



**Faculty of
Science**

RESEARCH PROJECTS

The role of growth factor signalling and c-Jun expression in the anti-tumor effect of natural polysaccharides

- ✉ CHOY Yuen Min • KWOK Tim Tak (Biochemistry)
 ☐ 1 September 1998
 ❖ Research Grants Council

Many anti-tumor polysaccharides had been isolated from plants, fungi and bacteria and were found to exhibit anti-tumor activities. Most people believed that, the anti-tumor activities of polysaccharides were mediated through activation of the host immune system rather than direct cyto-toxic effect. In the course of our studies on immunomodulatory and anti-tumor polysaccharides, we discovered that a bacterial capsular polysaccharide, *Klebsiella* K24 capsular polysaccharide (the structure of which had already been characterized), showed potent anti-tumor activities *in vivo* as well as *in vitro*. Also treatment with K24 capsular polysaccharide reduced the levels of tyrosine phosphorylation of different proteins as well as the expression of c-Jun. While the *in vivo* anti-tumor mechanism of these polysaccharides has been well documented, nevertheless, very little is known about the anti-tumor mechanism of these polysaccharides *in vitro*. Our aim is to see how these polysaccharides act directly on tumor cells. Since protein tyrosine phosphorylation in cells will likely be regulated by growth factor signalling pathway of which ras/MAPKK/MAPK constitutes the major part, we intend to examine the growth suppression effect of natural polysaccharides on tumor cells in relation to their roles in growth factor signalling pathway and gene expression. Natural polysaccharides from different sources and human cancer cells from different tissue origins will be used. The results will be important for future application of natural polysaccharides in cancer therapy. (CU98141)

Healthy Eating Movements

- ✉ GULDAN Georgia Sue • CHAN, Vivian* • WONG, Christine* • TSANG, C. Y. Chester* • FUNG, Y. K. Anne* • MA, Maggie* • HO, S. K. Winnie*
 ☐ 1 March 1999
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Optimal child development and lifelong health require that healthy eating habits be established during childhood and adolescence. Because children spend much of their time in schools where they are the focus of many educational activities, healthy

eating should be part of the school agenda, whether it is pre-, primary or secondary school. As part of the "Healthy Living into the Millennium" three-year campaign by the Department of Health, this project focuses on foods served in the pre-, primary and secondary schools in Hong Kong, and consists of three "movements" to be carried out from late 1998 through mid 2000. The first, the "Kindergarten Movement", consists of a seminar for pre-school principals and supervisors, a survey of eating arrangements in 700+ pre-schools and kindergartens, and the development of a teaching kit that will be disseminated to all kindergartens and nurseries in the SAR in early 2000. The primary school "Healthy Tuckshop Movement" consists of a KAP pretest survey of 1300 P1 to P5 pupils, followed by a year-long "Snack of the Month" program in 13 pilot primary school tuckshops, followed by a posttest survey after the movement to evaluate the changes in children's tuckshop purchasing habits. The "Healthy Lunch Movement" in 20 secondary schools consists of a healthy lunch competition in 20 secondary schools, involving pre- and posttest surveys of 10,000 students. It will also consist of seminars to caterers and school lunch suppliers, the publication of healthy catering guidelines, and a healthy menu and cooking competition for caterers. (BL98036)

Bioactivation and Detoxification of 4-(Methylnitrosamino)-1-(3-Pyridyl)-1-Butanone

- ✉ HO Wing Shing John
 ☐ 1 December 1998
 ❖ CUHK Research Committee Funding

4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone (NNK) is the tobacco-derived specific nitrosamine which can induce tumor formation. Metabolic activation of NNK is required for tumorigenicity. NNK bioactivation by cytochrome P450 enzymes in rats will be investigated by chemical inducers and inhibitors. Liver microsomal enzymes are believed to catalyze the formation of 4-hydroxyl-1-(3-pyridyl)-1-butanone (keto alcohol), 4-oxo-1-(3-pyridyl)-1-butanone (keto aldehyde), 4-(methylnitrosamino)-1-(3-pyridyl-N-oxide)-1-butanone (NNK-N-oxide), and 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanol (NNAL) from NNK. Treatments of rats with 3-methylcholanthrene (MC), phenobarbital (PB), pregnenolone 16- α -carbonitrile (PCN), safrole (SA) and isosafrole (ISA) will be done to study modulation of the tumorigenicity of NNK and the formation of its metabolites in the liver and lung. The effects of crocetin and resveratrol, known for its cancer chemopreventive activity, on NNK bioactivation will also be studied. A panel of monoclonal (anti-1A1, -2B1, -2C11, and -2E1) and polyclonal (anti-1A2, -1A2, -2A1, and -3A) antibodies will be used to assess the involvement of constitutive hepatic P450

enzymes in NNK metabolism. The proposed study will demonstrate the important role of P450 isozymes in the metabolism of NNK and the effects of inducers and natural inhibitors that can modulate the metabolism of NNK in the liver and lung. (BL98007)

Evaluation of Major Phytochemical Constituents in Radix Pseudostellariae and Glycyrrhizae in Detoxification and Anticancer Activity

- ✉ HO Wing Shing John • KWOK Tim Tak (Biochemistry) • LEE Hung Kay (Chemistry)
- 2 January 1999
- ❖ CUHK Strategic Research Program

The balance between detoxification and bioactivation of xenobiotics is highly dependent on the relative amounts and activities of different forms of cytochromes P450 that are expressed and the specific enzyme involved. Knowledge of the catalytic specificities and regulation of these respective enzymes is important in predicting and rationalizing individual differences in xenobiotic metabolism as well as metabolic interactions between endogenous and exogenous compounds. The emergency of a battery of specific chemical inhibitors that can be used *in vitro* and *in vivo* studies in experimental animals and humans has greatly facilitated the identification of individual cytochromes P450 responsible for bioactivation and detoxification reactions. The identification of isoform-selective, non-toxic inhibitors of the enzymes and the understanding of their reactions raise the possibilities of modulation of drug metabolism for therapeutic purposes. Previous studies have reported that some naturally-occurring chemical constituents of Radix pseudostellariae and glycyrrhizae can be good inhibitors of these metabolic activation of toxic substances. Also, these constituents may prevent or reduce the risk of some chronic intoxication and cancer development. Hence, the results will provide information on the active phytochemical constituents in these Chinese herbal medicine and their chemopreventive properties. Also, the studies will allow us to establish formulations of these constituents for safe consumption. (BL98028)

Isolation of Marker Genes for Prediction of Peroxisome Proliferator Chemical-Induced Hepatocarcinogenesis

- ✉ LEE Sau Tuen Susanna
- 1 December 1998
- ❖ CUHK Research Committee Funding

Peroxisome proliferators (PPs) are a large class of structurally diverse compounds which include

hypolipidemic drugs clofibrate and Wy-14,643, plasticizers, herbicides and solvents. In rodent exposure to PPs leads to hepatocyte peroxisome proliferation and cell proliferation and hepatocellular carcinomas. A member of steroid hormone receptor superfamily of ligand-activated transcription factors has been identified that can be activated by PPs and are therefore called "peroxisome proliferator-activated receptors" (PPAR). There appear to be four PPAR isoforms within vertebrates termed α , β , γ and δ . The recent development of transgenic mice lacking PPAR α (PPAR $\alpha^{-/-}$) by the principal investigator demonstrates that the characteristic pleiotropic responses to PPs such as hepatomegaly, peroxisome proliferation, transcriptional activation of target genes, and hepatocarcinogenesis, are mediated by PPAR α in rodents. To understand the molecular mechanisms by which PPAR α mediates the hepatocarcinogenic responses induced by PP exposure, a systematic search for differential expressed genes in responses to two PPs, clofibrate and Wy 14,643, will be performed in a PP-nonresponsive transgenic mouse strain lacking PPAR α (PPAR $\alpha^{-/-}$) and a PP-responsive mouse strain (PPAR $\alpha^{+/+}$) using differential display.

In the present proposed research, PPAR $\alpha^{-/-}$ and PPAR $\alpha^{+/+}$ mice will be fed 0.5% clofibrate or 0.1% Wy-14,643 diet for 11 months. At the end of the 11-month feeding period, liver will be collected for liver histological analysis and cDNAs synthesis. Only the cDNAs which showed consistent changes between the control and treated samples in the two strains of mice will be isolated, cloned, sequenced and characterized. These results will be important for the understanding of how PPAR α mediates the hepatocarcinogenic effects resulting from exposure to PPs. (BL98009)

Studies on the *In Vitro* Anti-Tumour Activities of Green Tea Epicatechin Isomers

- ✉ LEUNG Kwok Nam
- 1 January 1999
- ❖ CUHK Research Committee Funding

Tea is derived from the leaves of *Camellia sensensis* and is the most popular and widely consumed beverage worldwide. Green tea, which generally refers to the non-fermented tea, contains up to 30% polyphenolic compounds and the most abundant are the flavanols or green tea catechins (GTCs). There is increasing evidence showing that green tea contains potentially useful anti-mutagenic and anti-carcinogenic compounds. The researchers preliminary results have demonstrated that green tea epicatechin isomers can exhibit potent anti-proliferative and apoptosis-inducing activities on certain myeloid leukemia cell lines *in vitro* whereas

others have shown that polyphenols extracted from green tea are strong inhibitors of erythroleukemic cell proliferation *in vitro*. Despite these findings, until now, the direct anti-tumour activities of GTCs and the mechanisms involved are still poorly understood. This proposed research attempts to study the *in vitro* anti-tumour effects of green tea catechins and to elucidate the possible mechanisms of such effects. The major objectives and experimental approaches of this project are

- (1) to study the effects of purified green tea epicatechin isomers on the survival and proliferation of tumour cells *in vitro*, using a panel of well-characterized murine and human cancer cell lines;
- (2) to examine the differentiative and apoptosis-inducing activities of various green tea epicatechin isomers *in vitro*; and
- (3) to study the influence of epicatechin isomers on the expression of growth-related and apoptosis-regulatory genes such as *c-myc* and *bcl-2* genes.

The results of this proposed study might lead to a better understanding of the relationship between consumption of green tea and tumour growth and pave the way for the possible therapeutic use of green tea epicatechin isomers in the treatment of certain types of malignant tumours.

(BL98010)

Screening and Characterisation of Proteins that Interact with Trichosanthin

- ✉ SHAW Pang Chui
- ☐ 1 January 1999
- ❖ Research Grants Council

Trichosanthin (TCS) is a plant protein used medicinally in China for inducing abortion. TCS also exhibits multiple pharmacological properties, including anti-tumor and anti-human immunodeficiency virus-infected cells. TCS is a ribosome-inactivating protein which cleaves the N-glycosidic bond of the adenine at position 4324 on the 28S rRNA via N-glycosidase activity. For TCS to interact with its target rRNA, it needs to enter the cells, channel through the transport system and bind to the ribosome. In the process, most of the TCS is expected to be degraded by proteolytic enzymes. The processes of cell entry and transport of TCS are unknown. There is also little information on the intracellular proteins that interact with this class of proteins. Therefore, by using the yeast two hybrid system, we propose to screen the target proteins that interact with TCS. Then, DNA encoding these proteins will be sequenced and compared with the Genbank database to elucidate their identity. Further work will be carried out to find how some of these proteins interact with TCS.

(CU98039)

Conservation of Endangered Species Used in Chinese Medicine through Identification by Molecular and Chemical Approaches

- ✉ SHAW Pang Chui • WANG Jun (Biochemistry)
• BUT Pui Hay Paul (Biology)
- ☐ 1 April 1999
- ❖ Environment and Conservation Fund

A recent survey in China has found that about 10,000 species of plant and animal materials are used medicinally. Among them, several are now listed as endangered species in Appendices I or II in the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Trading of these species is either prohibited or restricted. As Hong Kong is a major entrepot and consumer market of Chinese medicinal materials, we propose to develop molecular and chemical methods for speedy identification of selected endangered animal and plant species used in Chinese medicine, so as to support conservation and enforcement programmes of these species. The protocols will be made available to herb dealers, enforcement agents, conservationists and the general public.

(BL98032C)

Compilation of IQ Contest Materials (Qs & As) for Publication

- ✉ TSO Wung Wai
- ☐ 1 September 1998
- ❖ Quality Education Fund

Researching, compiling and publishing a book containing answers to all essential questions raised in the territory-wide HK NG. IQ contest of the last 8 yrs for distribution to schools to facilitate easy reference and enable students to run tests for themselves, which is a valuable exercise to stimulate a continuous interest in facts and figures about science, general knowledge and logic.

(ED98024)

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>
1995-96	Metabolic Fate of Trans/Cis Fatty Acids Present in High-Trans Milk and Their Effect on Metabolism of Essential Fatty Acids (CU95302) ✉ CHEN Zhen Yu • GULDAN Georgia Sue

- 1996-97 Identification and Evaluation of Biologically Active Compounds Present in Chinese Green Tea (BL96030)
 ✍ CHEN Zhen Yu • FONG Wing Ping • FUNG Kwok Pui (Biochemistry) • HUANG Yu (Physiology) • KWOK Tim Tak (Biochemistry) • LEUNG Kwok Nam
- 1997-98 Investigation of Mechanisms of Cholesterol-Lowering Effect of Green Tea Epicatechin Isomers (CU97307)
 ✍ CHEN Zhen Yu • FONG Wing Ping
- 1995-96 Immunopotentiating and Anti-Tumour Effect of Klebsiella K7 Capsular Antigen (CU95315)
 ✍ CHOY Yuen Min • FUNG Kwok Pui (Biochemistry)
- 1996-97 Monoclonal Antibodies against Polysaccharides in Herbal Medicines: Production and Development of Affinity Chromatography and Immunoassay (CU96315)
 ✍ CHOY Yuen Min • NG M. H.* • FUNG Kwok Pui (Biochemistry)
- 1997-98 Preclinical and Clinical Validation of Fructus Crataegi and Green Tea in Lowering Blood Lipids (BL97006)
 ✍ HO Walter K. K. • CRITCHLEY Julian A J H (Medicine & Therapeutics) • MARK Tony* • TOMLINSON Brian (Medicine & Therapeutics) • CHEN Zhen Yu • WONG Nai Ching Henry (Chemistry) • WAN Chi Cheong David (Biochemistry) • LAM Wai Kei Christopher (Chemical Pathology) • ZHU Min (Pharmacy)
- 1995-96 Effects of Pesticides and Herbicides on Proton Flux Through the CFO.CF1 Complex in Chloroplasts (CU95321)
 ✍ HO Wing Shing John
- 1997-98 Metabolic Activation of Nicotine-Derived Metabolites in Rat Microsomes by Cytochrome P450 (BL97020)
 ✍ HO Wing Shing John
- 1995-96 Studies on the Regulation of Nuclear Calcium in C6 Glioma Cells (BL95028)
 ✍ KONG Siu Kai • TSANG David Sau Cheuk
- 1997-98 Nuclear Calcium - Storage, Mobilisation and Cytosolic Linkage (BL97021)
 ✍ KONG Siu Kai
- 1996-97 Use of Developed Gene Knockout Transgenic Mouse Models for Identification, Evaluation, and Define the Mechanisms of Chemical Toxicity and Human Diseases (BL96026)
 ✍ LEE Sau Tuen Susanna • TSANG David Sau Cheuk • WAN Chi Cheong David (Biochemistry) • CHAN Wood Yee (Anatomy)
- 1997-98 Production of Transgenic Mice Lacking the Fatty Acid-Activated Receptor: An Animal Model to Study Adipose Cell Differentiation and Obesity (CU97318)
 ✍ LEE Sau Tuen Susanna • CHAN Wood Yee (Anatomy) • CHEUNG Wing Tai (Biochemistry)
- 1997-98 Studies on the Signalling Mechanisms in Cytokine-Induced Monocytic Differentiation of Myeloid Leukemia Cells (BL97023)
 ✍ LEUNG Kwok Nam
- 1995-96 Trichosanthin Derivatives with Reduced Immunogenicity and Nephrotoxicity and Long Plasma Half-life (CU95324)
 ✍ SHAW Pang Chui • TAM Michael S C (Physiology)
- 1996-97 Transcriptional Regulation of Human Glycogen Synthase Kinase-3 α and -3 β -cloning and Analysis of Their Promoters (CU96305)
 ✍ SHAW Pang Chui • ANDERTON Brian H.* • MILLER C. C. J.*
- 1997-98 Screening for Proteins that Interact with Trichosanthin (MD97039)
 ✍ SHAW Pang Chui
- 1995-96 The Mechanism of Action of Tumour Necrosis Factor- α on Taurine Transport in Cultured Rat Astrocytes (CU95322)
 ✍ TSANG David Sau Cheuk • LEUNG Kwok Nam • STADLIN Alfreda (Anatomy)

RESEARCH OUTPUTS AND PUBLICATIONS

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- <P991533> **Chan, Ping Tim; Wing Ping Fong; Yuk Lin Cheung; Yu Huang; Walter Kwok Keung Ho and Zhen-Yu Chen.** "Jasmine Green Tea Epicatechins are Hypolipidemic in Hamsters (Mesocricetus Auratus) Fed a High Fat Diet" *Journal of Nutrition* vol.129 no.6, pp.1094-1101. USA, 1999.06.
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see also <P980930>, <P980996>, <P981405>, <P981406>, <P981418>, <P981419>, <P981420>, <P981421>, <P981422>, <P981939>, <P982934>, <P983221>, <P983617>, <P984221>, <P985005>, <P990320>, <P990397>, <P990408>, <P990635>, <P990997>, <P991661>, <P992036>, <P992515>

RESEARCH PROJECTS

Meta-Population Dynamics of Red Alga *Hypnea Charoides* in Tung Pign Chau, New Territories, Hong Kong

✉ ANG Put Jr.

☐ 1 December 1998

❖ CUHK Research Committee Funding

Tung Ping Chau, an island located on the northeastern part of the New Territories, is one of the few remaining places in Hong Kong where impact from human activities is relatively low. Coral reefs and algal beds characterize the coastline of this island. There is now serious consideration to designate this island as a marine reserve. Hence, baseline information are needed to help evaluate the condition of its marine environment. Algae are the most important primary producers in the coastal marine environment. However, relatively little is known about the biology and ecology of algae in Hong Kong as a whole. This research aims to further our understanding of the Hong Kong coastal environment and to provide baseline information on aspects of the biology and phenology of the dominant red algal species, *Hypnea charoides*, found in Tung Ping Chau. Questions on how the populations of this red alga maintain and re-establish themselves, and how these populations interact with biotic and abiotic factors in the environment will be addressed. A matrix model will be developed to describe the dynamics of these populations and to assess how different populations of this species, located possibly at different depths of the subtidal environment, could reinforce the structure of the whole community at different times of the year.
(BL98013)

Pharmaceutical, Nutritional and Biotechnological Application of Seaweed Resources in Hong Kong

✉ ANG Put Jr. • CHEUNG Chi Keung Peter • CHUNG Hau Yin • OOI Vincent E. C.

☐ 1 January 1999

❖ CUHK Strategic Research Program

Seaweed is one of the under-utilized marine resources in Hong Kong. More than 200 species of seaweed have been reported from this region alone. This project aims to explore the different potentials of seaweed as anti-oxidant, anti-tumor, hypotensive agents as well as their other pharmaceutical and nutraceutical properties. Their biotechnological application in animal feeds to enhance and improve the flavour and taste of cultured marine organisms will also be evaluated. The availability of seaweed stock throughout Hong Kong territorial waters will be

assessed to shed light on the best strategy that can be used to manage this resource.
(BL98027)

Distribution of Lignocellulolytic Enzymes in Mangrove Fungi and Physiological Parameters Affecting Their Production and Activity

✉ BUSWELL John Anthony • VRIJMOED L. L. P.*

☐ 1 December 1998

❖ CUHK Research Committee Funding

Decaying wood, leaves, sea grasses and other forms of lignocellulose in mangroves are considered to be a significant primary source in the food web of the tropical marine ecosystem. However, although the close association of marine fungi with degraded lignocellulosic substrates suggests a major role for these organisms in the degradation of such materials in the marine environment, very little is known about their capacity to produce cellulolytic and hemicellulolytic enzymes compared with terrestrial counterparts. The research proposed will examine the cellulolytic and xylanolytic capabilities of over 100 species of marine fungi collected from lignocellulosic substrates in mangrove ecosystems worldwide. The cellulolytic and xylanolytic systems of polysaccharide degrading fungi will then be characterised and quantified with respect to their major enzymic components, and the effects of salinity on fungal growth, enzyme production and enzyme activity determined. Parallel electron microscopy studies of mangrove wood species inoculated with selected strains of marine fungi will also be conducted to determine the extent of fungal colonisation and polysaccharide degradation *in situ* in order to evaluate the overall contribution fungi make to carbon cycling in mangrove ecosystems.
(BL98004)

Isolation, Identification and Biotechnological Characterisation of Hyperthermophilic Bacteria from Hot-Spring Environments in China

✉ BUSWELL John Anthony • WILLIAMS R.A.D.*

☐ 1 April 1999

❖ UK/Hong Kong Joint Research Scheme, the British Council

The objectives of this research are (1) to isolate and identify hyperthermophilic bacteria from selected hot spring environments in China, (2) to determine the biodiversity of isolates using modern molecular biological techniques, (3) to evaluate the biotechnological potential of isolates as a source of novel restriction enzymes, and (4) to examine isolates

for production of thermostable enzymes for use in industrial processes.
(BL98031)

The Hypocholesterolemic Effect of Mushroom Dietary Fibre in Hamsters

- ✉ CHEUNG Chi Keung Peter
- ☐ 1 December 1998
- ❖ CUHK Research Committee Funding

A large body of epidemiological evidence supports a direct relationship of plasma total and low-density lipoprotein (LDL) cholesterol and coronary heart disease (CHD). The search for natural food substances capable of lowering blood cholesterol level is important in the prevention and cure of CHD through diet intervention. Edible mushrooms which are high in dietary fibre, protein and sterols are ideal food plants with potential cholesterol-lowering ability. The researchers' on-going preliminary studies on the biological/medicinal properties of food plants have demonstrated the potential cholesterol-lowering property of a few Chinese edible mushroom such as straw mushroom, tree-ear, and white-jelly ear in animal models. The central aim of this proposal is to evaluate both the short-term and long-term cholesterol-lowering effect of the dietary fibre components in edible mushroom. In this proposed project, the mechanisms of the cholesterol-lowering effect of mushroom dietary fibre will also be investigated. Hamster which is an LDL animal like the human and has similar metabolic responses to fibre intake found in humans is chosen for study in this project. It is anticipated that the proposed study will give them a deeper insight towards understanding the cholesterol-lowering property of dietary fibre component in mushroom. It is believed that the findings in this project could provide the critical initial steps in developing the potential application of mushroom dietary fibre in the prevention and treatment of human hyperlipidemia.
(BL98014)

Using Spent Substrate of the Oyster Mushroom to Biodegrade Aromatic Pesticides

- ✉ CHIU Siu Wai
- ☐ 1 March 1999
- ❖ CUHK Research Committee Funding

Chlorophenols have been commonly used as pesticides worldwide including China but their recalcitrant nature, persistence and toxicities make them priority pollutants for treatment. In many countries including China who is the champion mushroom producer, the spent mushroom substrates remaining after harvesting of the mushroom crops are often discarded as wastes. The researchers have

proved that the spent substrate of oyster mushroom showed superior performance in biodegradation of biocide pentachlorophenol over many white rot fungi (Chiu et al., in press). It is therefore proposed to carry out a detailed analysis of the organisms present in the spent substrate involved in the biotransformation, and to determine whether complete mineralization of the biocide has taken place. Complete mineralization of pesticides into carbon dioxide and water is the ultimate removal of toxic pollutants in environment. Therefore, this study tests the recycling of spent mushroom substrate for bioremediation.
(BL98015)

A Review of the Control of Exotic Species in Ballast Water Discharges

- ✉ CHU Ka Hou • TAM Pui Fun (Centre for Environmental Studies)
- ☐ 1 September 1998
- ❖ Environmental Protection Department, HKSAR

The discharge of ballast water from ships visiting Hong Kong brings in various kinds of exotic (non-native) animal and plant species. These exotic species may exert both short-term and long-term impacts on the local economy and ecology of the marine environment. The objectives of this study are to collect and review the relevant information on the environmental and economic impacts of the introduction of exotic species and the current local and international practices, approach, rationale and future trends in controlling ballast water discharge in shipping ports and inshore water. This will help to determine the need for formulating practical and effective measures for the control of the introduction of exotic species by ballast water discharges in Hong Kong.
(BL98026)

Development of Molecular Markers for Genome Mapping in Penaeid Shrimp

- ✉ CHU Ka Hou • KWAN Hoi Shan
- ☐ 1 December 1998
- ❖ Research Grants Council

Penaeid shrimp are one of the most important aquaculture products. The future growth of shrimp farming depends very much on the genetic improvement of the cultured stocks. A genetic linkage map is essential for the development of breeding programs for strain improvement. The map will also provide information on the genome organization in this taxonomic group for phylogenetic comparison. The objectives of the proposed study are:

- (1) to develop expressed-sequence-tags as markers for genome mapping of the commercially important shrimp *Penaeus monodon*;
- (2) to identify cross-species markers by testing the applicability of markers developed for *P. monodon* in other shrimp; and
- (3) to use the markers to construct a linkage map of *P. monodon*. The methods to be used are polymerase chain reaction (PCR) based technologies and DNA electrophoretic analyses.

The data will contribute to a worldwide database that will compile results from different laboratories in an international group working on shrimp genome mapping. The linkage map can then be used to identify genes controlling economically important traits, such as growth rate and disease resistance, and also lay the groundwork for comparative and physical mapping. The ultimate goal is to breed genetically superior strains of shrimp for commercial production. The molecular markers and linkage map developed in this study are also applicable in other practical aspects of shrimp fisheries and aquaculture, such as molecular tagging in stock enhancement programs. (CU98062)

Nutrient Availability as Factor Affecting Ecosystem Development on Restored Landfills

- ✉ CHU Lee Man
- ☐ 1 October 1998
- ❖ CUHK Research Committee Funding

Completed landfills are generally covered with a layer of soil material for revegetation. Apart from the engineering works that control landfill gas and leachate, the success of restoration depends much on ecosystem development which relies on the accumulation of organic matter and nutrients, particularly N and P, in soil. The proposed research project focuses on the nutrient availability of landfill soils and their effects on ecosystem development on restored landfills. The objectives are:

- (1) to determine if N and P are limiting in the cover soil;
- (2) to study the transformation and accumulation of N and P in the cover soil, and their losses via leaching by a *in-situ* incubation experiment;
- (3) to examine the diversity and abundance of soil invertebrates, and microbial biomass and microbial activity of the cover soil; and
- (4) to assess the ecophysiological conditions of selected tree species on the landfills. Research along this line can give us information to conserve mineral nutrients in landfill ecosystems.

We hope the results obtained can aid in the understanding of soil development on completed landfills, which is useful in maintaining good vegetation growth, creating species-rich communities

and accelerating ecosystem development on restored sites .
(BL98016)

Comparison of Volatile Components Between Authentic and Imitation Crabmeats

- ✉ CHUNG Hau Yin
- ☐ 1 November 1998
- ❖ CUHK Research Committee Funding

In this experiment, the composition of the volatile components of a commonly consumed crab species in Hong Kong is the subject of investigation. Due to the popularity of imitation crabmeats nowadays, several brands will also be analyzed, and compared with the authentic crabmeats picked from claws, walking legs and bodies. The results will provide additional information on the volatile components in the edible crab species, and will show the similarities and differences between the authentic and the imitation crabmeats.
(BL98017)

Genetic Immunization Against *Toxoplasma gondii*

- ✉ FUNG Ming Chiu • LEUNG Kwok Nam (Biochemistry) • CHEN Xiao Guang*
- ☐ 1 September 1998
- ❖ Research Grants Council

The protozoan parasite, *Toxoplasma gondii*, is the causative agent of toxoplasmosis, a disease historically known for its severe sequel in congenital infections. It has recently gained importance for its ability to cause lethal encephalitis in AIDS patients. At present, *Toxoplasma gondii* infection is controlled by chemotherapy. However, chemotherapeutic regimes are poorly tolerated by many patients, especially those who are immunocompromised. Thus there is still an urgent need for the development of an effective vaccine against this protozoal disease. The major surface antigen P30 was proven to be useful to develop a subunit vaccine. We have recently cloned the P30 gene from a *Toxoplasma gondii* ZS1 strain isolated in Guangzhou and expressed this gene in the baculovirus expression system. Genetic immunization with naked plasmid DNA has been proven to be able to elicit the immune responses and to protect from the pathogens. Genetic immunization may even enhanced by co-expression of some cytokines such as IL-2, IL-12 and IFN- γ . However, the efficacy of different forms of antigen and the effect of the monocyte chemoattractant protein are still not clear. We therefore propose to study the immune responses and protective efficacy of the genetic immunization against *Toxoplasma gondii* with different forms of the P30 antigen and in combination with the monocyte chemoattractant

protein. Our study will laid a foundation to develop *Toxoplasma gondii* DNA vaccines which are better and cheaper than the recombinant antigen subunit vaccines for the control of *Toxoplasma* infection. (CU98142)

The Role of Prostaglandin D Synthase and Prostaglandin D JCS Cell and Normal Bone Marrow Cell Differentiation

✉ FUNG Ming Chiu • MAK Nai Ki*
☐ 1 January 1999
❖ CUHK Research Committee Funding

Prostaglandin (PG) D2 is a major produced in the central nervous system and mast cells, acting as neuromodulator and an allergic and inflammatory mediator. The PGD2 is formed from arachidonic acid by successive enzyme reactions. There are two types of prostaglandin synthase involved in the production of PGD2. It was reported that the lipocalin-type prostaglandin synthase was found in brain tissue while the hematopoietic prostaglandin synthase was found in myeloid cells. Recently we discovered the lipocalin-type prostaglandin synthase was upregulated during the TNF- α induce leukemia cells differentiation. The role of this brain type prostaglandin synthase and hence the prostaglandin D2 in the myeloid leukemia cell and bone marrow cell differentiation is not clear. The proposed project is to investigate the role of this brain type prostaglandin synthase and prostaglandin D2 in the leukemia cell differentiation and haematopoiesis. This may contribute to the understanding of the mechanism of myeloid leukemia cell differentiation and haematopoiesis. Hopefully it may lead to some development of anti-leukemia therapy. (BL98003)

Identification of Activin-Regulated Genes in the Differentiation of Mouse Leukemia Cell Line F5-5 by Representational Difference Analysis (RDA)

✉ GE Wei
☐ 1 March 1999
❖ CUHK Research Committee Funding

Activin is an important dimeric protein growth factor initially identified for its stimulation of pituitary follicle-stimulating hormone (FSH) secretion. In addition, activin has been demonstrated to induce differentiation of a variety of mammalian cells or cell lines including gonadal cell lines, hepatocytes, lung epithelial cells and erythroid cells. F5-5 is a mouse leukemia cell line that is highly proliferative *in vitro*. Upon activin administration, the cells quickly differentiate into hemoglobin-producing cells and lose the ability to proliferate. Since the inducing activity of activin is strong and specific, the system

offers an excellent model to address the questions about the mechanisms that control cell proliferation and differentiation. Although F5-5 cells have been used widely to detect activin activity, the molecular mechanisms by which activin exerts its action remain unknown. The present study proposes to systematically identify the genes of F5-5 cells that are up-and down-regulated by activin during the differentiation using representational difference analysis (RDA). RDA is a recently developed technique that combines both subtraction and amplification. It has been demonstrated to be an extremely powerful tool to identify differentially regulated genes between two cell populations. The proposed project will not only generate new knowledge on the mechanisms of activin actions, but also promise to provide insight into the molecular events behind cell proliferation and differentiation, the fundamental biological processes during animal development. (BL98018)

Elucidation of Gene Expression Profiles during Fruit Body Development of Shiitake Mushroom *Lentinula edodes* using Expressed Sequence Tags and Serial Analysis of Gene Expression

✉ KWAN Hoi Shan
☐ 1 December 1998
❖ Research Grants Council

The long term objective is to elucidate the molecular aspects of fruit body development, the most important and conspicuous developmental process in the life cycle of the cultivated mushroom *Lentinula edodes*. The Specific Aims are

- (1) to sequence random clones from a library of cDNA from early fruit body development to provide expressed sequence tags (ESTs) and as repertoire of full-length cDNA,
- (2) to conduct Serial Analysis of Gene Expression (SAGE) for 2 stages of fruit body development,
- (3) to match SAGE tags with ESTs/RAP clones, and
- (4) to construct a model of molecular events of mushroom fruit body development in Shiitake mushroom.

A cDNA library will be constructed. The main analytical method to be used is DNA sequencing. The kinds of genes expressed during fruiting will be revealed by the ESTs. SAGE provides quantitative profiles of large numbers of transcripts of each developmental stage by generating and counting 9- to 11-base tags of the transcripts. Matching SAGE tags to ESTs and RAP clones will yield expression profiles of many genes and forms the basis for the construction of an extensive model of the molecular events during fruit body development of *Lentinula edodes*. (CU98139)

Asparagine Synthetase Genes: Their Roles in Plant Growth and Development

- ✉ LAM Hon Ming
- 1 September 1998
- ❖ Research Grants Council

The proposed research aims to explore ways to improve the efficiency of nitrogen assimilation that, in the long run, will be a critical step towards increasing crop yield and ameliorating environmental problems caused by artificial fertilizers.

To achieve this end, a better understanding of the key regulatory elements in nitrogen metabolism is the essential first step. This proposal focuses on one particular enzyme, asparagine synthetase (AS). AS catalyzes the conversion of aspartate and glutamine into asparagine and glutamate. The substrates and products of this enzyme are major nitrogen carriers in plant metabolism. Thus AS would regulate the flow of organic nitrogen pool. The level of asparagine will be elevated under certain growth stages or stress conditions.

Since AS enzymatic activities are often encoded by a small gene family, it is important to understand the physiological roles of each of these genes *in vivo*. Using *Arabidopsis thaliana* as a genetic model plant, we have cloned three different genes for AS (*ASN1*, *ASN2* and *ASN3*). We have started to construct transgenic plants which would overexpress or underexpress these *ASN* genes. Detailed analyses of these transgenic lines under normal growth or under stress conditions will help to uncover the specific roles of these genes.

As an alternate approach, we isolated azaserine (an AS inhibitor) resistant mutants which overproduce asparagine. Characterization of these mutants will provide complementary information to the study of transgenic plants.

(CU98292)

Molecular Cloning of a Salt-inducible Gene Encoding a Putative RNA-binding Protein in *Arabidopsis thaliana*

- ✉ LAM Hon Ming
- 1 November 1998
- ❖ CUHK Research Committee Funding

The accumulation of salt has a severe impact on cellular physiology and thus leads to a retardation of plant germination, growth and development. Despite that many researches were conducted in order to understand the basic mechanisms of salt toxicity and defense responses, the exact target proteins (or metabolic pathways) are still unclear. The researchers' long-term goal is to use a model plant system *Arabidopsis thaliana* to study the genetics and

biochemistry of salt toxicity and tolerance in higher plants. Using differential display techniques, they have isolated a salt-inducible DNA fragment which encodes a putative RNP-CS-type RNA-binding protein. These RNP-CS-type RNA-binding proteins were previously found in plants and were suggested to serve a vital role in RNA transcription or processing during stress. Phylogenetic analysis placed the salt inducible DNA fragment that they cloned into a distinct class of plant RNA-binding proteins based on:

- (1) divergence in amino acid sequences at the RNA-binding domains, and
- (2) the apparent missing of the glycine-rich domains at the C terminus.

They propose to clone the full-length DNA clones of this new class of plant stress-inducible RNA-binding proteins. They will also study the temporal and spatial expression patterns of the newly isolated genes.

(BL98019)

Production of Vaccines against Lymphocytic Choriomeningitis Virus (LCMV) in Transgenic Plants

- ✉ LAM Hon Ming • SUN Sai Ming Samuel • FUNG Ming Chiu • SARON Marie-Francoise*
- 1 April 1999
- ❖ France/Hong Kong Joint Research Scheme

Feasibility of using transgenic plants for designing new vaccinal proteins has been demonstrated recently. We are interested in using the plant bioreactor to generate vaccines, in particular, oral vaccines. We have chosen the vaccine against lymphocytic choriomeningitis (LCMV) as our testing target. LCMV has been used as a model virus system for immunological studies and is a reference for testing new vaccines. Our research objectives include:

- (1) to express the LCMV nucleoprotein and its epitope region in transgenic plants, and
- (2) to test the immunological effect of products from these transgenic plants.

(BL98025)

A Study on Mushroom and Plant Products with Protective Effects Against Genotoxicity Using Single Cell Gel Electrophoresis Assay

- ✉ OOI Vincent E. C.
- 1 November 1998
- ❖ CUHK Research Committee Funding

This proposed study aims to search and identify certain selected species of mushrooms and plants with potent anti-mutagenic activity, and characterize the potential anti-carcinogenic substances from the extracts. The specific objectives are (1) to establish a

rapid, sensitive bioassay using *in vitro* single cell gel electrophoresis for detection of DNA damage by genotoxic agents, and develop an effective *in vivo* assay for determination of anti-mutagenic activity of the extracts and chromatographic fractions using a specific mutagen model, (2) to isolate and characterize any potential anti-mutagenic and anti-carcinogenic components from these herbs, and (3) to assess their possible mechanisms of action and therapeutic application.
(BL98002)

Production of High Value Pharmaceutical Proteins in Transgenic Seeds

- ✉ SUN Sai Ming Samuel • FUNG Ming Chiu • LAM Hon Ming • CHEN Xiao Guang* • HAN Wei*
- 1 December 1998
- ❖ Industrial Support Fund, Industry & Technology Development Council

The aim of this project is to produce high value pharmaceutical products at low costs by adopting state-of-the art plant biotechnology methods. A production platform to direct the synthesis of pharmaceutical proteins in transgenic seeds will be developed. This system will substantially lessen the expenses of manufacturing by reducing the cost in

- (1) synthesizing the products,
- (2) preventing the contamination of dangerous animal biologicals,
- (3) maintaining a consistent supply line with minimal batch variations, and
- (4) storing the products in stable conditions.

Three pharmaceutical proteins will be used as the prototype: human granulocyte colony-stimulating factor (G-CSF), human erythropoietin (EPO), and P30 antigen of *Toxoplasma gondii*. These products have high values in cancer therapy, anemia treatment, and parasite diagnosis and vaccination, respectively.
(BL98035C)

Engineering the Brazil Nut Met-rich Protein for Reduced Allergenic Activity

- ✉ SUN Sai Ming Samuel • LAM Wai Kei Christopher (Chemical Pathology)
- 1 December 1998
- ❖ Research Grants Council

Plant proteins are inexpensive and good source of dietary protein for humans and livestock, but they are nutritionally deficient in certain essential amino acids such as methionine (Met) in beans and lysine (Lys) in cereals. Plant breeding efforts for the past 40 years to enhance the contents of essential amino acids have met with little success. It has been estimated that enhancement of the content of Lys or Met in soybean

by 1% will bring additional value of US\$851M or 575M, respectively, to the US soybean crop. We have earlier demonstrated that it is feasible to enhance the Met content in tobacco seed proteins by up to 30% through the transfer and expression of a Met-rich protein gene from Brazil nut (BNMRP). Subsequently seed industry was able to use this gene and approach to generate soybean seeds with improved Met content. Unfortunately, BNMRP was found allergenic to some segment of the population. In this project, we proposed

- (1) to use genetic engineering approach to modify the BNMRP for reduced or negative allergenic activity, through allergenic determinant(s) and other related sequence(s) identification and protein engineering; and
- (2) to study BNMRP allergy in the Hong Kong Chinese population.

The project is a collaboration between plant molecular biologist and immunologist specialized in allergy.
(CU98351)

Feeding Ecology of Marine Cladocerans in Tolo Harbour

- ✉ WONG Chong Kim
- 1 December 1998
- ❖ CUHK Research Committee Funding

Marine cladocerans are important component of zooplankton communities in bays, inland seas, estuaries and upwellings. However, their role in the trophic transfer pathways of these communities is poorly defined because knowledge on their feeding habits is meager. Previous studies on the food items of marine cladocerans suggested that members of Podonidae are raptorial feeders of large particles, detritus and animal prey, and members of Sididae are suspension feeders of small algae and bacteria. Some of these results have been disputed. Several investigators found no animal remains in the guts of podonids. Another investigator claimed that *Penilia avirostris*, the single marine representative of Sididae, is not a bacterivore.

Four species of marine cladocerans have been found in Tolo Harbour. As a group, marine cladocerans constitute 5-8% of the zooplankton community. *Penilia avirostris* removed about 1% of the algal biomass per day. However, feeding on dinoflagellates and bacteria has not been documented and no information is available on the diets of the 3 species of podonids. The aim of this project is to provide information on the natural diets of marine cladocerans in Tolo Harbour. Gut contents of marine cladocerans collected from Tolo Harbour will be examined under light microscope and scanning electron microscope to determine

- (1) the degree of dietary overlap among different species,

- (2) if marine cladocerans can feed on red tide dinoflagellates and bacteria,
- (3) the extent to which the diet of various species is affected by hydrographical variables and
- (4) the amount of food selectivity exhibited by various species.

(BL98021)

Toxicological Study of Polycyclic Aromatic Hydrocarbon (PAHs) in MARPOL Wastes

✍ WONG Po Keung

☐ 1 October 1998

❖ CUHK Research Committee Funding

Ballast pumping and tank washing discharge large quantities of oily wastes (also known as MARPOL - MARine POLLution - wastes) into the marine environment in Hong Kong. The chemical compositions of these oily wastes are extremely complex. Among various components detected, some of them such as metals and polycyclic aromatic hydrocarbons (PAHs) are reported to be extremely toxic. These pollutants are quite persistent and can be biologically accumulated in marine organisms, and pose a serious problem to marine organisms.

There are some studies on the toxicity of metals in these oily wastes. However, PAHs in MARPOL wastes have not been well characterized and studied chemically and ecotoxicologically. In the proposed study, PAH profiles in water soluble fractions (WSFs) of MARPOL waste samples will be determined by chemical analysis for aromatic compounds such as PAHs in oily wastes developed by the investigator. In addition, the ecotoxicity of PAHs in WSFs of these oily wastes on selected local marine organisms such as bacteria, algae, amphipods and fishes will be determined. The information will be useful as additional information for the appropriate authority to set up the control policy for the discharge or treatment of oily wastes discharged by shipping activity.

(BL98020)

Removal and Recovery of Metal Ions from Electroplating Effluent by A Combined Chemical-Biomagnetic System

✍ WONG Po Keung • CHUA H.*

☐ 1 November 1998

❖ Research Grants Council

A chemical precipitation will be introduced to concentrate metal ions in electroplating effluent in order to minimize the fluctuation of the physico-chemical conditions of the metal containing solution. Metal ions such as Cu^{2+} and Ni^{2+} in electroplating effluent will be selectively, efficiently and completely removed and concentrated by calcium

hydroxide. The effects of physico-chemical factors such as temperature, pH, concentration of cations, anions and chelators on the precipitation of free and complexed Cu^{2+} and Ni^{2+} in electroplating effluent by calcium hydroxide will be determined. The metal sludge containing mainly copper and nickel hydroxides will be dewatered and dried to remove excess water content, and then dissolved by sulfuric acid to form solution with high concentration of Cu^{2+} and Ni^{2+} .

The pH of the metal solution will be adjusted by adding calcium hydroxide to pH=6. Cu^{2+} in the metal solution will then be selectively removed and recovered by a bioreactor with magnetite-immobilized cells of Cu^{2+} -binding specific *Pseudomonas putida* II-11. The pH of the metal solution passing through the Cu^{2+} removal bioreactor will be adjusted to pH=9. Ni^{2+} in this solution will be removed and recovered by another bioreactor with magnetite-immobilized cells of Ni^{2+} -binding specific *Enterobacter* sp. 4-2. The recovered copper sulfate and nickel sulfate solutions will be concentrated to the levels suitable for the direct reuse in electroplating industry.

Finally a small-scale batch system with a capacity of treating 1,000 liters of electroplating effluent will be built for a feasibility study under laboratory conditions.

(CU98134)

Provision of Services for Development of Sediment Toxicity Test Protocol Using Local Species

✍ WONG Po Keung • WONG Chong Kim • CHU Ka Hou

☐ 1 January 1999

❖ Environmental Protection Department, HKSAR

Two local marine amphipods (*Hyale* sp. and *Elasmopus rapax*) will be used to develop toxicity test protocol for contaminated marine sediments collected from various regions in Hong Kong.

(BL98037)

Study for Bacteriocidal Effect of "Ultra-Acidic Water" Generated by Electrolysis Process

✍ WONG Po Keung • WONG Chong Kim

☐ 1 February 1999

❖ Hong Kong Productivity Council

The bacteriocidal effect of "ultra-acidic water" generated by electrolysis process is determined. Five bacterial strains, including *Bacillus cereus*, *Escherichia coli*, *Salmonella typhimurium*, *Staphylococcus aureus* and *Vibrio parahaemolyticus*, represent bacteria with different properties are used in the present study. The positive control (20 ppm

sodium hypochlorite) and negative control (artificial seawater) are also included in the present study. (BL98029)

Study of Natural Antioxidants from Legume Seeds

- ✍ WONG Yum Shing
- ☐ 1 November 1998
- ❖ CUHK Research Committee Funding

Flavonoids are polyphenolic compounds that occur ubiquitously in plants. Epidemiological studies suggest a protective role of dietary flavonoids against coronary heart disease and other chronic disorders. It is suggested that the health-related properties of flavonoids are based on their antioxidant activity. In this study, antioxidant activities of twenty-five commonly consumed legume seeds are examined. (BL98022)

Effect of Prolactin and Growth Hormone on Heat Shock Protein 70 Expression in the Sea Bream *Sparus Sarba*

- ✍ WOO Norman Ying Shiu • DEANE Eddie Edward
- ☐ 1 December 1998
- ❖ CUHK Research Committee Funding

Marine fish including the sea bream exhibit a stress response that is characterized by marked induction of heat shock protein (HSP) expression at both the mRNA and protein levels. Enhanced HSP expression under stress conditions is known to confer survival benefits at both the cellular and organismic levels. There is evidence to suggest that prolactin and hormone are increasingly involved in the stress physiology of fish but the role played by these hormones in piscine HSP expression is unknown. The present project examines the possible regulatory role of prolactin and growth hormone on HSP70 expression at the mRNA and protein levels in the sea bream (*Sparus sarba*). Sea bream are often exposed to adverse environmental conditions during their culture and an understanding of their stress response in the present study would be important for the formulation of management strategies for the species. (BL98023)

Enhancing immunological competence of silver sea bream (*Sparus sarba*) through the combined application of salinity adaptation, hormonal factors and specific vaccines

- ✍ WOO Norman Ying Shiu
- ☐ 1 January 1999
- ❖ Research Grants Council

The silver sea bream is a commonly cultured marine fish in Hong Kong which exhibits high susceptibility to bacterial diseases such as vibriosis. Attempts to control vibriosis using antibiotics have only met with limited success and have led to the development of serious antibiotic resistance problems. This project examines a more effective way for disease control by strengthening the endogenous immunological defense mechanisms against disease. Stimulated immune competence to control vibriosis will be achieved using a combination of salinity adaptation, hormonal factors and vaccine development. Fish will be adapted to hyper- (33 ppt), iso- (12 ppt) and hypo-osmotic (6 ppt) salinities and their disease tolerance together with various indices of non-specific and specific immune function will be assessed. The differential immune response of sea bream to immunostimulatory (growth hormone, prolactin) and immunosuppressive (cortisol) hormones in different salinities will also be examined.

Various vaccines against *Vibrio alginolyticus* will be prepared and their efficacies against vibriosis will be assessed in sea bream subjected to different salinity and hormonal regimes. A clear understanding of the changes in the immune response of the sea bream under different salinity and hormonal regimes with or without immunization against the pathogen will provide us with an armory for the design of strategies against vibriosis. (CU98135)

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>
1996-97	Dynamics of the Brown Alga <i>Sargassum</i> Populations in Ping Chau Island, New Territory and an Assessment of Variations in Their Morphological Characteristics (CU96316) ✍ ANG Put Jr.
1997-98	Study on the Suitability of Ping Chau to be Established as Marine Park or Marine Reserve (BL97008) ✍ ANG Put Jr. • CHU Ka Hou • CHU Lee Man • WONG Chong Kim • WOO Norman Ying Shiu
1997-98	Reproductive Seasonality and Recruitment of Scleractinian Corals in Tung Ping Chau, New Territories, Hong Kong (BL97025) ✍ ANG Put Jr.
1990-91	Elucidation of Biochemical Events Regulating Secondary Metabolism in the

- Ligninolytic Fungus *Phanerochaete chrysosporium* (BP91015)
 ✎ BUSWELL John Anthony
- 1991-92 Enzymic Evaluation of Starch Availability in Foodstuffs (BP92007)
 ✎ BUSWELL John Anthony
- 1993-94 Establishment of an International Network of Institutions in Developing Countries and Centres for Research, Development and Training to Advance Mushroom and Bioconversion Technologies (BP94011)
 ✎ BUSWELL John Anthony
- 1995-96 Production and Secretion of Cellulolytic Enzymes by the Edible Mushroom, *Volvariella volvacea*, and Their Significance to the Utilization of Lignocellulosic Substrates and Mushroom Growth Yields (CU95328)
 ✎ BUSWELL John Anthony • PEBERDY John Frederick*
- 1997-98 Development of Manufacturing Protocols for Improved Production of Standardised Quality Mushroom Nutraceuticals from *Ganoderma Lucidum* (BL97004)
 ✎ BUSWELL John Anthony • CHANG Shu Ting • LIU Wing Keung Ken (Anatomy) • HSIAO Wen Luan Wendy*
- 1997-98 Production and Distribution of Cellulolytic Enzymes in the Edible Straw Mushroom, *Volvariella volvacea*, during Substrate Colonisation and Fruit Body Morphogenesis (CU97329)
 ✎ BUSWELL John Anthony
- 1997-98 Isolation, Identification and Biotechnological Characterisation of Hyperthermophilic Bacteria from Hot-Spring Environments in China (BL97026)
 ✎ BUSWELL John Anthony • WILLIAMS R.A.D.*
- 1995-96 A Floristic Study on the Biodiversity of Bryophytes in Hong Kong (CU94302)
 ✎ BUT Pui Hay Paul
- 1997-98 Chemical Quality Control of Chinese Medicines as a Support for Export of Proprietary Chinese Medicines (BL97003)
 ✎ BUT Pui Hay Paul • LAU Oi Wah (Chemistry) • CHAN Tak Wah Dominic (Chemistry) • WANG Mu-zhou*
- 1997-98 The Development of Chinese Medicines and Dietary Supplements for Treating Gastrointestinal Disorders and Coughing (MD97131)
 ✎ BUT Pui Hay Paul • FUNG Kwok Pui (Biochemistry) • CHAN Tak Wah Dominic (Chemistry) • HO Yee Ping (Pharmacy) • WOO Jean (Medicine & Therapeutics) • CHOW Hee Lum Albert (Pharmacy) • LI Chi Keung Ronald (Pharmacy)# • ZHU Min (Pharmacy) • KWAN Yiu Wa (Pharmacology) • LIN Ge (Pharmacology) • CHAN Hsiao Chang (Physiology) • KO Wing Hung (Physiology)
- 1997-98 International Ginseng Conference '99 – Biotechnology, Medicinal Uses and Marketing of Ginseng (BL97042)
 ✎ BUT Pui Hay Paul • SHAW Pang Chui (Biochemistry) • LIU Wing Keung Ken (Anatomy)
- 1997-98 Characterization of Pharmacologically Active Substances and Nutritional Evaluation of Selected Seaweeds in Hong Kong (CU97314)
 ✎ CHEUNG Chi Keung Peter • OOI Vincent E. C. • ANG Put Jr.
- 1997-98 Structural Elucidation of the Polysaccharides Isolated from *Pleurotus Tuber-Regium* (BL97027)
 ✎ CHEUNG Chi Keung Peter
- 1995-96 *A Molecular Analysis on the Ecological Impact of an Introduced Isolate on the Natural Population of Armillaria* (BL95011)
 ✎ CHIU Siu Wai • ANDERSON James B.*
- 1997-98 Screening Natural Populations of Chinese Shiitake Strains for Present and Future Commercial Potential (CU97326)
 ✎ CHIU Siu Wai • MOORE David* • LIN Fang Can*
- 1997-98 A Confocal Laser Scanning Microscopic Analysis on the Gill Development of a Mushroom (BL97016)
 ✎ CHIU Siu Wai • MOORE David*
- 1996-97 Evolutionary and Population Genetics and Penaeid Shrimps in the Indo-West Pacific: Allozyme and Mitochondrial DNA Analyses (CU96327)
 ✎ CHU Ka Hou

- 1997-98 Molecular Studies on Shellfish Allergens: Cloning, Sequencing, Expression and Immunological Responses (CU97321)
 ✎ CHU Ka Hou • LEUNG P.S.C.* • KWAN Hoi Shan • FUNG Ming Chiu
- 1996-97 Ecological Studies of Completed Landfills for Enhancing Natural Succession on the Man-made Habitats (CU96324)
 ✎ CHU Lee Man • WONG M. H.*
- 1997-98 Sediment Pollution and Purification Potential of Gei Wais at the Mai Po Marshes Nature Reserves (BL97029)
 ✎ CHU Lee Man
- 1997-98 Studies on the Volatile Components in Salted-Dried Fishes Prepared by Two Traditional Methods (BL97030)
 ✎ CHUNG Hau Yin
- 1995-96 Molecular Cloning and Expression of the Helminth Excretory/Secretory Antigen (and Interleukin-5 Like Molecule) (CU95326)
 ✎ FUNG Ming Chiu • MAK Nai Ki*
- 1997-98 Studies of the Novel Genes Differentially Expressed During Myeloid Cell Differentiation and Embryo Development (BL97031)
 ✎ FUNG Ming Chiu
- 1996-97 *Activin Regulation of Pituitary Gonadotropin Gene Expression and Oocyte Development in the Goldfish, Carassius auratus* (CU96308)
 ✎ GE Wei
- 1997-98 Distribution of Activin Type II and Type IIB Receptors in the Goldfish Pituitary (BL97033)
 ✎ GE Wei
- 1996-97 Development of a Species Genetic Linkage Map of the Shiitake Mushroom *Lentinula edodes* with Sequence-tagged-site, Expressed-sequence-tag, and Gene Markers (CU96310)
 ✎ KWAN Hoi Shan
- 1997-98 Yeast Complementation Analyses of Signal Transduction Genes Isolated from Early Fruit Body Development of Shiitake Mushroom *Lentinula edodes* (CU97322)
 ✎ KWAN Hoi Shan
- 1997-98 Reclaiming the Salty Lands for Agriculture (BL97002)
 ✎ LAM Hon Ming
- 1997-98 Cloning of Salt Inducible Promoters from *Arabidopsis thaliana* (BL97032)
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- 1996-97 Studies on the Antiviral Properties of Bioactive Polysaccharides and Proteins Isolated from Mushrooms (CU96330)
 ✎ OOI Vincent E. C. • NG Tzi Bun (Biochemistry) • YAO Qi-Zhi* • CHANG Shu Ting
- 1997-98 Developmental Alteration of the Expression and Kinase Activity of Cyclin-Dependent-Kinase 5 (Cdk5)/p35 in the Rats with Neonatal Unilateral Eye Removal (BL97034)
 ✎ OOI Vincent E. C. • CHAN Sun On (Anatomy)
- 1997-98 Characterization and Expression of Ribosome Inactivating Proteins in Plants and Mushrooms (CU97325)
 ✎ OOI Vincent E. C. • SUN Sai Ming Samuel • NG Tzi Bun (Biochemistry)
- 1996-97 Genetic Engineering of Rapeseed for Enhanced Nutritional Quality (CU96301)
 ✎ SUN Sai Ming Samuel
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 ✎ SUN Sai Ming Samuel • WONG Yum Shing
- 1997-98 An *in situ* study of the phytoplankton-zooplankton trophic transfer in the Zhujiang River estuary (CU97313)
 ✎ WONG Chong Kim
- 1997-98 Effects of Oxygen and Temperature on the Sensitivity of *Moina Macrocopa* to Chemical Pollutants (BL97035)
 ✎ WONG Chong Kim
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 ✎ WONG Po Keung
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 ✎ WONG Po Keung

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| 1997-98 | Enhancement of Metal Bioremediation by Rhizospheric Plant and Microbial Components (BL97014)
✉ WONG Po Keung • OW David* | 1989-90 | Induced Spawning and Larval Rearing of Marine Fish (BP89042)
✉ WOO Norman Ying Shiu |
| 1995-96 | A Study of the Nutritional Quality and Potential Food Use of Some Underutilized Legumes (BL95043)
✉ WONG Yum Shing | 1990-91 | The Rearing of Marine Fish Larvae (BP89060)
✉ WOO Norman Ying Shiu |
| 1997-98 | An Evaluation of the Nutritional Value and Potential Food Use of Some Underutilized Asiatic Pulses (BL97037)
✉ WONG Yum Shing • CHEUNG Chi Keung Peter | 1997-98 | Evaluation of Novel Microencapsulated Formulations for the Improved Survival and Development of Cultured Marine Fish Larvae (CU97302)
✉ WOO Norman Ying Shiu • COLLINS Peter M.* |
| 1989-90 | Environmental Physiology of Marine Teleosts (BP77001)
✉ WOO Norman Ying Shiu | 1997-98 | A Pioneering Study on Gene Regulation During Larval Development of the Sea Bream, <i>Sparus Sarba</i> (BL97038)
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RESEARCH PROJECTS

Thermodynamic Studies of Sequence Specific Local Structure of DNA by UV Spectroscopy

- ✍ AU-YEUNG Chik Fun Steve
 ☐ 1 February 1999
 ❖ CUHK Research Committee Funding

Structure and function study of DNAs is highly important because of its relevance to the researchers understanding of DNA replication and genetic information transfer. This proposal intends to secure funds to investigate the sequence specific thermodynamic properties (using UV spectrophotometry) of DNAs relevant to the understanding of the action of Epstein-Barr virus (EBV). The latter has been found in tumor cells and occurs in high incidence in the population of Hong Kong and the PRC. Recent NMR studies have shown that a trimer-tetramer model better accounts for the morphology of DNAs. However, the lack of DNA tetramer thermodynamic data prevents a proper structure-stability correlation to be carry out. Therefore, the objective of this study is to construct a DNA tetramer thermodynamic database to verify the structure-stability relationship of DNAs based on the trimer-tetramer model and to compare the results with that obtained from the existing two base-pair model for the prediction of the sequence-specific local structures. The outcome of this research could form the basis for the understanding of point mutation from structure and thermodynamic consideration. As well, it would provide a database containing thermodynamic properties of DNAs (stability information) which would be useful for developing short oligonucleotide probes in sequencing and genome characterization. (PS98017)

Biological Evaluation Agreement: Obtaining Compounds to Evaluate for Agriculture Utility

- ✍ CHAN Kin Shing
 ☐ 11 November 1998
 ❖ DuPont de Nemours and Company

This agreement is made with DuPont de Nemours and Company. The researcher will provide DuPont a list of chemical compounds, compositions or natural products, including the chemical structure and properties where known. Upon receipt of the list of compounds, DuPont will select those desired for evaluation of agricultural utility. (PS98016)

Asymmetric Catalytic Carbon-Carbon Forming Reactions Via Chiral Biaryls

- ✍ CHAN Kin Shing
 ☐ 1 December 1998
 ❖ Research Grants Council

Stereospecific catalytic synthesis of optically pure compounds in a predicatable and controllable manner constitutes a major and important development in industry and academics. Catalytic stereospecific synthesis of optically pure compounds offers a unique and efficient feature by chiral multiplication and is economical. Under the right condition, thousands of chiral product molecules can be produced by molecule of catalyst.

The optimization of the efficiency of these catalytic processes by steric and electronic finetuning of catalysts in the chiral induction will provide more economical chemical processes. The understanding of the subtle interplay of electronic and steric effects on asymmetric catalysis will aid to design more powerful catalysts. (CU98023)

Mass Spectrometry of Carbohydrates

- ✍ CHAN Tak Wah Dominic
 ☐ 1 October 1998
 ❖ Research Grants Council

In this project, the potential of MALDI-MS and ESI-MS for the characterization of both complex oligosaccharides and high mass polysaccharides will be evaluated systematically. Through these studies, we hope to devise a comprehensive method based on mass spectrometry to identify and characterize bioactive oligo- and polysaccharides in *Ganoderma lucidum*.

A series of experiments will be conducted

- (1) to study factors affecting the analysis of high mass polysaccharides under MALDI conditions;
- (2) to study and generalize the fragmentation behavior of model oligosaccharides with various sugar compositions under typical MALDI/PSD and ESI/CID conditions; and
- (3) to identify and characterize the bioactive oligo- and polysaccharides in *Ganoderma lucidum*. (CU98345)

Synthesis of [n]Paracyclophane-based Oligo[p-phenylene-(E)-vinylene]s with Configurational Chirality Residing in the Backbones

- ✍ CHAN Tze Lock
 ☐ 1 September 1998
 ❖ Research Grants Council

The synthesis and characterization of conjugated organic polymers has been an active area of research in both organic chemistry and material science for the past quarter of a century in a collective effort to

search for new materials for nanotechnology. In particular, poly(phenylenevinylene)s have received a great deal of attention because of their nonlinear optical and electroluminescent properties. Owing to their responsiveness to polarized light, chiral poly(phenylenevinylene)s should add a new dimension to this class of materials in respect to chiral recognition processes. Polydispersity renders polymers inconvenient for structure-property relationship studies. Instead, their oligomeric counterparts having uniform molecular weights, specified constitutions, and defined stereochemistry are required as model systems to map out the relationships between chemical structures and bulk material properties. Chiral oligomers provide an advantage over achiral ones by allowing structural characteristics to be assessed by polarization techniques. We propose to undertake the synthesis of series of [n]paracyclophane-based oligo[*p*-phenylene-(*E*)-vinylene]s with chirality residing in the oligomer backbone so that their pattern of chiro-optical and electro-optical behaviors may guide future design of polymers for special uses. (CU98121)

Molecular Metamorphosis: A New Approach to the Synthesis and Dendritic Macromolecules via Post-Dendrimerization Modifications

- ✉ CHOW Hak Fun
- 1 November 1998
- ❖ CUHK Research Committee Funding

The synthesis of highly-specialized polymeric macromolecules such as hyperbranched starburst molecules has been one of the important developments in polymer and material research. Although dendrimer chemistry is initially a spin-off from the conventional polymer chemistry arena, it has found potential usefulness not only in polymer industry, but also in medical and pharmaceutical applications. Traditionally such macromolecules are synthesized by polymerization of monomeric units in a stepwise and controlled fashion, resulting in the formation of structurally regular polymeric molecules. One disadvantage of such strategy is that a large number of synthetic operations are required to produce the target molecules and thus large scale production could be problematic. Here researchers propose a new synthetic approach to dendrimers *via* post-dendrimerization interconversions of dendritic molecules. In this project they plan to synthesize a series of poly(phenylene(*E*)-vinylene) dendrimers wherein the olefin functionalities are set up in one single step by a novel multiple functional group conversion reaction from a series of dendritic polysulfones, which in turn will be prepared *via* dendrimer interconversion from the corresponding polysulfide analogues. In essence, such post-dendrimerization transformations will change the

molecular morphology of the starting dendritic molecule and hence a molecular metamorphosis will result upon such synthetic conversion. The synthetic plausibility of such molecular metamorphosis will also provide important information with regard to the three-dimensional structure and interior properties of these hyperbranched molecules, which is vital to their understanding of these novel hyperbranched molecules. (PS98005)

Preparation of Nanocrystals-Doped SiO₂ Thin Films by RF-Sputtering Method

- ✉ HUI Ka Chung
- 1 September 1998
- ❖ CUHK Research Committee Funding

The proposed project involves the preparation of a series of SiO₂ thin films doped with nanocrystals of commercially available group IV semiconductors and II-VI semiconductors using a refurbished low-pressure radio-frequency (RF) sputtering unit. The electronic band structures of the thin films will be characterized by X-ray photoelectron spectroscopy (XPS); the structural information such as bonding and defect density will be determined by Raman Scattering; the cluster size and distribution will be studied with transmission electron microscopy (TEM); and the optical absorption properties of the thin films will be studied with UV-visible absorption spectroscopy. In addition to providing more data for theoretical physicists to confirm or refine their “quantum size effect” models, the systematic correlation of the optical behaviour and the extent of blue shift of the thin films prepared under various RF-sputtering parameters to their respective electronic band structure, structural defect and cluster size may contribute to the development and design of a new breed of semiconductor materials useful in the manufacture of solid state blue laser, optical switches, shutters and wave-guides etc. The project should be able to provide training for at least 3 M.Phil. students in the next 5 years. (PS98002)

Functionalization of Backbone Carbon on Polymer Surfaces with -COOH

- ✉ KWOK Wai Man Raymond • LAU Leo Woon Ming (Physics) • WU Chi • CHAN Chi Ming*
- 1 October 1998
- ❖ Research Grants Council

Modification of polymer surfaces to enhance biocompatibility, adhesion, wettability, coatibility and lubricity is very important in the manufacturing of polymer products. While a plasma exposure approach is widely used in such modification for

breaking some surface bonds and inserting the required functionality to the surface active sites, it often causes undesirable bond breakage and formation. For controlled bond breaking, we will use H_2^+ with a controllable kinetic energy as a projectile to knock out hydrogen from a C-H bond, with the understanding that for elastic binary collision, H_2 can transfer 89% of its kinetic energy to a H atom, but only 49% to a carbon atom. There is thus an energy window which is sufficiently high to cause C-H breakage but low enough to leave all C-C bonds intact. A unique instrument that includes a mass and energy selected low energy ion beam system and many powerful characterization/preparation units will be used for *in-situ* studies of H_2^+ collision and other related surface reactions. As a prototype application, the activated surface will then be dosed with $CH_2=CH_2COOH$ for the preparation of polymer surfaces with a single functionality of carboxylic acid, surfaces which are in demand in industry. The study will produce scientific information for engineering controlled bond breaking and single functionality on polymer surfaces. A PhD student will be trained in this interdisciplinary project.
(CU98106)

Transition Metal Thiolate and Selenolate Complexes with Unusual Coordination Geometry as Mimics to the Active Sites of Metalloproteins

- ✉ LEE Hung Kay
- ☐ 1 June 1999
- ❖ CUHK Research Committee Funding

The chemistry of transition metal thiolate and selenolate complexes has been the subject of much work and the matter of continuing investigation. The tendency of these complexes to aggregate and form insoluble polymers renders their characterizations difficult to be carried out. Recently, with the introduction of sterically demanding alkyl and aryl substituents, several neutral homoleptic transition metal thiolate and selenolate complexes have been isolated and structurally characterized. Neutral metal thiolates and selenolates containing both nitrogen-donor ligands and chalcogenate ligands, on the other hands, remain rare.

The objective of the proposed research work is synthesis and characterizations of a series of transition metal thiolate and selenolate complexes. The complexes are to be prepared from the corresponding transition metal amides and the appropriate bulky thiols or selenols. The structures of these complexes are to be determined by single crystal X-ray crystallography and comparison will be made with those of the active sites of metalloproteins with unusual coordination geometry.
(PS98018)

Syntheses, Structures and Reactivities of Metal Aza-allyl Complexes

- ✉ LEUNG Wing Por Kevin
- ☐ 15 July 1998
- ❖ Research Grants Council

Organometallic complexes which can potentially act as catalysts for olefin polymerisation and asymmetric catalysis will be studied in this work. This project is to develop the synthesis of a series of novel metal aza-allyl complexes and study their structures and reactivities. The aza-allyl ligand considered is based on the recently developed rearrangement reaction of lithium alkyls with organonitriles. Alkali metal (Li, Na and K) aza-allyl compounds will be prepared and used as transfer reagents for the synthesis of some metal aza-allyl complexes (e.g. Ti and Zr). The structures of these compounds will be studied by spectroscopic methods (NMR, mass spectroscopy) and X-ray structure determination. Catalytic activity of the zirconium and titanium aza-allyl complexes towards olefin polymerisation will be investigated. It is anticipated that the variation of organic ligands and leaving groups on the metal centres will play a key role in optimising the activity of polymerisation and asymmetric transformations.

(CU98126)

Ab Initio Molecular Orbital Studies on the Structures, Energetics, and Potential Energy Surfaces of Novel Chemical Species

- ✉ LI Wai Kee
- ☐ 1 January 1999
- ❖ CUHK Research Committee Funding

High-level *ab initio* calculations are applied to various molecular or ionic species to carry out structural and energetics studies on these systems. Such studies include:

- (1) Investigations of structures and stabilities of isomers;
- (2) Assessments of conflicting experimental thermochemical data existing in the literature and predictions of quantities with no available experimental results;
- (3) Investigations of potential energy surfaces;
- (4) Establishing dissociation channels for simple molecules/ions in conjunction with experimental photodissociative ionization studies;
- (5) Conformational analysis of biologically interesting molecules, etc.

(PS98006)

A First Principle Study on the Bimolecular Reaction $F_2+C_2H_4$

- ✉ LIU Zhifeng • TSE John S.*

□ 1 November 1998

❖ Research Grants Council

We propose a first-principle study on the mechanism and dynamics for the bimolecular reaction $F_2 + C_2H_4$. Experimentally this system was studied by trapping guest molecules in solid inert gases at cryogenic temperatures (matrices), and with the two reactants, F_2 and C_2H_4 , held in close proximity by the matrices, subsequent irradiation by IR laser could then selectively excite specific C_2H_4 vibration modes and induce bimolecular reactions between $F_2 + C_2H_4$. The results showed intriguing mode-specific dynamical behaviors, and the system was later studied by molecular dynamics (MD) simulation using a semi-empirical potential surface. To attack this important reaction from first principle, we plan to use *ab initio* MD, which computes the potential energy and forces along the trajectories within density functional theory, for direct simulations on the reactions between F_2 and mode-specifically excited C_2H_4 in both gas phases and in Xe matrices environment. In addition, high level *ab initio* Hartree-Fock based method is used to compute the energy and structure for transition states with better accuracy. By combining these two powerful methods. We hope to map out the reaction paths and elucidate the mode-specific dynamic features. (CU98122)

Synthetic and Structural Studies on Homo- and Heterometallic Complexes

✉ MAK Thomas Chung Wai • TANG Wen Xia*

□ 1 August 1998

❖ Research Grants Council

Homometallic and heterometallic complexes are compounds containing two or more metallic elements of the same type or different types, respectively. The terms binuclear and polynuclear are used, respectively, to designate complexes containing two and three or more metal centers surrounded by atoms or groups of atoms that are known as ligands. A bridging ligand is one that links two or more metal centers in a complex. Polymetallic compounds in which significant direct metal-metal bonding occurs are known as metal clusters.

Binuclear and polynuclear complexes have been shown as extremely important in such active areas as chemical synthesis, catalysis and bioinorganic chemistry. The present proposal focuses on the synthesis and characterization of two or more of the following classes of compounds that are relevant to the main stream of current research:

- (1) direct bonding between a transition element (e.g. iron, ruthenium, iridium) with another metallic element (e.g. copper, silver, mercury) in a bridged organometallic complex;

- (2) the assembly of inorganic helices using oligopyridine ligands;
- (3) silver clusters; and
- (4) chiral ferrocenes that catalyze the chemical synthesis of asymmetric organic compounds. (CU98022)

Studies of Hydrophilic and Non-aggregated 2, 3-Naphthalocyanines and Phthalocyanines

✉ NG Kee Pui Dennis

□ 1 August 1998

❖ Research Grants Council

Phthalocyanines (Pcs) and 2,3-naphthalocyanines (Ncs) are important macrocyclic compounds. Owing to their highly delocalized π -electron systems, these macrocycles exhibit a range of intriguing physical and chemical properties which render them useful in various disciplines ranging from catalysis, materials science to medicine. For some applications such as the catalytic degradation of pollutants and photodynamic therapy, it is desirable that the macrocycles can be soluble in water and, for the latter, free from molecular aggregation that will otherwise drastically decrease the luminescence quantum yield, shorten the triplet lifetime, and reduce their photosensitizing efficiency. Although numerous derivatives of Pc and Nc have been synthesized, the study of water-soluble and non-aggregated analogs is still in its infancy. We plan to link dendrimers containing hydrophilic terminal groups and carbohydrates to Pcs and Ncs. These sterically demanding fragments with a substantial number of hydrophilic moieties will not only prevent molecular association, but also enhance their solubility in water. Special emphasis will be placed on the Ncs and unsymmetrical systems because of their rarity and unique properties. The properties such as the electronic absorption, fluorescence, electrochemistry and aggregation behavior of the target macrocycles will then be investigated with various spectroscopic and electrochemical techniques, both in organic solvents and in water. (CU98117)

Sandwich-Like Metal Bis(tetrapyrroles)

✉ NG Kee Pui Dennis • Johann W. BUCHLER*

□ 1 June 1999

❖ Germany/Hong Kong Joint Research Scheme

Sandwich-type phthalocyaninato and porphyrinato metal complexes, in which the highly delocalised macrocycles are in close proximity, have been the subject of intensive research in recent years. Due to the strong electronic interactions between the π electron systems of the macrocycles, these complexes display unusual electrical, magnetic, optical and

electrochromic properties. The double-decker complexes $M^V(\text{Por})_2$ ($M = \text{Ce, U, Th, Zr, Hf}$; $\text{Por} =$ general porphyrinate) have also been proposed as models to mimic the structure and spectroscopic properties of the "Special Pair" found in the reaction centre of photosynthetic bacteria. This project involves the preparation of new homoleptic and heteroleptic double-decker complexes of tetrapyrrole derivatives such as phthalocyanines and porphyrins, and studies of their various physico-chemical properties.
(PS98025)

Synthesis and Reactions of 5,6-Bis (trimethylsilyl) benzo [c] furan

✉ WONG Nai Ching Henry

☐ 1 January 1999

❖ Research Grants Council

Being usually very reactive, benzo [c] furans (isobenzofurans) undergo readily Diels-Alder cycloaddition with dienophiles to restore their aromaticity. Therefore, they can be employed to construct six-membered ring compounds which are common building blocks of many natural and non-natural molecules. Our target, namely 5, 6-bis (trimethylsilyl) benzo[c] furan, is expected to react with various dienophiles to provide the corresponding endoxides. Utilizing our own low valent titanium protocol, these endoxides can be converted to their respective benzenoid systems. The incipient trimethylsilyl groups can then be displaced consecutively by hypervalent iodine groups. The resulting silylated iodonium salts can again be converted to benzyne derivatives which would be trapped by another 5, 6-bis (trimethylsilyl) benzo [c] furan. In this way, linear silylated acenes, e.g. tetracenes, pentacenes, hexacenes, heptacenes, octacenes and nonacenes could be realized. These molecules might be utilized as potential candidates for electro-optical materials.
(CU98014)

The Formation and Stabilization of Surfactant-Free Polymer Nanoparticles

✉ WU Chi

☐ 1 January 1999

❖ Research Grants Council

Polymer nanoparticles are so useful in many novel fields of science and technology that the micronization of polymer materials becomes a very fast developing high-tech industry. One recent important discovery is that small hydrophobic polymer particles may offer a general route for the oral administration of a wide range of bioactive molecules, such as drugs and DNA, because these

small particles can squeeze between cells of the lining and enter the circulatory system. Another example is our recent finding that using polymer nanoparticles instead of a conventional thin film can provide a quick method to evaluate the polymer biodegradability. It is well known that hydrophobic nanoparticles can be prepared by a microemulsion polymerization of monomers in the presence of a large amount of surfactant/co-surfactant which are often harmful in biomedical applications. The removal of these surfactant molecules without affecting the particle stability is extremely difficult, if not impossible. It has been a long standing challenge in colloid science to make surfactant-free nanoparticles (10-100 nm in size) stable in water. Very recently, we have developed two novel methods to prepare surfactant-free polymer nanoparticles. Here, we propose a systematic study of how the formation conditions affect the particle size distribution and stabilization. This study will not only lead to a basic understanding of the formation and stabilization of the nanoparticles, but also provide the micronization know-how for local industries.
(CU98123)

Synthesis, Structure and Reactivity Studies of Organoactinide Complexes

✉ XIE Zuowei

☐ 1 January 1999

❖ CUHK Research Committee Funding

In comparison with organolanthanides and group IV organometallics, ring-bridged organoactinide chemistry is largely unexplored although it is well-established that the bridged ligands can afford complexes with advantageous solubility, crystallizability, thermal stability and resistance to ligand redistribution. On the other hand, the chemistry of metallacarboranes of 5f elements other than uranium is still unknown and the cationic organoactinide chemistry has just begun to be explored. The chemistry of such types of complexes is expected to be significant and varied. The aim of this project is to explore and develop this new chemistry of metallacarboranes that incorporate the actinides and of organoactinide complexes with various kinds of ring-bridged π ligands. It is anticipated that the results from this research will have an immediate impact in organoactinide chemistry, and will enhance the understanding in chemical bonding as well as chemical and physical properties of this type of compounds. This research may also lead to the emergence of a new type of catalysts for olefin and ring-opening polymerization.
(PS98007)

Enhanced Photocatalysts for the Degradation of Volatile Organic Compounds

- ✉ YU Chai Mei
- ☐ 1 September 1998
- ❖ Research Grants Council

Photocatalytic degradation is a promising technique for the treatment of volatile organic compounds (VOCs). Titanium dioxide (TiO₂) works as a catalyst with ultraviolet light to generate highly reactive oxidizing agents that attack and destroy VOCs in the environment. However, pure TiO₂ (anatase or rutile) catalyzed processes are unlikely to succeed commercially due to their poor solar efficiency. This project improves the photocatalytic activity by incorporating metal ions uniformly into the lattice of TiO₂. Our preliminary studies show that these solid solution catalysts are much more effective than pure TiO₂ for the degradation of acetone in air. This approach should open up a new door for photocatalysis research. A systematic approach is used to synthesis, characterize, and evaluate the effectiveness of a series of metal ion-TiO₂ solid solutions. (CU98124)

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

Edition Title/Investigators

- 1995-96 Construction of Cobalt (III) Porphyrin Based Coordination Polymers and Its Application to the Synthesis of the Dimensional Organic Conductors (CU95726)
✉ AU-YEUNG Chik Fun Steve
- 1994-95 Asymmetric Catalysis by Metal Complexes of Chiral Pyridyl Phenols and Their Derivatives (PS94010)
✉ CHAN Kin Shing
- 1995-96 Synthesis and Properties of Non-bridged Rhodium[II] and Iridium[II] Metal Dimers (BP94001)
✉ CHAN Kin Shing
- 1996-97 Mechanistic Studies of 1,2-Rearrangement of Alkyl Rhodium Porphyrins (CU96702)
✉ CHAN Kin Shing
- 1997-98 Asymmetric Catalysis via Chiral Pyridyl Phenols (PS97019)
✉ CHAN Kin Shing
- 1996-97 Development of New Methods to Perform Matrix-assisted Laser Desorption/Ionization (MALDI)

- Experiments in Fourier-Transform Ion-Cyclotron-Resonance Mass Spectrometer (CU96727)
✉ CHAN Tak Wah Dominic
- 1996-97 Sequence Analysis of Natural and Modified Oligonucleotides using Ultra-high Resolution Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (PS96004)
✉ CHAN Tak Wah Dominic • DERRICK Peter J.*
- 1997-98 Chiral Recognition in Mass Spectrometry (CU95598)
✉ CHAN Tak Wah Dominic
- 1996-97 Further Exploration of a Recently Developed One-flask Ramberg-Backlund Reaction (CU96712)
✉ CHAN Tze Lock
- 1996-97 Synthesis and Properties of Novel Metallodendrimers: Controlling the Redox Behaviour of Metal Complexes by Dendritic Modification (CU96710)
✉ CHOW Hak Fun
- 1996-97 Synthesis of Extremely Large Macrocycles by Transition Metal Catalyzed Metathesis (PS96006)
✉ CHOW Hak Fun
- 1997-98 Optically Active, Axially Chiral, Binaphthol-based Conjugated Oligomers: Synthesis, Characterization, Properties and Applications (CU97726)
✉ CHOW Hak Fun
- 1989-90 Study of Oxygen Chemisorption on Zr(0001) by LEED (BP89043)
✉ HUI Ka Chung
- 1997-98 Interaction of Low Energy Ions and III-V Semiconductors (CU97705)
✉ KWOK Wai Man Raymund • BELLO Igor* • LAU Leo Woon Ming (Physics)
- 1995-96 Assessment of the Quality and Curative Effects of Epimedium Species by Chemical Pattern Recognition Techniques (PS95019)
✉ LAU Oi Wah • YEUNG Hin Wing (Biochemistry)# • NG Tzi Bun (Biochemistry)
- 1997-98 Functional Models of Catechol 2,3-Dioxygenase (PS97007)
✉ LEE Hung Kay

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|---------|---|---------|--|
| 1990-91 | Synthesis of Novel Transition-Metal Alkyls (BP90039)
✍ LEUNG Wing Por Kevin | 1996-97 | Syntheses and Biological Evaluation of Pseudo-disaccharides as Potential Glycosidase Inhibitors (CU96711)
✍ SHING Kung Ming Tony |
| 1990-91 | Synthesis of Organometallic Compounds of Alkali Metals (BP90040)
✍ LEUNG Wing Por Kevin | 1997-98 | Enantiospecific Total Syntheses of Anticancer Agents Simalikalactone D and Quassamarin (CU97708)
✍ SHING Kung Ming Tony |
| 1996-97 | Synthesis and Application of Organotransition Metal and -Lanthanide Compounds in Olefin Polymerisation and Asymmetric Catalysis (CU96720)
✍ LEUNG Wing Por Kevin | 1989-90 | Theoretical Studies of (a) Aluminium-Ethylene Complexes (b) CH_3SOH^+ (c) Ge Compounds (d) HPOH and HNOH (BP89048)
✍ SO Suk Ping |
| 1997-98 | First Principle Molecular Dynamics Study on the Reaction Mechanisms of Thermal Dissociation for Molecules and Energetic Materials (CU97711)
✍ LIU Zhifeng • TSE John S.* | 1989-90 | Synthesis of Novel Aromatic Compounds (BP83001)
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✍ MAK Thomas Chung Wai • WONG Nai Ching Henry | 1997-98 | Total Synthesis of Plakortones A and B (PS97010)
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✍ MAK Thomas Chung Wai • ZHANG Hong-jie* • NI Jia-zuan* | 1996-97 | Diffusion Inside Nanocavities of Polymer Gel Networks (CU96707)
✍ WU Chi • AU-YEUNG Chik Fun Steve • LIN Ge (Pharmacology) • HUNG Leung Kim (Orthopaedics & Traumatology) |
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✍ WU Chi • KULICKE W. -M.* |
| 1997-98 | Structural Studies on Silver Acetylide and Its Double Salts (PS97009)
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RESEARCH PROJECTS

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>
1997-98	Development of Over-the-Counter Pharmaceutical Product Based on Local Medicinal Plants (BL97039)

✉ KONG Yun Cheung • KWAN Hoi Shan (Biology)

1996-97 Detection and Clinical Relevance of Genetic Abnormalities (E2A/PBX1 and BCR/ABL) in Pediatric Acute Lymphoblastic Leukemia by Multiplex Polymerase Chain Reaction (MD96030)

✉ LEE Chuen Kwun Joseph • NG Heung Ling Margaret (Anatomical & Cellular Pathology)

see also <P980891>

RESEARCH PROJECTS

Preconditioners for Ill-Conditioned Toeplitz Matrices

- ✉ CHAN Hon Fu Raymond • Gabriele STEIDL* • Daniel POTTS*
- 1 May 1999
- ❖ Germany/Hong Kong Joint Research Scheme

This research proposal is centered on the development of fast iterative methods for solving linear systems where the coefficient matrices are ill-conditioned Toeplitz matrices. Such systems arise in many applications, e.g. integral equations, signal processing and queueing networks. The preconditioned conjugate gradient method is proposed as the main tool for solving such systems. For a large class of Toeplitz systems including the well-conditioned ones, we have already shown that the method with either circulant preconditioners or band-Toeplitz preconditioners is faster than existing direct methods by a factor of $o(\log n)$. The band-Toeplitz preconditioners work especially well for ill-conditioned systems but have a drawback of requiring explicit formula of the generating functions of the Toeplitz matrices. The purpose of this research is to extend the circulant preconditioner idea to general ill-conditioned Toeplitz systems. We will focus on designing good circulant preconditioners that incorporate the band-Toeplitz preconditioner idea but without requiring the explicit knowledge of the generating functions. We will establish theoretically the convergence rate of the method. (PS98026)

Convolution Equations Associated with Scalings

- ✉ LAU Ka Sing • LEUNG Chi Wai
- 1 October 1998
- ❖ Research Grants Council

We are interested in the solution f of the equation $f(x)=f * \sigma(\beta x)$, where $\beta>0$ and σ is a given regular Borel measure. When $\beta=1$, the equation is the classical convolution equation usually defined on \mathbb{R}^n , locally compact groups or Lie groups. The solution f is called σ -harmonic function. It has been studied in great detail in the last half century and it plays a significant role in harmonic analysis, geometry, probability and statistics. The case for $\beta\neq 1$, in a discrete form on \mathbb{R} , has attracted a lot of attention recently in the areas of wavelets, signal processing, fractals and dynamical systems. The development is in an exponentially fast pace and many basic questions remain unanswered.

We propose to give a detailed investigation of the above equation for the whole range of β . For the

classical case with $\beta=1$, we will continue to investigate in the very elegant setup on locally compact groups and Lie groups. For the newly emerged case $\beta\neq 1$, we will first concentrate on the equation defined on the real line. Our long term goal is to bring it up to \mathbb{R}^n and to the more general groups. Since the motivations for the equation come from very different origins, the techniques and foci are quite different. It is also our aim to provide a systematic approach to such problems. (CU98057)

Harmonic Functions on Groups and Homogeneous Spaces

- ✉ LEUNG Chi Wai • CHU Cho Ho*
- 1 September 1998
- ❖ CUHK Research Committee Funding

The researchers investigate harmonic functions and measures on locally compact groups and homogeneous spaces. Their objective is to describe the positive harmonic functions on homogeneous spaces of nilpotent groups and to study the dimension of the space of bounded harmonic functions on a group. (PS98003)

Invariants of Compact Strongly Pseudoconvex CR Manifolds and Applications

- ✉ LUK Hing Sun • YAU S. T. Stephen*
- 1 December 1998
- ❖ Research Grants Council

CR manifolds as the abstraction of smooth boundaries of domains in complex spaces play a significant role in the field of several complex variables. A central problem is to study how the CR structure on a boundary determines the complex structure inside.

In this project we investigate the relation between invariants of a compact strongly pseudoconvex CR manifold M embedded in \mathbb{C}^n and invariants of the isolated singularities of the complex subvariety V that M bounds. In one direction, we compute various cohomologies on the CR manifold in terms of invariants of the singularities. In the reverse direction, we use certain invariants of the interior isolated singularities to define global algebraic invariants for the CR manifold, which provide in particular an algebraic classification of three dimensional CR manifolds embeddable in \mathbb{C}^3 , and relate them back to known CR invariants.

There are two important sets of complete local CR invariants: one may be described as intrinsic and the other as extrinsic. For the latter, we investigate conditions which guarantee that the subvariety V has boundary regularity at M and extends

holomorphically across M . Results in this direction would lead to applications of projective connections and reflection principles to the global equivalence problem and to problems on proper holomorphic maps.
(CU98051)

Asymptotic Analysis of Optimization and Variational Problems

- ✉ NG Kung Fu • PANG Jong Shi*
- ☐ 1 January 1999
- ❖ Research Grants Council

The research is concerned with the study of some fundamental asymptotic aspects of optimization problems and variational inequalities, including investigation on interrelationships of minimizing and stationary sequences of smooth/nonsmooth functions, error-bounds, convergence analysis as well as on various generalizations of convexity, derivatives and variation principle.
(CU98002)

Burside Type Problems Related to Semigroups

- ✉ SHUM Kar Ping • GUO Yuqi* • STRUKOV Segy P.* • NGUEYH Van Sanh* • SEN M K*
- ☐ 30 September 1998
- ❖ CUHK Research Committee Funding

Problem of determining or almost determining algebraic objects by their properties or numeric parameters provide an important impetus for research in algebras. These problems bring to algebra new ideas and methods. The most celebrated achievement in this direction in recent years is E.I. Zelmanov's solution of the Restricted Burnside Problem (R.B.P.) in the theory of finite groups. Professor Zelmanov won his Field's medal in 1994 in solving the RBP Problem in finite groups. In fact, RBP concerns the possibility of (almost) determining a finite group by the degree of its elements and the number of its generators. In this project, researchers study problems in finite semigroups which are close to RBP by using linear representations of semigroups. Preliminary work has been done. It is expected that some problems in semigroups related to Burnside Problem in group theory can be solved, although the method used is different. In addition, research on modules, varieties of semigroups and bands by the researchers and their collaborators will be continued.
(PS98012)

Mathematical Study of A Chemotaxis System

- ✉ WEI Juncheng
- ☐ 1 October 1998
- ❖ CUHK Research Committee Funding

Researchers plan to study the following Keller-Segel model in chemotaxis:

$$\begin{cases} \mu_t = \Delta \mu - \chi \nabla \cdot (\mu \nabla v) & \text{in } \Omega \times \mathbb{R}_+ \\ \Gamma_t^\nu = \Delta v - \beta v + \alpha \mu & \text{in } \Omega \times \mathbb{R}_+ \end{cases} \quad (1)$$

Chemotaxis refers to a mechanism for aggregation of organisms which move preferentially towards relatively high concentrations of a chemical that they themselves secrete. Understanding of such phenomenon is of great interest both to biologists and mathematicians interested in pattern formation. In this project researchers are interested in two problems associated with (1): time-independent solutions and singularity formations. For time-independent solutions, they will concentrate on the effect of parameters (χ, β, α) on the existence, nonexistence and multiplicity. For singularity formation, they will study singularity formed at multiple points on the boundary.
(PS98013)

Efficient Numerical Methods for Solving Inverse Problems

- ✉ ZOU Jun
- ☐ 1 September 1998
- ❖ Research Grants Council

Inverse problems are encountered frequently in industry and engineering applications, e.g. in the analysis of the heat conductivity of a material deep under the earth, of the seriousness of a contaminated region. These can be modelled by identifying coefficient parameters in boundary or initial-boundary value problems. This research project is to develop efficient numerical methods for the identification of physical parameters in these problems.

We will carry out the parameter identifying process in such a way that the physical solution of the modelling equation matches the observed data optimally in a certain measurement. The problem is first formulated as a constrained minimization system with some regularization. Then finite element methods are proposed to approximate the constrained problem. As the resulting discretized systems are highly nonlinear and ill-conditioned, computational cost is usually extremely expensive compared with the related direct problem. To speed up the resolution process, we will propose the domain decomposition technique to split the global discrete system into smaller ones. Multi-level coarse grid initializing will be utilized to provide a good initial guess for starting the iterative process.
(CU98004)

Numerical Identification of Parameters in Physical and Engineering Systems

- ✉ ZOU Jun • YAMAMOTO Masahiro*

- 1 October 1998
- ❖ CUHK Research Committee Funding

Researchers shall propose a new efficient numerical method for identifying physical parameters in some physical and engineering systems. They formulate the numerical identifying process in such a way so that the physical solution of the modeling equation matches the observed data optimally in a certain norm. The major tool will be the output least squares approach combined with the error equation method so that they can separate the resolution of the physical parameter and the solution of the original modeling system. Then special finite element methods will be utilized to approximate the corresponding constrained minimization problem in a way that the resulting discrete systems can be solved very efficiently using iterative methods. (PS98014)

Numerical Methods for Ill-Posed Problems in Computed Tomography

✉ ZOU Jun • Peter MAASS* • Dicken VOLKER*

- 1 April 1999
- ❖ Germany/Hong Kong Joint Research Scheme

We investigate numerical solutions of a highly nonlinear ill-posed inverse problems arising from the development of tomographic methods for medical diagnosis. We will propose a nonlinear regularized numerical method and conduct its convergence analysis and numerical simulations for some problems from real applications. (PS98027)

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

Edition Title/Investigators

- 1997-98 Bifurcation of the Caustic of Off-Center Reflection (PS97023)
✉ AU Kwok Keung Thomas
- 1997-98 Fast Iterative Methods for Integral Equations (CU97730)
✉ CHAN Hon Fu Raymond
- 1997-98 Fast Dense Matrix Methods for Integral Equations of the Second Kind (PS97022)
✉ CHAN Hon Fu Raymond
- 1996-97 Curvature Flows for Curves and Surfaces (CU96722)
✉ CHOU Kai Seng

- 1997-98 Multifractal Structure and Self-similarity (CU97703)
✉ LAU Ka Sing
- 1996-97 Second-Order Generalized Derivatives of Nonsmooth Functions (CU96706)
✉ NG Kung Fu
- 1996-97 Mathematical Theory of Option Pricing (PS96018)
✉ SHUM Kar Ping
- 1997-98 Representation Theory of Finite Groups and Group Algebras (PS97003)
✉ SHUM Kar Ping
- 1997-98 General Theory of Morita Equivalence for Rings, Semigroups, General Classical Groups and Their Applications (CU97720)
✉ SHUM Kar Ping
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✉ TAM Luen Fai
- 1997-98 Some Contributions to Linear & Nonlinear Analysis (PS97025)
✉ TAM Ping Kwan • TAN Kok Keong*
- 1997-98 Harmonic Maps and Structures of Manifolds (CU97722)
✉ WAN Yau Heng Tom
- 1996-97 Concentration Phenomena in Nonlinear Elliptic Equations (CU96721)
✉ WEI Juncheng • CHOU Kai Seng
- 1997-98 On the Effect of Domain Geometry and Topology in Nonlinear Elliptic Equations (CU97723)
✉ WEI Juncheng
- 1997-98 Mathematical Methods in Phase Transitions and Biology (PS97005)
✉ WEI Juncheng • WINTER Matthics*
- 1996-97 Modern Numerical Methods for Industrial/Engineering Problems: Electromagnetic Field, Oil Reservoir/Aquifer Simulations, and Queuing Networks (CU96513)
✉ ZOU Jun • HON Benny Y.* • CHAN Hon Fu Raymond

RESEARCH OUTPUTS AND PUBLICATIONS

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- <P974960> **Luk, Hing Sun and Stephen S.T. Yau.** "Some Remarks on Compact Strongly Pseudoconvex CR Manifolds". *Advanced Studies in Pure Mathematics CR-Geometry and Overdetermined Systems* vol.25, pp.237-246. 1997.
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see also <P991930>

RESEARCH PROJECTS

Statistics and Scaling in Turbulence

- ✉ CHING Shuk Chi Emily
- ☐ 1 August 1998
- ❖ Research Grants Council

All flows of liquids and gases can be divided into two very different types: laminar and turbulent flows. Most fluid flows in natural environments, in engineering applications, and in everyday life are turbulent. The motion of air in the earth's atmosphere and the flows in water-pipes are two common examples. In turbulent flows, physical quantities, such as velocity and temperature, display irregular fluctuations both in time and in space. This feature renders the need for a probabilistic description of turbulence. Mixing and transport are much enhanced in turbulent flows. For example, atmospheric turbulence plays a fundamental role in the transfer of heat and moisture, which has a considerable effect on changes in weather, and also determines the spreading of pollutants. Turbulence is thus a problem of practical importance. It is also one of the greatest challenges in physics for which a satisfactory theory is yet to be developed. Our earlier work suggests that an approach using conditional statistics may be fruitful. In particular, we have demonstrated the importance of several conditional averages for understanding the statistics of fluctuating quantities and the intermittency problem, the two major issues in turbulence research. In this project, we propose to apply and extend these ideas to study turbulent advection and the relation between the statistics and coherent structures. Furthermore, we shall analyse various experiments to examine some commonly employed hypotheses and concepts in turbulence research.

(CU98119)

Structure and Dynamics of Multi-Component Bose-Einstein Condensates

- ✉ CHU Ming Chung
- ☐ 1 December 1998
- ❖ CUHK Research Committee Funding

Bose-Einstein condensate, a state of matter characterized by its macroscopic quantum coherence, has been realized experimentally recently. It is a well-controlled many-body quantum system accessible for both theoretical and experimental studies. Researchers propose to study both the internal and external structure of a multi-component Bose-Einstein condensate. They will also investigate the interaction between such a condensate with quantized electromagnetic fields.

(PS98008)

Pattern Recognition of Radar Echoes for Rainstorm Forecasting

- ✉ CHU Ming Chung • WONG Wing Hung
- ☐ 1 January 1999
- ❖ Hong Kong Observatory

We apply an artificial neural network method to detect potential convergence of rainstorm-causing clouds. We also test a method using Empirical Orthogonal Functions to short-term forecast of severe rainstorms.

(PS98024)

Theory of harmonic generations in random composites of nonlinear dielectrics

- ✉ HUI Pak Ming
- ☐ 1 January 1999
- ❖ Research Grants Council

Second (SHG) and third harmonic generations (THG) in random composites of nonlinear dielectrics will be investigated theoretically and numerically. Most of the previous studies in the nonlinear optical properties of composite materials have been focussed on the optical Kerr effect and related processes. Processes involving summation of frequencies such as SHG and THG in random composites have not been fully investigated. We aim at deriving general expressions for the effective SHG/THG coefficients in terms of the local field distributions in the corresponding linear random medium with the same microgeometry. These general expressions form the fundamental relationships for further developments of analytical approximations and numerical methods. Effective medium approximations (EMA), which are useful to applied physicists and engineers for quick estimation of the effective nonlinear response, will be developed. Numerical simulations on random admittance networks will be carried out. Results will provide useful insight into the validity of EMA and the development of better theories. The effective SHG/THG coefficients as a function of component concentrations, frequency, and degree of anisotropy will be studied. Results of this project provide the basic understanding to the essential physics of nonlinear optical properties of random composites.

(CU98129)

Unusual Electromagnetic Radiation Characteristics in Media

- ✉ LAI Hon Ming
- ☐ 1 November 1998
- ❖ CUHK Research Committee Funding

Unusual electromagnetic radiation characteristics in various media, including anisotropic and dispersive ones, are to be investigated. Particular attention is to be paid to the possibility of 1/R-dependent radiation flux along a certain direction, and the existence of complex Doppler effect and all-forward radiation flow in the case of a moving source, in media like magnetoplasmas and crystals.

(PS98009)

Development of Advanced Surface Analysis and Engineering Technologies for the Metal Finishing and Related Industries

✉ LAU Leo Woon Ming • KWOK Wai Man Raymund (Chemistry) • WILSON Ian Howard (Electronic Engineering) • YEUNG L. K. Kinny* • LO W. Y.*

□ 1 July 1998

❖ Industrial Support Fund, Industry & Technology Development Council

In the development of high-value added manufacturing, it is often strategically important to perform detailed materials analysis of existing products in the market. In such a reverse engineering process, a wide spectrum of advanced surface and materials analysis technologies is required. In subsequent product and process development stages, a fast feedback of process performance and product evaluation is also extremely important. Once again, advanced surface and materials analysis are required. In addition, increasingly, buyers of these products are setting up more and more stringent acceptance criteria regarding surface related properties, such as adhesion and interfacial metallurgy in all coating products. Quality assurance of these properties by in-house or third-party analysis thus becomes critical. In short, advanced surface analysis and their effective applications in industry are invaluable tools in the development of high-value added manufacturing. In 1998, with an Industrial Support Fund from the Industry Department, 25 manufacturers sponsored the establishment of an advanced surface and materials analysis centre (ASMAC) at the Chinese University of Hong Kong. The operation of ASMAC is jointly carried out by a team of dedicated members from the Chinese University of Hong Kong and the Hong Kong Productivity Council who are experienced in surface analysis, surface engineering, and industrial liaison. Under the umbrella of the Materials Science and Technology Research Centre at CUHK, the ASMAC provides a comprehensive range of surface and materials analysis techniques and surface engineering techniques to local manufacturers.

(PS98023)

Engineering New Etching Processes for Semiconductors with Hyperthermal Ion Bombardment

✉ LAU Leo Woon Ming

□ 1 September 1998

❖ Research Grants Council

In the development of new etching processes for semiconductors, ion beam techniques are attractive because ion momentum can be correlated to directional etching, and kinetic energy to a reduction of thermal energy requirement. If necessary, the ion species can be mass-selected with a magnetic field. These unusual attributes associated with hyperthermal ion bombardment can lead to novel reactions with performance well beyond that of conventional reactions driven by thermal energy. In the semiconductor industry, many reactive ion etching processes have already been widely employed, in spite of the fact that they are not necessarily well understood and optimized. For example, while ion bombardment at 200-500eV is commonly used for etching InP and GaAs with a CH_4/H_2 plasma, the energetic ion bombardment also causes undesirable surface damage of the etched semiconductor. Recently, the applicant discovered in his preliminary study that CH_3^+ bombardment of InP at 3eV and 350°C yielded effective etching with no surface damage. In the proposed project, the applicant will confirm and expand such a discovery by performing a thorough study of reactions induced by mass-separated CH_3^+ bombardment of InP as a function of ion energy and substrate temperature. The study will generate data for the design of new etching processes with ion energy about two orders of magnitude lower than those in the current practice.

(CU98315)

Service Engineer for the Advanced Surface and Materials Analysis Centre

✉ LAU Leo Woon Ming

□ 1 April 1999

❖ Physical Electronics, Inc.

Under this project, an equipment maintenance centre at the Advanced Surface and Materials Analysis Centre, the Chinese University of Hong Kong, is to be set up. The centre will serve the two recently installed analytical instruments, PHI Quantum 2000 XPS and PHI 670 SAM, and four other similar instruments supplied by Physical Electronics, Inc. to the Hong Kong SAR and Pearl River Delta Region of P.R. China.

(EE98047C)

Studies of Spatial Soliton in a Photorefractive Crystal Induced by a Laser Beam

✉ LEE Wing Kee

□ 1 March 1999

❖ CUHK Research Committee Funding

Laser beam (signal beam) self-trapping or spatial soliton within a photorefractive crystal induced by another laser beam (control beam) will be studied. The following properties will be investigated.

- (1) time resolved variation of the transmittance of the signal beam after the control beam is turned on or off,
- (2) changes of the beam profile of the signal beam (within the crystal and far field) after switching on (or off) the control beam,
- (3) spatial variations of the refractive index of the crystal after the control beam is switched on or off,
- (4) interactions between two signal beams, and
- (5) roles played by photovoltaic and pyroelectric effects.

(PS98019)

Decoherence Effects of Quantum Computers

✉ LEUNG Pui Tang

☐ 1 December 1998

❖ CUHK Research Committee Funding

The feasibility of quantum computation, which makes use of the principles of interference and superposition of quantum states to solve computational problems, is a subject of current interest. Though, in principle, quantum computers can be built with two-state quantum systems (quantum bits or qubits), they always undergo decoherence due to the inevitable coupling of the qubits to the environment. In fact, the problem of decoherence has been recognized as a major obstacle to quantum computation soon after the idea of quantum computation became an active area of current research and various quantum error-correction schemes have been proposed in order to overcome this difficulty. In reality, the qubits may either decohere independently or cooperatively and the latter has not yet been studied properly. In this project, starting from physical models of quantum computers, researchers propose to study under what circumstances the qubits decohere independently or cooperatively, and design feasible correction schemes for them.

(PS98010)

Electron-Phonon Interactions in Highly Correlated, Quasi-One-Dimensional Electronic Materials

✉ LIN Hai Qing • CAMPBELL David Kelly*

☐ 1 October 1998

❖ Research Grants Council

We propose to conduct a combination of analytic and numerical studies to examine the effects of electron-phonon interactions in strongly correlated, quasi-one-dimensional (1D) electronic materials. In particular, we shall focus on three classes of such 1D materials:

- (1) the recently discovered inorganic spin-Peierls compounds, in which lattice distortions alter the nature of the ground state at low temperatures;
- (2) conducting polymers, including their highly doped states in which a metal-insulator transition occurs; and
- (3) charge transfer salts, in which unusual combinations of non-uniform charge and non-uniform spin densities can coexist in the ground state.

We will employ a variety of numerical techniques (exact diagonalizations, quantum Monte Carlo simulations) and analytic methods (spin-wave theories) to study these systems for both adiabatic and quantum phonons. Our studies will reveal physical nature of these materials and shed light on the development and design of novel materials.

(CU98120)

Tunable solid state lasers in the VUV pumped by discharge excimer lamp

✉ LO Yam Kuen Dennis

☐ 1 January 1999

❖ Research Grants Council

The conceptual design and breadboard construction of a lamp-pumped solid state laser emitting in the vacuum ultra-violet (VUV) spectral region (110-220nm) is to be carried out in this proposed research. The novel features of this solid state laser include the use of a discharge-driven rare-gas excimer (Ar₂* or Kr₂*) lamp as the pump source. The laser active medium is a rare earth (4f shell) ion activated fluoride crystal with a broad emission band (~20 nm) in the VUV, thus allowing for tunable laser action. The discharge driven flashlamp can be built in modular forms and is highly compact (table top size). The fluorescence efficiency of the discharge flashlamp is up to ~50%. Compared to the electron-beam or F₂ laser pumped solid state lasers, the discharge flashlamp pumped devices promise to offer advantage in size reduction and improvement in efficiency by one order of magnitude. The success of this research would make possible a table top laser device that is useful in micromanufacturing, laser-based photolithography and photochemistry. Both theoretical modeling and spectroscopic measurements will be performed in this research.

(CU98024)

Processing and Properties of Al-Based Metal Matrix Composites Reinforced by Ceramic Particles and Intermetallic Compounds

- ✉ NG Hang Leung Dickon
- ☐ 1 November 1998
- ❖ CUHK Research Committee Funding

A new process had been invented for the making of aluminum-based metal matrix composite (MMC) materials in a prior project. The process involved the reaction of aluminum and oxides of some particular transition metals (such as tungsten or molybdenum) in powder form at moderately high temperature. The tempered products were hard, strong but light which contained the aluminum matrix, aluminide intermetallic compounds and ceramic particles in whisker form. This proposed project is a continuation of the prior project, it involves the development of the fabrication process and the study of formation of reinforcements in the matrices of these MMC products. In this proposed project, the researchers aim to:

- (1) further investigate and improve the making of the aluminum-based metal matrix composite (MMC) materials by optimizing the fabrication procedures, i.e., determine the appropriate powder compositions, the firing temperature and the duration for heat treatment, in order to obtain better physical, chemical and mechanical properties,
- (2) study the microstructure of the products formed in different fabrication conditions, and relating the microstructure to the various properties of the products,
- (3) characterize the mechanical properties of the products, such as Young's modulus, yield strength, tensile strength, and fracture toughness,
- (4) determine the corrosion resistance of the products in acidic, alkaline, and moist environment, and
- (5) study the possibility of transforming the invented products from a laboratory scale to large commercial scale.

Recently, active research work has been launched to improve the hardness and toughness of the products: by either annealing them in weakly reducing atmosphere, or by increasing the proportion of oxide of the transition metals in the initial raw powder mixture. These and the rest of the mentioned objectives will be tackled in this project, and it requires two more years for completion. (PS98011)

Experimental Investigation of the Relationship Between the Temperature Power Spectrum and the Viscous Shear in Turbulent Rayleigh-Bénard Convection

- ✉ XIA Keqing
- ☐ 1 January 1999
- ❖ CUHK Research Committee Funding

The researchers propose to measure the viscous shear and boundary layer thickness in high Rayleigh number turbulent convection in water, using a method based on the cutoff frequency of the temperature power spectrum obtained in the fluid. The viscous boundary layer thickness determined by this method will be used to compare with that in gas obtained by the same method and with that in water determined by a direct laser light scattering method. The results obtained in this study will have important implications on the relevance of the viscous shear in turbulent convection and on the behavior of the velocity field under different Prandtl numbers. Both are important to the understanding of the mechanism for heat flux transfer in the hard-turbulence regime of Rayleigh-Bénard convection. (PS98020)

Weathering and Aging of Modified Concrete

- ✉ YAU Kwok Fung
- ☐ 1 January 1999
- ❖ CUHK Research Committee Funding

Preliminary tests show that polymer modified concrete has excellent water repellency and impermeability, rendering the structure waterproofing by the material itself. This is a relatively new direction in the building industry. However, the effect of the modification on the long-term performance has to be investigated. This study is mainly on the effects of weathering and aging on water permeability and mechanical properties of these structures.

Commercially available testing cells usually simulate one or two but not all of the three major factors of weathering, which are ultra violet radiation, moisture actions (including dew and rain), and thermal cycling. There have been reports that the combine effects of all three major factors are very different from the prediction made from the results of testing the individual factors. That is, these effects are expecting to be synergetic. Hence, an essential part of this study is the building of a test cell to provide real-life environmental situation base on commercially available units and components. The test cell will be able to test samples for the combine effect of all the three major factors. While standard accelerated methods will be used, actual data of Hong Kong's weather in the last ten years will be used to control the condition of the cell via computing equipment. This test cell can also be used to investigate the life expectance of other industrial products subject to weathering and aging in services. These products include Hong Kong's increasing production and exportation of high quality, high-value-added vehicle components and parts. (EE98035)

Manufacture of High Temperature Superconducting Cables

- ✉ YAU Kwok Fung • LAU Leo Woon Ming
- 1 January 1999
- ❖ Chen Hsong Holdings Ltd • Industrial Support Fund, Industry & Technology Development Council

Superconducting cables can be used for no-loss power transmission when they are cooled down to the superconducting state. High temperature superconductors (HTSC) can be cooled by liquid nitrogen, which is inexpensive, user-and environmental friendly. Many large-scale applications of superconductivity are, thus, made possible. The economic impact is huge.

The latest proven technology for HTSC cable fabrication is the Field Induced Nano-Engineering (FINE) derived from Electrophoretic Deposition (EPD). This project aims at the industrial manufacture of high temperature superconducting cables using this cutting-edge technology. (PS98022)

The Inversion Problem for Quasinormal Modes

- ✉ YOUNG Kenneth • LEUNG Pui Tang • LING Siu Hing* • SUEN Wai Mo* • WONG Samuel S. M.*
- 1 October 1998
- ❖ Research Grants Council

Physical systems have characteristic ringings (normal modes). For example, a string clamped at both ends and tuned to middle C would ring at frequencies $f=\omega/2\pi=256$ Hz, 512 Hz, 768 Hz, ... (in multiples of 1, 2, 3, ...); on the other hand, a string clamped at one end and free at the other, if also tuned to middle C , would ring at $f=256$ Hz, 768 Hz, 1280 Hz, ... (in multiples of 1, 3, 5, ...). The *inversion problem* in wave mechanics attempts to determine the system from its characteristic frequencies. Conservative systems can be determined from *two* sets of characteristic frequencies (corresponding to the two examples given above). However, for an open system with waves leaking to the outside, the characteristic ringings (quasinormal modes) are described not only by a rate of repetition ($\text{Re } \omega$), but also by a rate of decay ($\text{Im } \omega$). The projects studies the conditions under which these open systems can be completely determined from *one* set of complex characteristic frequencies. Where this is not possible, the remaining degrees of freedom will be characterized. Practical inversion algorithms will be developed.

This problem is of general theoretical interest: for many physical systems, only one set of characteristic frequencies can be observed. More specifically,

inversion using gravitational waves from black holes may allow the astrophysical environment to be studied, and provides a new tool for gravitational wave astronomy. (CU98006)

Optical Nonlinearity Enhancement via Electric Field Induced Aggregation

- ✉ YU Kin Wah
- 1 August 1998
- ❖ Research Grants Council

We propose to use anisotropic microstructure for optical nonlinearity enhancement of composites of metal nanocrystals in a dielectric host. We perform molecular dynamics simulation on a suspension of uniform spheres in a dielectric liquid under an intense electric field. The field-induced polarization forces between the spheres cause rapid aggregation and lead to anisotropic gel-like structures. The degree of anisotropy of the resulting structure is characterized by various correlation functions of the spheres distribution, which is in turn related to the optical response of the structure via the spectral representation. We aim at taking advantage of the anisotropic structure to separate the optical absorption peak from the nonlinearity enhancement peak, thus increasing the applicability of the suspension as a nonlinear optical system. (CU98290)

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>
1996-97	Model Study of Fracture Propagation in Solids (CU96718) ✉ CHING Shuk Chi Emily • NAKANISHI Hiizu* • LANGER James S.*
1997-98	Large Scale Flow and Heat Flux in Turbulent Convection (PS97011) ✉ CHING Shuk Chi Emily
1996-97	Theoretical and Computational Study of Sonoluminescence (CU96715) ✉ CHU Ming Chung • LEUNG Pui Tang
1996-97	Coalescences of Neutron Star Binaries: Effects of Nuclear Physics (PS96011) ✉ CHU Ming Chung
1997-98	General Relativistic Astrophysics: Coalescences of Neutron Star Binaries (CU97712)

- ✎ CHU Ming Chung • LEUNG Pui Tang • SUEN Wai Mo*
- ✎ LEUNG Pui Tang • CHU Ming Chung
- 1993-94 Novel Optical Materials for Photonics Technologies (BP94012)
 ✎ HARK Sui Kong • HUI Pak Ming • LEE Wing Kee • LO Yam Kuen Dennis • NG Hang Leung Dickon • WONG King Young • CHAN Kam Tai (Electronic Engineering) • HSU Chung Chi (Electronic Engineering)
- 1996-97 Many-Body Physics of Novel Electronic Materials in Reduced Dimensions (CU96714)
 ✎ LIN Hai Qing
- 1997-98 Quantum Monte Carlo Simulations of Three Band Hubbard Model (CU97713)
 ✎ LIN Hai Qing • GUBERNATIS J.E.*
- 1997-98 Vehicular Traffic Flow Problems: Statistical Physics Approaches (CU97714)
 ✎ HUI Pak Ming
- 1997-98 Electronic Structure and Magnetic Properties of Quasi One-Dimensional Organic Ferromagnet II (PS97021)
 ✎ LIN Hai Qing
- 1997-98 Effects of Electron-Electron Interactions in Quantum Dots (PS97012)
 ✎ HUI Pak Ming • DENG W.*
- 1996-97 Bosons in Confining Potentials (PS96013)
 ✎ LIU Kwok Leung • LO Chi Fai
- 1997-98 Financial Markets as Complex Dynamical Systems (PS97006)
 ✎ HUI Pak Ming • JOHNSON Neil F.*
- 1997-98 Option Valuation of Constant Elasticity of Variance Process with Absorbing Boundaries and Its Applications to the Hong Kong Equity Market (PS97015)
 ✎ LO Chi Fai • HUI Cho Hoi*
- 1989-90 Microstructure of Undercooled Ge and Si (BP87003)
 ✎ KUI Hin Wing
- 1996-97 Negative Conductivity in Weakly Ionized Gases (CU96701)
 ✎ LO Yam Kuen Dennis
- 1989-90 The Viscosity of Easy Glass Formers (BP87004)
 ✎ KUI Hin Wing
- 1997-98 Experimental Study of Dye-Doped Sol-Gel Derived Silica as Tunable Solid State Laser Materials (CU97504)
 ✎ LO Yam Kuen Dennis
- 1996-97 Properties of Undercooled Molten Eutectic Alloys (CU96719)
 ✎ KUI Hin Wing
- 1996-97 The Study of Rare-Earth Transition-Metal Based Permanent Magnets (PS96023)
 ✎ NG Hang Leung Dickon
- 1996-97 Synthesis of Glassy Spinodals in Eutectic Alloys (PS96012)
 ✎ KUI Hin Wing
- 1995-96 Facing-target Sputtering Guns: Characteristics and Applications (CU95720)
 ✎ WONG Hong Kuen
- 1997-98 Grain Refinement in Undercooled Metals (PS97020)
 ✎ KUI Hin Wing
- 1995-96 Interplay of Magnetic and Superconducting Properties of Oxide Multilayers (PS95016)
 ✎ WONG Hong Kuen
- 1997-98 Surface Reactions with Hyperthermal SO_2^+ on Ag (110) and Cu (100) (PS97013)
 ✎ LAU Leo Woon Ming
- 1996-97 High Pressure Effects in Single-Crystal (La, Ca) MnO_8 Thin Films (PS96015)
 ✎ WONG Hong Kuen
- 1997-98 Studies of Interferences of High-Order Rainbows (PS97014)
 ✎ LEE Wing Kee
- 1997-98 Oxygen Effects in Colossal Magnetoresistance Materials (CU97718)
 ✎ WONG Hong Kuen
- 1995-96 Laser Interaction with Micrometer-sized Droplets and Fibres (CU95716)
 ✎ LEUNG Pui Tang • LAI Hon Ming
- 1995-96 Mechanism of Photo-emission in Rapidly-oscillating Micrometer-size (PS95039)

1995-96	Investigation of Relaxation Mechanisms of the Second Order Nonlinear Optical Activity in Polymeric Materials (CU95702) ✍ WONG King Young	Membrane Assembly of Fuel Cells (PS97016) ✍ XIA Keqing
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1994-95	Experimental Studies of Turbulent Convection (PS94012) ✍ XIA Keqing	1995-96 Wave Phenomena in Open Systems (CU95706) ✍ YOUNG Kenneth • LEUNG Pui Tang • CHING Shuk Chi Emily • SUEN Wai Mo*
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RESEARCH PROJECTS

Optimal Sequential Sampling Plans

- ✉ LAM Yeh
- ☐ 1 April 1999
- ❖ CUHK Research Committee Funding

In this project, the researchers shall focus their attention on the study of sequential sampling plans. This is a sampling plan by which they will make a decision every time after an item in the batch is sampled. There are three possible decisions: acceptance, rejection and continuation. To do this, assume that the quality variable has a normal distribution, researchers shall establish an equation that the minimum expected cost must satisfy. Afterwards, they try to solve the equation for the minimum expected cost. Then, they may find an optimal sequential sampling plan and study its properties. They shall also study the behaviour of the optimal plan due to a change in the parameters of their model. An algorithm for determining an approximate optimal sequential plan will also be developed. Then, the researchers shall make a comparison between the optimal sequential plan and the optimal single/double plan. Furthermore, they should generalize the above results to the case that the quality of an item is measured by its lifetime which has an exponential distribution. (PS98015)

Causal Relationship

- ✉ LAU Tai Shing
- ☐ 1 July 1999
- ❖ CUHK Research Committee Funding

Usually the results of statistics can be used to show the association between two factors when the data come from observational study. The main reason is that there are some confounding factors which cannot be controlled. The researchers have some results to show relate association to causation under some conditions. But they have to assume that the factors are binary (e.g., diseased and nondiseased). In this grant they propose to study the possible extension to the case that factors assume multiple values (e.g., different severity of the disease) (MD98067)

Further Developments on the Local Influence Approach

- ✉ POON Wai Yin • POON Yat Sun* • LEE Sik Yum
- ☐ 1 September 1998
- ❖ Research Grants Council

Utilizing certain basic tools such as influence graph and normal curvature in differential geometry, Cook (1986) developed a general approach for assessing the influence of local departures from the assumptions underlying a statistical model. This local influence approach provides a relatively simple and unified approach for handling a variety of problems; and numerous researches based on the approach had emerged in the literature. However, several issues were raised in the discussion of Cook's (1986) paper. These issues remain unsolved and hence hinder the further development of the approach and its practical applicability. This project investigates methods to address these issues and develops new tools for the approach so to wider its scope of applications. The practical applicability of the proposed methods are demonstrated with selected statistical problems. (CU98186)

Third Analysis of Survey Error

- ✉ WU Ka Ho Eden • CHEN Zhao Guo*
- ☐ 1 January 1999
- ❖ CUHK Research Committee Funding

Data for a socio-economic variable obtained from repeated survey are with error. Usually, estimates of the variance of the error are obtained in the survey process and published by statistical agencies; but estimates of the correlation of the error (equivalently, time series models fitted to the error) are rarely given. Knowing the correlation, some methods, called signal extraction, may predict the variable more precisely than the given data. The correlation structure of the survey error depends on the way of same sampling unit appears in the sample on more than one occasion, the so-called overlap. If the individual unit values, or other elementary estimates such as the values for rotating panels, are available to the analysts, the model or the correlation of survey error can be fitted or estimated. This is referred to *primary analysis*. However, in most situations, these values are not available either on the ground of confidentiality or due to lack of suitable program for handling repeated survey; analysts have to be based on the aggregated data in the published form and the methods used for modelling or estimating are referred to *secondary analysis*. These methods are usually based on very bold model assumptions and being less convincing. Surprisingly, it was ignored in the literature that auxiliary sources may often be available for analysing survey error. The researchers now refer the methods combining data from other sources with survey data to *third analysis* which is not only working with assumptions (like secondary analysis), but really uses more data. This leads to a new research direction in modelling survey error. One common situation is, as benchmarks, the annual sums without error (say, obtained from reporting) or with

much smaller error available offered by another source, they may develop methods to fit the monthly survey error by ARMA models using both published monthly survey data and annual benchmarks. (PS98021)

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

Edition Title/Investigators

1997-98 Statistical Matching Using Multiple Imputations Survival Analysis for Residents in Hong Kong 1991-1995 (PS97018)
 ✎ LAU Tai Shing • LI Kim Hung • WONG Tze Wai (Community and Family Medicine)

1989-90 Analysis of Continuous and Polytomous Variables (CS85001)
 ✎ LEE Sik Yum • POON Wai Yin

1989-90 Analysis of Incomplete Data (CS88002)
 ✎ LEE Sik Yum • POON Wai Yin

1989-90 Analysis of Structural Equation Models with Correlated Data (CS89006)
 ✎ LEE Sik Yum • POON Wai Yin

1997-98 Analysis of Structural Equation Models via the Bayesian Approach (CU97217)
 ✎ LEE Sik Yum • POON Wai Yin

1989-90 Analysis of Fuzzy Data (CS89005)
 ✎ POON Wai Yin • LEE Sik Yum • LEUNG Y. P.*

1996-97 Conformal Normal Curvature and Assessment of Local Influence (PS96029)
 ✎ POON Wai Yin

1997-98 Multiple Forecasts and Causality Analysis in Time Series Modelling (CU97401)
 ✎ WU Ka Ho Eden • CHEUNG Siu Hung • CHAN Ping Shing Ben

RESEARCH OUTPUTS AND PUBLICATIONS

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