG Chi Wai • NG Chi Keung*

☐ 1 April 2003

❖ CUHK Research Committee Funding (Direct Grants)

Let G be a locally compact group. G is said to be a C*-unique if $L^1(G)$ has exactly one C*-norm. This property was first studied by J. Boidol. In our previous joint works (RGC Direct Grant 2001 – 2002), some permanent properties of C*-unique groups were studied and two papers concerning these results were written. One of these papers had been accepted by *Mathematische Zeitschrift* (2002) and the other one will be submitted to an international refereed journal.

Based on the above works, we are going to investigate the following related problems:

Problem 1: Is any amenable locally compact group a retract of a C^* -unique group?

Problem 2: If N is a C^* -unique closed normal subgroup of G and G/N is compact, does it imply that G is also C^* -unique?

Problem 3: Let G be a connected group. Does the set of locally separated points in the primitive ideal space of G always contain an open and dense subset?

For the first question, we have shown that the answer is positive for any discrete group in our previous work.

The Last question is related to the characterization of connected C^* -unique groups. This question was asked by Boidol but so far, nothing is known about it. (PS02862)

Geometry of CR Manifolds and Applications

✉ LUK Hing Sun • YAU Shing Toung Stephen*

□ 1 December 2002

❖ Research Grants Council (Earmarked Grants)

The notion of CR manifolds is an abstraction of smooth boundaries of complex spaces. An important example is the Milnor line, which has played a central role in Singularity theory. It was a surprising discovery in topology that some Milnor links may be exotic spheres. In this project, we shall first study the metric and pseudoconformed properties of Yau's list of differentiable representatives of exotic 7-spheres as intersections of weighted homogeneous hypersurfaces in C^5 with the standard 9-sphere, focusing on the amount of positive curvature on the one hand, and the Chern-Moser invariants on the other. The projective structures will also be studied using Segre family theory. With these examples understood, we shall next investigate

the geometry of compact strongly pseudoconvex CR manifolds in general, in the framework of Chern-Moser theory.

As applications of the general theory, we shall relate the geometry of compact strongly pseudoconvex CR manifolds to properties of the interior singularity they may create. In particular, we shall seek such geometric characterization of rational singularities. In another direction, we follow Kuranishi's program of studying deformation of isolated singularities via deformation of CR structures.

(CU02033)

Error Bounds in Mathematical Programming

✉ NG Kung Fu • PANG Jong Shi*

□ 1 December 2002

❖ Research Grants Council (Earmarked Grants)

We purpose to use various forms of generalized directional derivatives/subdifferentials to provide the first and higher order sufficient/necessary conditions for a system to have error bounds.

(CU02029)

On Regularities and Constraint Qualifications in Mathematical Programming

✉ NG Kung Fu • YE Jane* • LI Chong* • HUANG L R*

□ 1 May 2003

❖ CUHK Research Committee Funding (Direct Grants)

We employ techniques from approximation theory and the nonsmooth analysis as well as the Banach space theory to study infinite system of convex inequalities.

(PS02616)

Analytic Problems on Riemannian and Kähler Manifolds

✉ TAM Luen Fai

□ 1 September 2002

❖ Research Grants Council (Earmarked Grants)

In this project the principal investigator will study some analytic and geometric problems on complete noncompact Riemannian or Kähler manifolds. A first question is to understand gap phenomena in the category of Ricci curvature. The PI plans to investigate under what conditions and decay rates so that if the Ricci curvature of the a manifold decays fast enough at infinity, then the manifold would be Ricci flat. To understand the structures of complete Kähler manifolds, there are some important analytical tools: the Poisson equation, Poincaré-Lelong equation and the Kähler-Ricci flow. The PI plans to study these equations and in particular their relations. One might expect to have interesting results by using the Pincaré-Lelong equation to study the Kähler-Ricci flow on noncompact Kähler manifolds, which was developed by W.-X,Shi. The study is related to a well-known conjecture by Yau and Green-Wu that a complete noncompact Kähler manifold M of positive holomorphic bisectional curvature is biholomorphic to C^m .

The PI also wants to continue his study on harmonic maps between noncompact manifolds. The behaviors of harmonic maps of polynomial growth from nonnegatively curved complete noncompact manifolds into Cartan-Hadamard manifolds are basically well understood. The PI plans to continue to study the case that the harmonic maps grow faster. The structures of such harmonic maps are rich as exhibited by recent works in the field. The PI plans to understand how to extend boundary maps at

infinity to harmonic maps between manifolds with strongly negatively pinched sectional curvature. The problem is related to conjectures of Schoen and Li-Wang.

(CU02032)

Mathematical Theory of Boundary Layers and the Prandtl's System

✉ XIN Zhouping

□ 1 October 2002

❖ Research Grants Council (Earmarked Grants)

The boundary layer theory has been one of the fundamental parts of the fluid dynamics. For fluids whose viscosity is small, the absence of sliding on the surface of a body essential affects the flow about the body only in the vicinity of its surface, in a thin layer next to its wall. This phenomena gave rise to the boundary layer theory. The Prandtl's system governs the first approximation of the flow velocity in the boundary layer. Despite the great importance and substantial progress achieved in the past in theoretical, numerical, and experimental aspects of this theory, yet many basic issues, such as the well-posedness of various initial-boundary value problems for the Prandtl's boundary layer system in general Sobolev's spaces or Holder spaces, qualitative behavior of solutions to the Prandtl's system and their asymptotics, and rigorous justification of the Prandtl's boundary layer theory, ect., remain open in many physically relevant cases and continue to challenge the field. The main goal of this research project is to continue our current effort to attack some of these problems by rigorous analysis, asymptotic methods, and numerical simulations. Specific problems to be investigated in this project include. Well-posedness of initial-boundary value problems for unsteady

Prandtl's system in some Sobolev spaces; stability of solutions to the Prandtl's system under small initial perturbations, asymptotic equivalence between solutions to the Prandtl's system and those to the Navier-Stokes system for larger Reynolds number, detachment of the boundary layers; interactions of boundary layer and shock layers; and detailed asymptotic structure of solutions to the Navier-Stokes type equations.

(CU02040)

Efficient Numerical Methods for Solving Electromagnetic Maxwell's Systems

✉ ZOU Jun

□ 1 October 2002

❖ Research Grants Council (Earmarked Grants)

Electromagnetic simulation is encountered in many scientific and engineering applications, such as plasma physics, diffraction of electromagnetic waves, and microwave devices etc. The electromagnetic equations are a coupled system of first order differential equations with 6 unknown functions for the electric and magnetic fields. The numerical solution of such Maxwell's system is extremely time-consuming.

This first issue in solving the Maxwell's system lies in the lower regularities of the fields when the physical domain consists of more than one media with different permittivities and permeabilities.

This poses one of the major difficulties in designing an efficient numerical method. Another challenge for solving the Maxwell's system is how to incorporate tow divergence constraint equations in the numerical solution. It is known that it will generate the non-physical spurious solutions if one does not incorporate two divergence equations in the discretization schemes.

In this project we propose to decouple the interface Maxwell's system, confined in the physical domain which involves more than one different medium, into two independent systems: one involves only the electric field and the other involves only the magnetic field. Then we construct some finite element methods for solving the two independent systems. Our goal is to design the numerical methods in a way that they can achieve the same convergence rates as the existing numerical methods do for non-interface Maxwell's equations in a homogeneous medium.

(CU02048)

Hodge Theory and Applications in Geometry and Topology

✉ ZUO Kang

□ 1 October 2002

❖ Research Grants Council (Earmarked Grants)

Hodge Theory is the crossroads where algebraic geometry, topology, arithenetic geometry and Mathematic Physic (such as Mirror Symmetry) meet. Many outstanding problems can be formulated in problems in Hodge Theory. We plan to develop Hodge Theory and use it to study concrete problems in:

1. Families of Calabi-Yau manifolds
2. Topology and Geometry on quasi-compact Kähler manifolds.

(CU02034)

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

Edition Title/Investigators

| | | |
|---------|--|--|
| 1999-00 | Iterative Method for Ill-Conditioned Toeplitz Systems (CU99212) ✍ CHAN Hon Fu Raymond • NG Kwok Po* | ✍ LUK Hing Sun • YAU Shing Toung Stephen* |
| 2001-02 | New Applications of Iterative Toeplitz Solvers (PS01243) ✍ CHAN Hon Fu Raymond • NG Kwok Po* | 2000-01 Partial Ordering and Convexity in Applied Functional Analysis and Applications (CU00290) ✍ NG Kung Fu |
| 2001-02 | Multigrid Toeplitz-like Solvers and Applications (PS01539) ✍ CHAN Hon Fu Raymond • STEFANO Serra-Capizzano* • CRISTINA Tablino-Possio* • EVGENIJ Tyrtysnikov* | 2000-01 On Hoffman's Error Bound and Vector Optimization (PS00674) ✍ NG Kung Fu • HAN Zhiqing* • WEN Song* • HUANG L R* |
| 2000-01 | Topics in Curvature Flows (CU00294) ✍ CHOU Kai Seng | 1999-00 Harmonic Maps and Harmonic Functions on Noncompact Manifolds (CU99217) ✍ TAM Luen Fai |
| 1999-00 | Multifractals, Iterated Function Systems and Stochastic Models (CU99215) ✍ LAU Ka Sing • ANH Vo Van* | 2000-01 Analysis on Complete Manifolds (CU00291) ✍ WAN Yau Heng Tom • LI Wai Kwong Peter* |
| 2000-01 | Ruelle Operators and Dynamical Systems (CU00293) ✍ LAU Ka Sing • FAN Ai Hua* • LEUNG Chi Wai | 1999-00 Point Condensations Generated by Reaction-Diffusion Systems (CU99218) ✍ WEI Juncheng |
| 2001-02 | On Some Problems in Tilings (PS01240) ✍ LAU Ka Sing • WANG Yang* | 2001-02 Localized Structures of Reaction-diffusion Systems (PS01594) ✍ WEI Juncheng |
| 2001-02 | On a Certain Class of Group Algebras (PS01598) ✍ LEUNG Chi Wai • NG Chi Keung* | 2001-02 Existence and Stability of Multiple Spikes (PS01238) ✍ WEI Juncheng |
| 2000-01 | Explicit Construction and Decoding Algorithms of Algebraic-geometric Codes (CU00295) | 1999-00 Analysis of Nonlinear Evolution Partial Differential Equations in Compressible Fluids (CU99219) ✍ XIN Zhouping |

- 2000-01 Analysis of Some Problems for Incompressible Euler and Navier-Stokes Equations (CU00279)
✍ XIN Zhouping
- 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*
- 2000-01 Numerical Methods for Solving the Singular Maxwell Equations (PS20006)
✍ ZOU Jun • CIARLET Patrick* • Garcia EMMANUELLE*
- 2001-02 Simultaneous Reconstruction of Initial Temperature Distributions and Heat Radiative Coefficients (PS01244)
✍ ZOU Jun
- 2001-02 Numerical Reconstruction of Initial Temperature Distributions (PS01811)
- 2000-01 Cohomology of Moduli Spaces of Vector Bundles and Fundamental Groups of Quasi-Compat Kahler Manifolds (PS00538)
✍ ZUO Kang • SUN Xiaotao* • YANG Yihu*
- 2001-02 Uniformization and Moduli Spaces of Algebraic Manifolds (PS01239)
✍ ZUO Kang
- 2001-02 Cohomological Theory with Coefficients in Local Systems and Applications to Algebraic Geometry (PS01791)
✍ ZUO Kang • YANG Yihu*

RESEARCH PROJECTS

Turbulent Convection: Statistics, Large-scale Circulating Wind, and Heat Transport

✉ CHING Shuk Chi Emily

☐ 1 October 2002

❖ Research Grants Council (Earmarked Grants)

All flows of liquids and gases can be divided into two very different types: laminar and turbulent flows. Most fluid flows in nature, engineering applications, and in everyday life are turbulent. Turbulence is thus a problem of practical importance. It is also a great challenge in physics for which a satisfactory theory is yet to be developed. Rayleigh-Benard convection is one of the most studied systems in fluid turbulence. In this system, a closed cell of fluid is heated from below. Hot fluid near the bottom of the cell will tend to rise and cold fluid on the top will tend to fall. As a result, fluid motion is driven by the applied temperature difference. When the temperature difference is large enough, the fluid motion becomes turbulent in which velocity and temperature display irregular and complex fluctuations both in time and in space. There are many issues of interest in this problem. In this project, we shall study three different aspects: (1) the statistics of the velocity and temperature fluctuations, (2) the large-scale circulating wind which is one of the prominent geometric structures that recur in the flow amid the turbulent environment, and (3) the heat transport by the fluid, which is an overall response of the system to the thermal forcing. We shall attempt to gain understanding of the problem via a combination of data analyses, analytical work and numerical study of simplified models.

(CU02046)

Resonant Raman Scattering of Semiconductor Nanostructures

✉ HARK Sui Kong

☐ 1 December 2002

❖ CUHK Research Committee Funding (Direct Grants)

Using existing MOCVD facility, $Zn_xCd_{1-x}Se$ semiconductor nanostructures in the form of quantum wells and quantum dots will be grown. The electronic and vibrational states of these systems are strongly modified by the spatial confinements. Resonant Raman scattering is an ideal tool to probe these modified states, as it probes the phonons through actual electronic transitions. Strong coupling of electrons and phonons in the nanostructures helps to make multiple phonon processes more accessible experimentally than in bulk matter, particularly so under resonance conditions. We have already obtained informative resonant Raman spectra of one kind of quantum dots grown. However, the number of spectra obtained was restricted to the few available excitation energies of the laser employed. We plan to use a continuous tunable laser source to study the largely remaining regions of the resonance curve. Similar studies will also be extended to other nanostructures that we are growing. The Raman studies will add to our other on-going studies of the optical properties of these nanostructures by low temperature photo- and cathodo-luminescence, morphological studies by AFM and structural studies by X-ray diffraction.

(PS02817)

Spatial Solitons in Photovoltaic Photorefractive Crystals and Their Interactions

✉ LEE Wing Kee

□ 1 November 2002

❖ Research Grants Council (Earmarked Grants)

A light beam propagating in a medium (or even in vacuum) tends to broaden in space due to diffraction. It has been reported in 1993 that a milliwatt laser beam propagating in a certain type of crystals (known as photorefractive crystal) can be made significantly narrower and propagates with an essentially constant width. The narrowed (or self-trapped) laser beam is called a photorefractive spatial soliton. Recently, we discovered a *new type* of photorefractive spatial soliton that we call “all optical spatial soliton”, meaning that the formation of this type of solitons *does not* required an applied electric field (required by the vast majority of its known counterparts), and can be achieved by exploiting the induction of *another* laser beam. This new type of photorefractive spatial soliton exhibited properties that are different from those of the three known types photorefractive spatial solitons. In this research project, we will investigate selected properties of all optical spatial solitons, with aims to: (1) identify the mechanism(s) of its formation; (2) study variations of the morphology of all optical spatial solitons as control parameters are changed; and (3) search for other new types of photorefractive spatial soliton. Results of our research are expected to have applications in optical beam shaping, switching, steering, and communication.

(CU02035)

Synthesis of Uniform II-VI One Dimensional Nanostructures and Their Growth Mechanism Study

✉ LI Quan

□ 15 March 2003

❖ CUHK Research Committee Funding (Direct Grants)

One-dimensional (1D) II-VI nanomaterials have great potential in optoelectronic industry due to their excellent luminescence properties. The major hurdle for the application of these 1D nanomaterials lies in the fabrication process itself, i.e., the non-uniformity of the nanostructure’s morphology, growth direction and crystalline structure. In this study, several series of II-VI compound 1D nanostructures (nanowires and ribbons) will be fabricated by thermal evaporation using different processing parameters, including the source material, catalyst, deposition temperature, gas flow rate and processing pressure. The resulting nanostructures will be analyzed and compared in terms of chemical composition and morphology/microstructure. Based on the interrelationship between the deposition parameters and the resulting nanostructure, a general growth mechanism of the II-VI 1D nanostructures (using thermal evaporation) will be proposed. We aim at locating the deposition conditions, which may result uniformity in nanostructure’s morphology, growth direction and crystalline structure. The luminescence properties of the uniform nanostructures will also be investigated.

(PS02431)

A Parallel Quantum Monte Carlo Study of Magnetic and Electronic Properties of Strongly Correlated Electron Materials

✉ LIN Hai Qing • GUBERNATIS J E*

□ 1 August 2002

❖ Research Grants Council (Earmarked Grants)

We propose a computationally oriented project to clarify and unveil the microscopic mechanisms for many unusual properties of strongly correlated electron materials. We will generate experimentally verifiable signatures of these mechanisms, base the generation of these signatures on simple microscopic models, and detail the behavior of these models with respect to important properties like magnetic susceptibility, superconducting pairing correlations, and electron densities. We will assess the experimental relevance of multi-band Hubbard models to these materials. Our main objective is the establishment of rules-of-thumb for the design and interpretation of experiment, obtained by studying the variation of the properties of these models with their relatively few parameters. Recent advances in computational hardware and software for parallel computing provide an opportunity to impact this scientifically important class of materials in a way that did not exist a few years ago. Our results will clarify the fundamental physics of this challenging class of materials. The feasibility of our proposed approach has already been tested and confirmed in a preliminary study.

(CU02037)

Estimation of Default Probability by Three-factor Structural Model

✍ LO Chi Fai • HUI Cho Hoi*

☐ 1 December 2002

❖ CUHK Research Committee Funding (Direct Grants)

This project proposes a three-factor structural model for estimating probability of default. The model incorporates stochastic asset value of a corporate, liability and interest rate with time-dependent model parameters. A corporate defaults when its leverage

ratio increases above a predefined default-triggering level. Using average market data for corporates with different external credit ratings, the three-factor model is capable of producing the term structures of probability of default for rated corporates, that can be compared with the average default rates of the corresponding ratings reported by Standard & Poor's. The three-factor model can also be applied to estimation of probability of default under the internal ratings-based approach proposed in the New Basel Capital Accord.

(PS02932)

Correlative Study of Thermoluminescence and Surface Analytical Techniques in the Provenance Determination of Ancient Ceramics

✍ LO Yam Kuen Dennis

☐ 1 January 2003

❖ CUHK Research Committee Funding (Direct Grants)

A correlative study for thermoluminescence and the surface analysis in the provenance determination of ancient ceramics is proposed. Ancient ceramics have been routinely tested for provenance using thermoluminescence or surface analysis. However conflicting dating results from the two techniques have given rise to confusion in the antiques and arts community, causing great distress to the dealers and collectors alike. The one salient example is the case of a pair of blue and white vases, which was dated to Yuan Dynasty according to the results of one techniques, only to be disproved later by the other. It is our thesis that the conflict in testing results is a case of signal contamination: Pristine TL signal can be "contaminated" by energetic particles/photons emitted during surface analysis. This thesis will be put to the test by performing the two methods

sequentially but in different order. At the conclusion of the project, we expect to resolve the apparent conflict of the provenance results, which has undermined the confidence of the role of science and technology in areas of arts and humanity. The effect of ionizing radiation in influencing the provenance determination by thermoluminescence testing will also be studied.

(PS02857)

Production of IT-based Resource Materials for Physics

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

□ 7 January 2003

❖ Science Education Section, Education and Manpower Bureau, HKSAR Government

The project aims at producing IT-based resource materials for secondary school physics teaching. The deliverables include (1) a website integrating all the existing physics education websites of ED, (2) clip arts, short video clips and animation for physics teaching, (3) software for analyzing motions in videos, (4) an interactive quiz using Flash as a platform, and (5) a physics learning and teaching package in the Ocean Park. The materials will be delivered on the Web to all physics teachers in Hong Kong. Tryouts of the materials will be carried out and evaluated.

(ED02849)

Video Bank for Secondary-school Physics Teaching

✍ WONG Wing Hung • MAK Se Yuen (Dept of Curriculum & Instruction)

□ 1 July 2001

❖ UGC Interface Projects 2000

We proposed to develop a video bank for physics teachers in Hong Kong. The deliverables of the proposed project include a bank of video clips of physics experiments, seminars and an online discussion forum. Video clips packaged in CDROM format will be delivered to all physics teachers free of charge, and all teachers are invited to attend the seminars. The project is expected to bring direct benefits to over 500 physics teachers and generations of students. We expect that this work will support the professional needs of teachers and alleviate their burden of collecting and producing videos and ultimately we can develop transferable techniques of video producing, so that teachers will be able to make their own videos and share the videos with other teachers.

(PS01882)

Field-induced Structural Transformation of Self-assembled Colloids

✍ YU Kin Wah

□ 1 November 2002

❖ CUHK Research Committee Funding (Direct Grants)

We consider self-assembly processes of two types of colloidal particles interacting through type-dependent forces. We examine the phase diagram of the resulting structures under various different conditions. Based on the crystalline structures formed, we further consider the field-induced structure transformation by applying external electric fields. The possible transformation from one crystal lattice to the other one offers various potential applications in self-assembled colloidal systems.

(PS02545)

✉ HUI Pak Ming

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

| <u>Edition</u> | <u>Title/Investigators</u> | | |
|----------------|---|---------|---|
| | | 1989-90 | Microstructure of Undercooled Ge and Si (BP87003) ✉ KUI Hin Wing |
| | | 1989-90 | The Viscosity of Easy Glass Formers (BP87004) ✉ KUI Hin Wing |
| 2000-01 | Velocity and Temperature Statistics in Turbulent Convection (CU00286) ✉ CHING Shuk Chi Emily | 2000-01 | Mechanical Behavior of Bulk Nanostructured Alloys Synthesized by Rapid Solidification (CU00170) ✉ KUI Hin Wing |
| 2000-01 | Cosmic Ray Telescope (PS20004) ✉ CHU Ming Chung • LEE Yuk Yan • CHENG Kai Ming • TONG Shiu Sing Dominic • WONG Wing Hung • LAU Leo Woon Ming • CHAN Ki Hung* | 2001-02 | Thermal Stability of Nanostructured Alloys Prepared by Metastable Liquid Spindol Decomposition and the Search for High-temperature Nanostructures (MP01184) ✉ KUI Hin Wing |
| 2000-01 | Energy Focusing of Waves in a Cavity with Oscillating Boundaries (PS00566) ✉ CHU Ming Chung | 1999-00 | Engineering Homoepitaxial Growth Of cBN (CU99440) ✉ LAU Leo Woon Ming |
| 2001-02 | Dynamics of a Driven Bose-Einstein Condensate: Coherent Structures and Control (PS01237) ✉ CHU Ming Chung • LEUNG Pui Tang | 2000-01 | Applications of Quasinormal-Mode Expansion in Open Wave Systems (CU00282) ✉ LEUNG Pui Tang |
| 2001-02 | Optical Properties of Wide Band Gap II-VI Semiconductor Quantum Dots (PS01247) ✉ HARK Sui Kong • LAU Leo Woon Ming | 2001-02 | Mie's Scattering from Imperfect Spheres (PS01910) ✉ LEUNG Pui Tang |
| 2001-02 | Physics of Adaptive Behaviour in a Population of Competing Agents (PS01241) | 2001-02 | Fabricaton of Zn-based One-dimensional Nanostructures and Their Optical Properties (PS01746) ✉ LI Quan |

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|---------|--|---|
| 2000-01 | Phase Separation in Colossal Magnetoresistance Materials (CU00288) ✉ LIN Hai Qing • CAMPBELL David Kelly* | Reinforced Aluminum-based Metal Matrix Composites (MP01235) ✉ NG Hang Leung Dickon • CHAN Lap Ip Sammy* |
| 2001-02 | Exact Diagonalization Studies of Quantum Spin Models (PS01246) ✉ LIN Hai Qing • BETTS Donald D* | 2000-01 The Development of Polycrystalline Light-emitting Device in Ultra-violet Region (EE99660) ✉ ONG Hock Chun Daniel • HO S T* • CHAN Y C* |
| 2001-02 | Exact Diagonalization Studies of Antiferromagnetic Heisenberg Model with Frustration on Square Lattice (PS01567) ✉ LIN Hai Qing • TIAN G S* • YAO K L* • WAN S L* | 2000-01 The Study of ZnO for the Use of Polycrystalline Optoelectronic Devices (EE99461) ✉ ONG Hock Chun Daniel • DU G T* • HO S T* • DAI J Y* |
| 1998-99 | Tunable Solid State Lasers in the VUV Pumped by Discharge Excimer Lamp (CU98024) ✉ LO Yam Kuen Dennis | 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)# |
| 1999-00 | Dye-doped Sol-gel Materials for Low Power Optical Processing Applications (CU99366) ✉ LO Yam Kuen Dennis | 2001-02 The Defect Characterizations of ZnO Thin Films (PS01315) ✉ ONG Hock Chun Daniel |
| 2001-02 | Compact Long-pulse Vacuum Ultra-violet Source for Micro-fabrications (EE01218) ✉ LO Yam Kuen Dennis | 1999-00 An IT-based Resource Package for Secondary Schools in Hong Kong (Subject: Physics) (ED99035) ✉ TONG Shiu Sing Dominic • WONG Wing Hung • CHU Ming Chung • LAU Leo Woon Ming |
| 2000-01 | Study of In-site Reactions During the Sintering Process of Aluminum-based Metal Matrix Composites (PS00664) ✉ NG Hang Leung Dickon | 2000-01 Production a Web-based Self-Learning Package for Secondary School Teachers in Hong Kong: Using Contextual Themes |
| 2001-02 | Fabrication and Characterization of Alumina Whiskers and Intermetallics | |

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|---------|---|---------|--|
| | in the Teaching of Physics in Secondary Schools (ED20020) | | ✍ XIA Keqing |
| | ✍ TONG Shiu Sing Dominic • WONG Wing Hung • LAU Leo Woon Ming | 2000-01 | Development of a Technique for and the Determination of the Viscous Boundary Layers in Low Prandtl Number Turbulent Convection (CU00281) |
| 2001-02 | Isotope Effect in Single-crystal Manganite Thin Films (PS01752) | | ✍ XIA Keqing |
| | ✍ WONG Hong Kuen | 2001-02 | Turbulent Thermal Convection in Low and High Prandtl Number Fluids over Rough Surfaces (PS01242) |
| 1999-00 | Non-destructive Dating of Ancient Ceramics by Laser Induced Thermoluminescence (CU99009) | | ✍ XIA Keqing • TONG Penger* |
| | ✍ WONG King Young • LO Yam Kuen Dennis • LEE Chung Kay • LAU Leo Woon Ming • KWOK Wai Man Raymund (Dept of Chemistry) • NING Hung Pun Gary (Art Museum) | 2001-02 | Experimental Investigation of Chaotic Modes in Turbulent Rayleigh-Benard Convection (PS01447) |
| | | | ✍ XIA Keqing |
| | | 2000-01 | First-Principles Approach to Dynamic ER Effects in Complex Fluids (CU00284) |
| 2001-02 | Technology and Materials Innovations in Using Electrically Luminous Plastics in the Display Industry (PS01645) | | ✍ YU Kin Wah |
| | ✍ 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 | First-principles Approach to Dielectric Dispersion of Nonspherical Cells (PS01245) |
| | | | ✍ YU Kin Wah |
| | | 2001-02 | Computer Simulation of Electrorheological Fluids in the Dipole-Induced-Dipole Model (PS01705) |
| 1993-94 | Study of Statistical Nature of Particle Motion in Fluids (BP00101) | | ✍ YU Kin Wah |
| | ✍ XIA Keqing | | |
| 1994-95 | Experimental Studies of Turbulent Convection (PS94012) | | |

RESEARCH PROJECTS

Long-memory Time Series Analysis for Bursty Data in I/O Performance and Finance

✉ CHAN Ngai Hang

☐ 1 December 2002

❖ Research Grants Council (Earmarked Grants)

Owing to the advent of computing technology, high frequency data occur in various disciplines. The tick-by-tick data observed in financial applications are typical examples of high frequency data. High frequency data tend to be nonnegative, discrete valued, highly dependent, large in sizes, perhaps in the order of millions, and bursty or heavy-tailed. Data of this nature are less studied in traditional statistical literature and offer new and interesting challenges to statisticians. An important goal of the present proposals is to develop useful time series methodology for analyzing such high frequency data. Specifically, two interrelated applications of long-memory time series methods in computer disk design and finance will be pursued. Finding convenient toolkits for data synthesis in computer hard disk design constitutes the first part of this project. Novel long memory seasonal time series will be developed from which simulators for hard disk can be built. The second part of this project concerns the applications of long memory time series in modeling stochastic volatility factors in financial applications. Efficient estimation methods for multivariate models in portfolio analysis will be established. Completion of this project will bring important significance into the understanding of long memory time series modeling of high frequency data and enhance considerably the applicability of long

memory time series methods in finance, engineering and risk management.

(CU02043)

Resilience Indicators Phase II: Measures of an Economy's Ability to Withstand Financial Shocks

✉ CHAN Ngai Hang • WONG Hoi Ying

☐ 1 January 2003

❖ Hong Kong Monetary Authority

Contrary to the common practice of looking into possible signals to predict a crisis, the main objective of this project aims at developing a scheme of measures to indicate the capacity of an economy to withstand a crisis, given that a crisis occurs. In order to measure the sustainability of an economy to a crisis, one has to identify possible relevant factors for indicating different types of shocks arising from different economical or political conditions. Once the identification is conducted, one has to translate the relevant factors into quantifiable entities so that a resilience measure can be constructed based on these quantifiable factors. In this proposal, three stages are proposed to achieve this goal: identification of factors through data mining procedures, quantification of factors by statistical techniques, and development of a resilience measuring system.

(PS02380)

Test of Fit for the Log-gamma Distribution

✉ CHAN Ping Shing Ben

☐ 1 December 2002

❖ CUHK Research Committee Funding (Direct Grants)

The assessment of adequacy of models upon which inferences are based on is important. The empirical

distribution function (EDF) test statistics are one of methods to check the goodness-of-fit of a given distribution. They measure the discrepancy between the sample estimate of the distribution function and the specified distribution. In this project we would like to study the EDF test statistics for the three parameter log-gamma distribution. The log-gamma distribution is a wide distribution family including two most popular distributions, normal and extreme-value, as members. Two different cases will be investigated separately: Case 1: only the location and scale parameters are unknown; Case 2: all the shape, location and scale parameters are unknown. The percentage points of the EDF test statistics for finite sample size are determined by Monte-Carlo method and the asymptotic distributions of the test statistics will also be determined analytically.
(PS02986)

Sensitivity Analysis of Family Selection in Multiple Inferences

- ✍ CHEUNG Siu Hung • WU Ka Ho Eden
- 1 December 2002
- ❖ Research Grants Council (Earmarked Grants)

The focus of this project is to address fundamental issues in the area of multiple testing and simultaneous predictions. The results of this work bear imminent impact on multiple comparison methodologies and applications. In recent years, the phenomenal speed of ‘data explosion’ paves the way for the increase in the popularity of multiple inference (including testing and prediction) techniques. These techniques are essential in many disciplines such as physiology, agrobiolology, industrial quality control, microarray data analysis and business forecasting. However, a persistent criticism of multiple comparison

procedures is that the family of inferences is often arbitrarily selected; yet conclusions may rely heavily on the choices of the inferential families. In this project, we seek to develop a comprehensive approach to analyze the sensitivity of multiple inference procedures on the choices of inferential families. The major task includes providing useful tools for multiple inference practitioners to select appropriate statistical tools in multiple testing environments.
(CU02042)

New Development on Semiparametric Techniques

- ✍ FAN Jianqing
- 1 February 2003
- ❖ CUHK Research Committee Funding (Direct Grants)

Semiparametric modeling is one of the most popular techniques in contemporary statistics. It enables statisticians to reduce modeling biases and at the same time maintain the explanatory power of traditional parametric methods. This proposal will develop some cutting-edging technique for semiparametric modeling. Two inner related avenues are proposed for study. Firstly, a family of semiparametric models is introduced to model the volatility of assets (e.g. stocks, bonds, currencies). The models are flexible enough to capture the possible change of the dynamics of the models values over time. Several semiparametric techniques will be introduced to estimate the volatilities of the market prices of a portfolio. Furthermore, the information from remote history will be incorporated, through state-domain modeling as prior information. Combination of these techniques will result in more accurate estimation of volatility for asset pricing and risk managements. Secondly, we will study the

varying-coefficient partially linear models arising frequently in statistical modeling. A profile least-squares technique will be introduced for estimating parametric components. The main focus of this proposal is to examine whether the profile likelihood ratio tests are applicable to the testing problems on the parametric component of semiparametric models. We aim at demonstrating that the profile likelihood ratio statistics are asymptotically distribution-free and follow χ^2 -distributions under null hypotheses. This not only unveils a new Wilks' type of phenomenon, but also provides a simple and useful method for semiparametric inferences.

(PS02324)

Inference for General Non-Linear Random Effects Models with MCMC Stochastic Approximation

✉ GU Ming Gao

□ 2 September 2002

❖ Research Grants Council (Earmarked Grants)

Advances in modern technology lead to an explosion of data collected across different disciplines. However, most of them remain largely unexplored due to the lack of efficient algorithms. Fast and reliable statistical methods have to be developed to cope with data of unprecedented complexity in diverse fields such as medicine, finance, genomics and environmental sciences. A common model which plays a important role in those investigations is the non-linear random effects model. We shall use the ideas of MCMC and Stochastic approximation to attack the problems. Completion of these topics will bring important insights into their respective fields of scientific investigations.

(CU02041)

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

✉ LEE Sik Yum

□ 1 November 2002

❖ Research Grants Council (Earmarked Grants)

In social and psychological studies, investigators frequently encounter latent variables that cannot be measured directly by one single measure. Relations among latent variables and manifest variables are important in establishing a model for making correct decision. The structural equation model (SEM) is well-recognized as an important technique for analyzing these relations. At present, there are more than a dozen SEM packages to cope with the strong demand in various fields. However, these packages are not general and sophisticated enough to deal with many situations which involve complicated models and complex data structures. For instance, the most widely used LISREL program is developed on the basis of a single-level linear structural equation with no fixed covariates, hence it is incapable of assessing the interaction and quadratic effects among latent variables nor the effects of covariates. Moreover, its underlying statistical theory is based on the assumptions that the data are continuous and independent. Hence it cannot be applied to two-level and/or ordinal categorical data that are very common in social and psychological research. There is an urgent need in the field for developing a general SEM and associate computer programs to handle complicated situations presently not dealt with by existing SEM packages. In response to this need, the main objective of this project would be to develop

a two-level nonlinear SEM with covariates and a mixed type of continuous and discrete data. We will develop rigorous statistical methods for estimating unknown parameters, testing the goodness-of-fit of the posited model and selecting an appropriate model among competitive models. We will also develop general computer programs for producing the results. The proposed model, the newly developed statistical methods and computer programs will greatly enhance the applicability of SEMs to social and psychological research.

(CU02243)

Maximum Likelihood Analysis of Mixture of Structural Equation Models

✉ LEE Sik Yum

□ 1 December 2002

❖ CUHK Research Committee Funding (Direct Grants)

Structural equation modeling (Jöreskog, 1978; Bentler, 1980) is a multivariate technique in studying covariances and other relationships among observed and latent variables. Based on observed data that satisfy a number of assumptions in a single population, it has been applied widely in behavioral, medical and social sciences. However, in practice, there are a lot of problems in which the data are form a mixture of populations instead of a single population. The objective of this research project is to develop statistical theory and computing algorithm in maximum likelihood (ML) analysis of mixture of structural equation models. We will investigation the estimation, local influence analysis and model selection. Recent tools in statistical mythologies will be applied to some important areas in financial and social sciences.

This project will serve as a pilot study for an Earmarked grant proposal in the future.

Please refer to the attached detailed proposal.

(PS02917)

Analysis of Ranking Data with Structural Equation Modeling

✉ POON Wai Yin

□ 1 December 2002

❖ CUHK Research Committee Funding (Direct Grants)

Ranking is an easy, quick and natural data collection method that is useful in researchers of a wide range of disciplines. Ranking data has its unique characteristics and it may not always be possible to employ conventional statistical techniques in analyzing the latent content of ranking data. A number of approaches have been developed to model and analyze ranking data. Among others, the Thurstonian approach accompanying with Structural Equation Modeling (SEM) has been confirmed a useful one. This project explores various relationships between ranking data and ordinal categorical data, with a view to make use of the existing SEM software designated for analyzing ordinal data to analyze ranking data.

(PS02911)

Benchmarking Socio-economic Time Series with Survey Error Modelling

✉ WU Ka Ho Eden • CHEN Zhao Guo* • CHEUNG Siu Hung

□ 1 December 2002

❖ Research Grants Council (Earmarked Grants)

In survey data analysis, benchmarking has long been recognized as an important area with crucial applications. It is now being widely used by both government and market research institutions. For a target socio-economic variable, two sources or time series data with different frequencies and precisions may be available. Typically, the lower-frequency data are more reliable and are considered as benchmarks. Using benchmarks to adjust the higher-frequency but less reliable data usually can improve the quality of prediction by a substantial amount. Such adjustment procedures are called benchmarking. Simulation results showed that by using advanced benchmarking methods, the Root Mean Squared prediction error of the variable may be reduced by more than 40% as compare to many other popular methods. However, current benchmarking methods rely on the assumption that models of survey error are apriori given. Nowadays, the most popular methods of survey error modelling require either the values of individual units or rotating panels obtained in the survey process. Unfortunately in practice, the information are seldom available due to various factors such as confidentiality and data storage problem. A few other available methods use aggregated survey data in the published form to derive models under very restrictive and subjective assumptions, and hence the results are normally quite unreliable. The objective of our project is to develop survey data analysis techniques using both survey data and benchmarks to derive data-driven tactics for survey error modelling. In addition, our techniques are superior than previous methods since our model assumptions are more reliable and general. We also investigate the benefits of using the survey error modelling procedures in various advanced benchmarking procedures.

(CU02314)

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

| <u>Edition</u> | <u>Title/Investigators</u> |
|----------------|---|
| 2000-01 | Long-memory Time Series Analysis of Disk Access Patterns (PS00494) ✉ CHAN Ngai Hang |
| 2001-02 | Resilience Indicators: Measures of an Economy's Ability to Withstand Financial Shocks (PS01681) ✉ CHAN Ngai Hang • WONG Hoi Ying |
| 2000-01 | Testing Equivalence in Paired-sample Design: An Exact Unconditional Approach (CU00261) ✉ CHAN Ping Shing Ben • CHAN Siu Fung Ivan* • TANG Man Lai# |
| 2001-02 | Multiple Comparisons and Bioequivalence Studies in Two-way Designs (PS01561) ✉ CHEUNG Siu Hung • WU Ka Ho Eden |
| 2000-01 | Wavelets in Statistical Function Estimation and Nonparametric Inferences (CU00299) ✉ FAN Jianqing |
| 2001-02 | Nonparametric Techniques for Multivariate Failure Time Data (PS01262) ✉ FAN Jianqing |

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| 1989-90 | Analysis of Continuous and Polytomous Variables (CS85001) ✍ LEE Sik Yum • POON Wai Yin | ✍ LI Kim Hung |
| 1989-90 | Analysis of Incomplete Data (CS88002) ✍ LEE Sik Yum • POON Wai Yin | 1989-90 Analysis of Fuzzy Data (CS89005) ✍ POON Wai Yin • LEE Sik Yum • LEUNG Y P* |
| 1989-90 | Analysis of Structural Equation Models with Correlated Data (CS89006) ✍ LEE Sik Yum • POON Wai Yin | 2001-02 Practice and Influence Analysis of Structural Equation Modeling with Ordinal Data (SS01347) ✍ POON Wai Yin |
| 1999-00 | Statistical Developments of Nonlinear Structural Equation Models (CU99088) ✍ LEE Sik Yum | 2001-02 A Model for Credit Migrating Risk (PS01664) ✍ WONG Hoi Ying |
| 2000-01 | Influence Diagnostics for Statistical Models with Missing Data and Their Applications to Models with Latent Variables (CU00356) ✍ LEE Sik Yum | 2000-01 A Graphical Approach for Determining the Order of Non-stationary Time Series (PS00661) ✍ WU Ka Ho Eden • CHEN Zhao Guo* |
| 2001-02 | Development of a General Model Selection Procedure for Complex Structural Equation Models (SS01346) ✍ LEE Sik Yum | 2001-02 Multiple Forecasts with Autoregressive Time Series Models (PS01414) ✍ WU Ka Ho Eden • CHEUNG Siu Hung |
| 2001-02 | Sampling Correlated Varieties from Partially-specified Distributions (PS01989) | |

