

NCTS Mid-term Report for 2005 (Sub-Project II)

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Sub-Project II

1. Report of the Principal Investigator

(Prof. Chien-er Lee)

Missions and the Organization/Executive Structure

The missions of the Sub-Project II are two folds: (1) To support/help the NCTS academic activities held in the southern Taiwan, including Tainan, Kaohsiung, Chiayi, and Pingdong. (2) To provide an exclusive and friendly space as a solid platform of interactions and cooperations among members and visitors of various focused groups. In this way we can help promote the research of the focused teams to a level of excellence.

The principle investigator is responsible for the running of this sub-project. Its executive structure includes the Executive Committee, the Mathematics and the Physics Divisions, and the administration office. The Executive Committee is responsible for the final decision of the recruitment of center scientists and each division has its own academic executive committee which consists of the coordinators of the focused groups based on the Sub-Project II and some relevant experts if needed. Each focused group has its own committee to plan academic activities over the year.

The National Center for Theoretical Sciences building is in operation

The National Cheng Kung University has been most supportive of NCTS. It offered three floors of the former Guest House in the Cheng Kung Campus of NCKU (total area about 1500 m²) as the physical facility for the NCTS activities in the south. The facilities which are shared by the Mathematics and the Physics divisions of the Sub-Project II includes two medium-sized (having 80 sites) lecture rooms, four discussion rooms, 22 offices for visiting /center scientists, and administrative sections. The NCTS facility has been completed and formally opened for use on April 25, 2005. An opening ceremony co-chaired by NCKU president Chiang Kao and the NCTS Director Tu-Nan Chang was held, and then followed by a mixed Math-Physics workshop at that date. In this workshop, we cordially invited four well-known scientists to give speeches: Prof. Tu-Nan Chang to talk about the visions for NCTS by starting from academic interchanges, Prof. Ting-Kuo Lee to present the development in Physics by starting from the nano-technology, Prof. Jin Yu to talk about the role played by NCTS in the development of Mathematics in Taiwan, and Prof. Ming-Chang Kang to discuss the present status and the future prospect of Mathematics in Taiwan.

The recruiting of center scientists are underway

The President of NCKU has granted four extra center scientist positions (two for each discipline of Mathematics and Physics) to NCTS. Center scientists will be also hired as permanent faculty members of the respective departments with at most one-course teaching duty per semester. The Physics Division has already formally called for the applicants for the center scientist positions, and we already have some applicants. Two center scientists in physics are expected to be appointed

before the next academic year. The recruiting procedures for the Mathematics Division are also underway.

Summer short-term visitors

To cope with the opening of the NCTS building in April this year, we opened for the applications of summer visitors. There are total nine short-term summer visiting scientists accepted to NCTS in the south this summer. Some of these short-term visitors are described in some detail by various focused/research groups. All visitors were assigned an office in the third/fourth floor of the NCTS building. Daily researches and discussions, open lectures, and various mini-workshops had been proceeded in this exclusive NCTS building.

The Sub-Project II has also supported the local academic activities held in NCKU, NSYSU and NCCU. and two other research groups: (1). The group of “Phenomenology and Methods of Gauge Field Theory” coordinated by Prof. Chuan-Hung Chen in NCKU. (2). Program on biosensor, coordinated by Prof. Min-Hsiung Tsai in NSYSU. Their reports will also be included in the “Highlights of the Programs”.

Outlook

Starting from April 2005 to the end of September, the Sub-Project II has supported nine workshops/series lectures as described in various focused/research groups. In the future, we will continue to support visitors and all academic activities proposed by focused groups and research teams which are based on the Sub-Project II. We also welcome all academic activities planned by other focused groups to be held in the southern Taiwan, especially to use the NCTS building as the venue

Starting from the 2006- project, the Sub-Project II will have a new principle investigator, Prof. Soon-Yi Wu, to replace the original one, Prof. Chien-er Lee, who will retire on next February. Prof. Wu has been a well-known mathematician and has made an impressive contribution on optimization. Together with Prof. Wei-Min Zhang, the organizer of the Physics Division and all enthusiastic colleagues, the Sub-Project II will surely have a great leap forward.

2. Mathematics Division

(Organizer: Prof. Soon-Yi Wu)

Mathematics division of subproject II has 3 focused groups. Since the most active researchers in optimization are in southern Taiwan, optimization has been focused as an important research area in the subproject II of NCTS. Each focused group of mathematics division in subproject II has proceeded quite well. From April 2005, the mathematics division of subproject II has held one international workshop on semi-infinite programming, and one workshop on graph colorings. One workshop on Functional Analysis is going to held in 2006. The National Cheng Kung University has offered two center scientists to promote the research in mathematics for subproject II.

Three focused groups for the mathematics division of the sub-project II of NCTS are:

Focused Group I: Algebra and Geometry

Chief Coordinator for 2005: Prof. Ying-Ji Hong

Coordinator for Algebra: Prof. Chin-Hung Lam

Coordinator for Geometry: Prof. Eugene Zhu Xia

Focused Group II: Analysis and Application

Chief Coordinator for 2005 Prof. Soon-Yi Wu

Coordinator for Optimization: Prof. Soon-Yi Wu

Coordinator for Analysis: Prof. Nagi-Ching Wong

Focused Group III: Applied Mathematics

Chief Coordinator for 2005: Prof. Xuding Zhu

Coordinator for Discrete Mathematics: Prof. Xuding Zhu

Coordinator for Differential Equations: Prof. Chi-Kun Lin

The organizers, chief coordinators and coordinators are for helping to promote the activities of the Mathematics Division of the sub-project II of NCTS.

2.1 Highlights of the Programs

2.1.1 Focus Group: Algebra and Geometry

A. Algebra Program

Coordinator: Ching Hung Lam

Our main goal is in 2005 is to improve the understanding between our members and to start some common research work.

The activities for our program at 2005 are as follows:

I. Weekly seminar

It started from Feb 2005 and over 15 talks have been given by now. Topics covered include vertex operator algebra, quantum error correcting codes and symplectic geometry.

II. Mini-course

An 8-hour mini-course titled “Groups of even order” was given by Professor Koichiro Harada of Ohio State University. The main content is on Brauer-Fowler program on characterizing finite simple group by the centralizer of its involutions. Many new and old ideas were discussed.

III. Foreign Visitors

There are 7 visitors from Jan 2005 – Sep 2005. Their activities can be summarized as follows:

Foreign Visitors	Activities	Date
Koichiro Harada, Ohio State	<ul style="list-style-type: none">• Discussion with C.H. Lam and W.F. Ke on research problems in finite group theory• An 8-hour mini-course “Groups of even order” and a talk “Group order formula” were given.	2/18- 3/15
T. Arakawa, Nagaya	<ul style="list-style-type: none">• Two talks on “Representations of W-algebras” were given.• Discussion with C.H. Lam and N. Lam on research problems in W-algebras and VOA	3/1- 3/14
Wei gen Yan, Academia Sinica	<ul style="list-style-type: none">• A talk titled “Enumeration of Perfect Matchings of Graphs” was given• Discussion with C.H. Lam and W.F. Ke on graph and lattice theory	6/22- 6/26
Winnie Li, Penn State	<ul style="list-style-type: none">• A talk titled “Low density parity check codes” was given	7/25- 7/26
Gernard Wendt, Linz	<ul style="list-style-type: none">• Discussion with W.F. Ke on near ring and design	7/26-7/31
Hubert Kiechle, Hamburg	<ul style="list-style-type: none">• Discussion with W.F. Ke on group theory and near ring• A joint paper was written	7/28-8/9
Christian Neumaier, Linz	<ul style="list-style-type: none">• A talk titled “Maximal subnear-rings of $M_0(G)$ and bijections generating $M_0(G)$” was given	8/9-8/17

IV. International Workshop

On Mar 2005, an international workshop on Algebra was held. The main theme was on ring theory and their applications. There were over 30 participants from 10 different countries, which included the winner of 1994 Fields Medal, Efm Zemanov.

B. Geometry

Coordinator: Eugene Xia

Eugene Xia has been running weekly student seminars at NCTS South on Commutative Algebra, Riemann Surfaces and Discrete Groups. In May 2005, NCTS South funded River Chiang to

attend a conference in Banff, Canada on Moment Maps in Various Geometries. NCTS South funded Eugene Xia for a trip to attend a Higgs bundle conference in Strasbourg, France and Basel, Switzerland in March 2005 and another trip to Shanghai, China to attend the Third Pacific Rim Conference on Mathematics during which he gave a presentation on the dynamics of the mapping class action on moduli spaces.

Future Activities:

Professor David Fisher of Indiana University plans to visit NCTS South in this academic year. He specializes in Lie Groups and Algebras. He plans to deliver lectures and hold discussion sessions at NCTS.

We also plan to invite Professor J-K Chen (National Taiwan University) to give lectures at the National Cheng Kung University.

There are also plans to invite Ser Tan Pew of National Singapore University during, Eugene Lerman of Australian National University, Viktor Ginzburg, of University of California, Santa Cruz and Henrique Bursztyn of the Fields Institute.

2.1.2 Focus Group: Analysis and Application

A. Optimization

Coordinator: Soon-Yi Wu

In this year, our researches mainly focus on the semi-infinite optimization problems. We held an international workshop on semi-infinite programming from August 24-27. The topics of this workshop included the theory, algorithms, and the applications of the semi-infinite programming. We had four international famous professors as the plenary speakers for the workshop. The names and the speech times of the four professors are as follows:

1. Prof. H. Th. Jongen (RWTH Aachen University, Germany)

Speech Title: On Gradient Flows in Global Optimization

2. Prof. E. Polak (University of California, Berkeley)

Speech Title: Reliability-Based Optimization Using Simple Average Approximations

3. Prof. Jan-J. Rückmann (Universidad de lasAméricas)

Speech Title: Kuhn-Tucker Constraint Qualifications in Generalized Semi-infinite Programming

4. Prof. Kok Lay. Teo (Curtin University of Technology)

Speech Title: Optmal Design of Complex FIR Filters with Arbitrary Magnitude and Group Delay Responses

We invited ten professors from Hong Kong, USA, Spain, Germany and Netherlands for the workshop. A special issue will be published by the Journal of Computational and Applied Mathematics for the workshop. This workshop is a very important for people doing research on semi-infinite optimization. The workshop had 25 speech titles in total, and more than 50 people

attendee the workshop.

Prof. Jane Ye of Victoria University, Canada paid a visit to our center from 14 to 28 May, 2005. During his visit, we had many discussions on generalizing semi-infinite programming problems. We have cooperated a manuscript entitled First Order Optimality Conditions for Generalized Semi-Infinite Programming Problems, which was submitted to SIAM Journal on Optimization. The titles of the four talks made by her are as the following:

- Lecture 1:
Mathematical Programs with Equilibrium Constraints, Bilevel Programming Problem and Their Applications
- Lecture 2:
Nonsmooth Optimization and Mathematical Programs with Equilibrium Constraints
- Lecture 3: Necessary and Sufficient Optimality Conditions for Mathematical Programs with Equilibrium Constraints
- Lecture 4: Quasiconvex Programming with Locally Starshaped Constraint Regions and its Application to Quasiconvex Program with Equilibrium Constraints

From November 2005 to March 2006, we also plan to invite Prof. S. C. Fang, and Prof. James R. Wilson of North Carolina State University, USA, and Prof. David Yang Gao of Virginia Tech University, USA, to pay their visits to our center. We will plan our research to collaborate with them in Optimization. Optimization will be focused as an important research area in sub-project II of NCTS.

Speeches:

■ Prof. James R. Wilson

Speech Title: Recent Advances in Output Analysis and Optimization for Discrete-Event Stochastic Simulation

■ Prof. David Yang Guo

Speech Title: Complete Solutions and Extremality Criteria to Polynomial Optimization Problems

B. Analysis

Coordinator: Nagi-Ching Wong

I. Highlights of the Program

(1) In the first half of year 2005, we have invited several analysts from aboard: Chi-Kueng Ng (China), Lisheng Shu (China), and Christian Neumaie (Austria). We will have more visitors in the second half year. The list includes Chris Phillips (USA), Nanjing Huang (China) and

Chi-Wai Leung (Hong Kong).

- (2) In October and December 2005, we will hold two workshops in functional analysis and operator theory. One of them is planned to be held in National Dong Hwa University at Hualien. The theme of them will emphasize on promoting new research problems and encouraging fresh PhD's and graduate students to join the activities.
- (3) A biweekly seminar series on functional analysis is held in National Sun Yat-sen University. Graduate students are invited to speak in the seminars. Postdoctoral fellows and young researchers are also welcome. The first two talks were given by Jyh-Shyang Jeang on local automorphisms and local derivations on operator algebras. Chin-Cheng Lin also gave a talk on boundedness of the Marcinkiewicz integral.
- (4) We are preparing an international conference on Jordan structures to be held in early 2006. This will be an important event in functional analysis and operator algebras. The list of invited speakers includes L. G. Brown (Purdue), L. J. Bunce (Reading), C-H. Chu (London), C. M. Edwards (Oxford), Y. Friedman (Jerusalem), Hwa-Long Gau (Taiwan), Liming Ge (Beijing and New Hampshire), Mark C. Ho (Taiwan), R. Iordanescu (Bucharest), J. M. Isidro (Santiago), J-S. Jeang (Taiwan), W. Kaup (Tübingen), C. W. Leung (Hong Kong), Bingren Li (China), Chin-Cheng Lin (Taiwan), Ying-Fen Lin (Taiwan), M. Mackey (Dublin), M. Neal (Denison), C. K. Ng (China), T. Nomura (Kyushu), A. M. Peralta (Granada), G. Roos (St. Petersburg), B. Russo (Irvine), S-Y. Shaw (Taiwan), M-H. Shih (Taiwan), L. Stacho (Szeged), H. Upmeyer (Marburg), N-C. Wong (Taiwan), P-Y. Wu (Taiwan), J-C. Yao (Taiwan), B. Zalar (Maribor), G. Zhang (Chalmers). We also expect a number of contributed talks from young analysts and graduate student, too.

2.1.3 Focus Group: Applied Mathematics

A. Discrete Mathematics

Coordinator: Xuding Zhu

1. From August 5th to Aug 6th, we organized a workshop on edge-coloring and graph decomposition. About 70 participants attended this workshop. The following lectures are given at the workshop. Graph decomposition and its Applications (傅恆林), An Analog of Alspach's Problem on Complete Bipartite Graphs (高金梅), A Survey of Ascending Subgraph Decomposition (胡維新), Some Problems in Graph Decomposition (林強), Decomposing Graphs into Specified Subgraphs (黃國卿), Rotational and Cyclic Cycle Systems (吳順良). This workshop introduces many open problems in the area of graph decomposition.
2. On Aug. 23rd, we organized a workshop on Quantum algorithms. Professor Guan introduced the basic ideas of quantum calculations, and Wong Yuanjin and Zhuan Shuoshuo presented some concrete examples of quantum algorithms.
3. We had a series of talks given by visitors and we also organized a series of student seminars.

4. In the coming semester, we will have many visitors. Professor Pavol Hell from Simon Fraser University will visit us from Dec. 8th to Dec. 13th. From Dec. 9th to December 13th, Professor Claude Tardif from Royal Mount College will visit us. From Dec. 19th to Dec. 23rd, we will have two visitors: Professor Douglas West from Illinois University at Urbana-Champaign and Professor Mike Albertson from Smith College. From Jan. 20th to Feb. 20th, Professor Daqing Yang from Fuzhou University and Professor Wensong Lin from South-East University will visit us for one month.
5. Through the many visits of researchers from abroad last year, and through the seminars and workshops, collaboration among local researchers and between local researcher and visitors are enhanced. We had quite a few joint papers finished, and further collaborations are carrying on.

B. Differential Equations

Coordinator: Chi-kun Lin; Chun-Kong Law

(I) Overview

This year, most of our activities are on partial differential equations, in particular, evolution equations. The main activities are the minicourse on dimensional analysis and Differential Equations given by Chi-Kun Lin, one of the coordinator, and a series of talks on stability of traveling waves given by Ming Mei of Concordia University. The visit of Ming Mei reacts well with the visit of Xinfu Chen, who is also an expert of traveling waves.

At both Cheng-Kung University and Sun Yat-sen University, we organize regular student's seminars on differential equations.

(II) Minicourse

This year we organized one minicourse on Dimensional Analysis and Differential Equations, lectured by Chi-Kun Lin (National Cheng-Kung University). In this course, he introduced the concept of dimensional analysis and applied this idea to study different kinds of differential equations. In particular, we will focus on the Riesz potential, Hardy-Littlewood-Sobolev inequality, and the related Sobolev type inequalities which are important in differential equations. The course helped to establish the intuition in various problems involving scaling and dimensions, e.g. similarity reduction, fundamental solutions. Lots of examples were given. There were about 20 researchers and students attending this mini-course. Detailed schedule is as follows:

1. 04/22/2005 14:10-16:00 (Prof. Lin, Chi-Kun)
Dimensional Analysis and Differential Equations (I)
2. 04/29/2005 14:10-16:00 (Prof. Lin, Chi-Kun)
Dimensional Analysis and Differential Equations (II)

3. 05/13/2005 14:10-16:00 (Prof. Lin, Chi-Kun)
Dimensional Analysis and Differential Equations (III)
4. 05/20/2005 14:10-16:00 (Prof. Lin, Chi-Kun)
Dimensional Analysis and Differential Equations (IV)

(III) Activities of Visiting Scholars

We also have a number of visitors this year. Besides giving talks and lectures, they have intensive discussions with researchers and students of the Center. We expect a number of good papers as a result of these deep discussions.

■ Ming Mei (Concordia University, Canada) 2005/5

Dr. Mei visited CTS for one month and gave a series of talks on “Nonlinear stability of reaction diffusion equations”. This model came from the biology, the blowfly problem in Australia for example, and was successfully modeled by Nicholson. See attached report of the visit. Detailed schedule is as follows:

1. 05/12/2005 13:10-15:00 (Prof. Mei, Ming)
Nonlinear stability of reaction diffusion equations (I, II)
2. 05/19/2005 13:10-15:00 (Prof. Mei Ming)
Nonlinear stability of reaction diffusion equations (III, IV)
3. 05/26/2005 13:10-15:00 (Prof. Mei, Ming)
Nonlinear stability of reaction diffusion equations (V, VI)
4. 06/02/2005 13:10-15:00 (Prof. Mei, Ming)
Nonlinear stability of reaction diffusion equations (VII, VIII)

Chi-Kun Lin (National Cheng-Kung University) 2005/3/7

1. Quasi-neutral limit of the quantum hydrodynamic equation

We consider the zero Debye length asymptotic of solutions of isentropic quantum hydrodynamic equations for semiconductors at nano-size and show that the current density consists of the divergence free vector field involved in the incompressible Euler equation and highly oscillating gradient vector field caused by the highly electric fields for small Debye length. This means that that the quantum effects possibly may not dominate the charge transport within the channel of semiconductor devices (for instance MOSFET) of nano-size for isentropic quantum fluids.

- Sally Shao (Cleveland State University, USA) 2005/5
 1. Asymptotic and numerical solutions for diffusion models for risk reserves.
 2. The leaky-integrator recurrent neural dynamics, the state space search algorithm and their applications.

- Ming Mei (Concordia University, Canada) 2005/5
 1. Nonlinear stability of reaction diffusion equations.

- William Ziemer (Indiana University, USA) 2005/5
 1. The topological measure theoretical analysis of the support of a Sobolev function (The material is a power point file and can be downloaded from the website of CTS.)

- Xinfu Chen (University of Pittsburgh) 2005/6
 1. Traveling waves of bistable/monostable dynamics
 2. The Allen-Cahn diagram and phase transitions

- Jun Zou (The Chinese University of Hong Kong) 2005/10
 1. Iterative Methods for solving Saddle-Point Systems and Electromagnetic Problems

2.2 Activities of on site scientists

The following scholars who were supported by NCTS to give talks in the international conference or to visits some research institutes aboard to do research.

Name	Affiliation	Time	Visit
River Meng-jung Chiang	NCKU	2005/05/21-2005/05/29	Moment maps in various geometries
Soon-Yi Wu	NCKU	2005/05/13-2005/05/22	Visit Prof. Jane Ye (Victoria Univ., Canada)
Li-Da Tong	NSYSU	2005/06/22-2005/07/01	2005 International and the Third Cross-Striat Conference on Graph Theory and Combinatorics
Yung-Fu Fang	NCKU	2005/06/24-2005/09/10	Visit Prof. Grillakis and Machedon, Univ. of Maryland
Jiaojiao Wu	NSYSU	2005/06/26-2005/06/30	2005 International and the Third Cross-Striat Conference on Graph Theory and Combinatorics

Eugene Zhu Xia	NCKU	2005/08/17-2005/08/21	Third Pacific Rim Conference on Mathematics
Jen-Chih Yao	NSYSU	2005/09/01-2005/09/08	Visit Prof. Franco Giannessi, Univ. of Pisa

2.3 Publications

■ In Preparation

1. K.W.Lih, C.Y.Lin and L.D.Tong, The cover problem of m -Mycielskian graphs and Kneser graphs, in preparation.
2. Pavol Hell and Xuding Zhu, On the Rainbow Chromatic Number of Graphs, in preparation.
3. Hong-Gwa Yeh, A note on circular colorings of edge-weighted directed graphs. In preparation.
4. Yung-Chih Lu and Hong-Gwa Yeh, On proteins with unique optimal foldings in the 2D HP model. In preparation.
5. Anthony T. Lau and Ngai-Ching Wong, “Disjointness and orthogonality preserving maps of Fourier algebras”, *in preparation*.

■ Preprints

1. T. S. Chen and C.H. Lam, Extension of tensor products of unitary Virasoro vertex operator algebras, preprint.
2. C. H. Lam and M. Miyamoto, Neimeier lattices, Coxeter elements and McKay E_8 observation on the Monster simple group, preprint.
3. W. F. Ke and H. Kiechle, Automorphisms of Certain Design Groups II, preprint.
4. Li-Shu Chen, Jyh-Shyang Jeang and Ngai-Ching Wong, “Disjointness preserving shifts on $C_0(X)$'s”, *preprint*.
5. Lawrence G. Brown and Ngai-Ching Wong, “Left quotients of a C^* -algebra, III: Operators on left quotients”, *preprint*.
6. Audrey Curnock, John Howroyd and Ngai-Ching Wong, “isometries of affine function spaces”, *preprint*.
7. L. C. Zeng, S.Y. Wu and J.C. Yao(2005),Proximal Method for General Mixed Quasi Equilibrium Problems, preprint
8. C. Ling, Q. Ni, L. Qi and S. Y. Wu (2005), A New Smoothing Newton-Type Algorithm for Semi-Infinite Programming,preprint.
9. M. Lopez, S. Y. Wu, C. Ling and L. Qi(2005), An Infinite-Dimensional Mathematical programming Approach to Separation in $L_p(X,A,u)$, preprint.
10. Xinfu Chen, Y.H. Cheng and C.K. Law, Reconstructing potentials using zeros of

one eigenfunction, preprint.

■ Submissions

1. C.H. Lam, S. Sakuma and H. Yamauchi, Ising vectors and automorphism groups of commutant subalgebras related to root systems, submitted.
2. Sandi Klavzar, Tsai-Lien Wong and Xuding Zhu, Distinguishing sets of graphs and group actions. Submitted.
3. Sandi Klavzar, Tsai-Lien Wong and Xuding Zhu, Distinguishing labelings of group action on vector spaces and graphs. Submitted
4. Daniel Kral, Li-Da Tong and Xuding Zhu, Upper Hamilton numbers and Hamilton spectra of graphs, Submitted.
5. Daphne Liu and Xuding Zhu, Fractional Chromatic Number of Distance Graphs Generated by Two-Interval Sets. Submitted.
6. Yin-Fen Lin and Ngai-Ching Wong, “Compact disjointness preserving maps of continuous functions”, *submitted to Studia Math.*
7. Jung-Hui Liu, Ngai-Ching Wong and Jen-Chih Yao, “Local automorphisms of operator algebras”, *submitted to Illinois J. Math.*
8. Man-Chung Ng and Ngai-Ching Wong, “A non-compact approach to the duality between prior beliefs and trading demands”, *submitted to J. Economics Theory.*
9. S. J. Li, S. Y. Wu, K. L. Teo and X. Q. Yang and S. Y. Wu, Robust Envelop-constrained Filter with Orthonormal Bases and Semi-Definite and Semi-Infinite Programming, submitted to *Optimization and Engineering.*
10. S.C. Fang, S. Y. Wu, and S. Ilker Birbil, Solving Variational Inequalities Defined on a Domain with Infinitely Many Linear Constraints, submitted to *Computational Optimization and Applications.*
11. S. Y. Chen and S. Y. Wu , Algorithms for Semi-infinite Transportation Problem, submitted to *Journal of Optimization Theory and Applications.*
12. J. Ye and S. Y. Wu (2005), First Order Optimality Conditions for Generalized Semi-Infinite Programming Problems, Submitted to *SIAM Journal of Optimization.*
13. C.N. Chen, L.F. Cheung, Y.S. Choi and C.K. Law, Integrability of rotationally symmetric n-harmonic maps, submitted.

■ Under Revision

1. Gerard J. Chang and Li-Da Tong, The Hamiltonian Property of Multi-loop Network, under revision.
2. S. J. Li, S. Y. Wu, K. L. Teo and X. Q. Yang, A solution Method for Generalized Semi-Infinite Programming, *submitted to Optimization Methods and Software*.

■ Accepted Papers

1. K.W. Lih, C.Y. Lin and L.D. Tong, On an interpolation property of outerplanar graph, *Discrete Applied Math.*, accepted.
2. Sandi Klavzar and Xuding Zhu, Cartesian powers can be distinguished by two labels. . *European Journal of Combinatorics*, to appear.
3. Ngai-ChingWong, Triple homomorphisms of operators algebras, *Southeast Asian Bulletin of Math.*, to appear.
4. Lu-Chuan Zeng, Ngai-Ching Wong, and Jen-Chih Yao, Strong convergence theorems for strictly pseudocontractive mappings of Browder-Petryshyn type, *Taiwanese J. Math.*, to appear.
5. Lai-Jiu Lin, Ngai-Ching Wong and Zenn-Tsuen Yu, “Continuous selections and fixed points of multi-valued mappings on non-compact or non-metrizable spaces”, *Proc. Amer. Math. Soc.*, to appear.
6. Lu-Chuan Zeng, Ngai-Ching Wong and Jen-Chih Yao, “On the convergence analysis of modified hybrid steepest-descent methods with variable parameters for variational inequalities”, *J. Optimization Theory and Application*, to appear.
7. Lu-Chuan Zeng, Ngai-Ching Wong and Jen-Chih Yao, “Convergence of hybrid steepest-descent methods for generalized variational inequalities”, *Acta Math Sinica (english series)*, to appear.
8. Yen-Cherng Lin, Ngai-ChingWong and Jen-Chih Yao, “Strong Convergence Theorems of Ishikawa Iteration Process With Errors For Fixed points of Lipschitz Continuous Mappings in Banach Spaces”, *Taiwanese J. Math.*, to appear.
9. L. C. Zeng, G. M. Lee and Ngai-Ching Wong, “Ishikawa Iteration with Errors for Approximating Fixed Points of Strictly Pseudocontractive Mappings of Browder-Petryshyn Type”, *Taiwanese J. Math.*, to appear.
10. Ngai-Ching Wong, “The triangle of operators, topologies and bornologies”, in the Proceedings of the 2nd International Congress of Chinese Mathematicans, to appear.
11. Jung-Hui Liu and Ngai-Ching Wong, “2-Local automorphisms of operator algebras”, *J. Math.*

Anal. Appl., to appear.

12. S. Y. Wu, D. H. Li, L. Qi and G. Zhou(2005), An Iterative Method for Solving KKT System of the Semi-Infinite Programming, to appear in *Optimization Methods and Software*.
13. C. Ling, L. Qi, G. Zhou and S. Y. Wu(2005), Global Convergence of a Robust Smoothing SQP Method for Semi-Infinite Programming, to appear in *Journal of Optimization Theory and Applications*.
14. S. J. Li. K. L. Teo, X. Q. Yang and S. Y. Wu(2005), Gap Functions and Existence of Solutions to Generalized Vector Quasi-Equilibrium Problems, to appear in *Journal of Global Optimization*.
15. S. J. Li, S. Y. Wu, X. Q. Yang and K. L. Teo (2005), A Relaxed Cutting Plane Method for Semi-Infinite Programming, to appear in *Journal of Computational and Applied Mathematics*.
16. L. C. Zeng, Q. H. Ansari and S. Y. Wu, Strong Convergence Theorems of Relaxed Hybrid Steepest-Descent Methods for Variational Inequalities, to *appear in Taiwanese Journal of Mathematics*.
17. Y.H. Cheng and C. K. Law, On the quasinodal map for the Sturm-Liouville operator, Proc. Royal Soc. Edinburgh, series A, to appear (2005). (SCI)
18. Z.C. Li, C.S. Huang and R.C.D. Chen, Interior boundary conditions in the Schwarz alternating method for the Trefftz method, Engineering Analysis with Boundary elements, to appear (2005). (SCIE)
19. H.Y. Hu, Z.C. Li and A.H.D. Cheng, Radial basis collocation methods for elliptic boundary value problems, Inter. J. Computers & Mathematics with Application, to appear (2005). (SCI)
20. Z.C. Li, Y.L. Chan, G.G. Georgiou and X. Xenophotos, Special boundary approximation methods for Laplace equation problems with boundary singularities (application to Motz problem), Inter. J. Computers & Mathematics with Applications, to appear (2005). (SCI)
21. H.T. Huang, Z.C. Li and A. Zhou, New error estimates of biquadratic Lagrange elements for Poisson's equation, accepted by Applied Numerical Mathematics, to appear (2005). (SCI)
22. H.Y. Hu and Z.C. Li, Collocation methods for Poisson's equation, Computer Methods in Applied Mechanics and Engineering, to appear (2005). (SCI)
23. H.T. Huang and Z.C. Li, Effective condition number and superconvergence of the Trefftz method coupled with high order FEM for singularity problems, Engineering Analysis with Boundary elements, to appear (2005). (SCI)

24. Z.C. Li, Algorithms for curve image under geometric transformations, Inter. J. Information, to appear (2005).

■ Papers Appeared

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2. Yin-Fen Lin and Ngai-Ching Wong, “Power compact disjointness preserving maps of continuous function spaces”, *Bulletin of the Irish Mathematical Society*, 55 (2005), 7–14.
3. Y.H. Cheng, C.T. Shieh and C.K. Law, A vectorial inverse nodal problem, Proc. Amer. Math. Soc., Vol. 133, no.5, 1475-1484 (2005). (SCI)
4. C.C. Chen, C.K. Law and F.Y. Sing, Optimal lower estimates for eigenvalue ratios of Schrodinger operators and vibrating strings, Taiwanese J. Math., Vol. 9, no.2, 175-185 (2005). (SCI)
5. Z.C. Li, T.T. Lu, H.Y. Hu and A.H.D. Cheng, Particular solutions of Laplace’s equations on polygons and new models involving mild singularities, Engineering Analysis with Boundary Elements, Vol. 29 (1), 59-75 (2005). (SCIE)
6. T.T. Lu and Z.C. Li, The cracked-beam problem solved by the boundary approximation method, Applied Mathematics Letters, Vol. 18 (1) 11-16 (2005). (SCI)

3. Physics Division

3.1 Academic Executive Committee

The Academic Executive Committee (AEC) for the physics division consisted of the division head plus coordinators of each focused/research group which are based on Sub-Project II and representatives from the National Cheng Kung University, the National Sun Yat-Sen University and the National Chung Cheng University

Ching Cheng (鄭靜) (National Cheng Kung University)

Rue-Ron Hsu (許瑞榮) (National Cheng Kung University)

Tsan-Chuen Leung (梁贊全) (National Chung Cheng University).

Min-H. Tsai (蔡民雄) (National Sun Yat-Sen University)

Shiow-Fon Tsay (蔡秀芬) (National Sun Yat-Sen University)

Chuan-Hung Chen (陳泉宏) (National Cheng Kung University)

Chopin Soo (許祖斌) (National Cheng Kung University)

Wei-Min Zhang (張為民)/ Yan-Ten Lu(盧炎田)(National Cheng Kung University)

The obligations of AEC include nominating candidates for center scientists, recruiting postdocs, making decisions on extra funding requested by focused/research groups for visiting scientists and overseas travels to conferences/workshops for graduate students and faculty members from related institutions, and suggesting improvements to academic activities organized by various focused/research groups. The above nominated candidates and extra funding requested are then submitted to the principle investigator for support and further processes

3.2 Highlights of the Programs

3.2.1 Focused Group: Quantum Information Science

Committee member:

Wei-Min Zhang (National Cheng Kung Univ., Chairman), Hsi-Sheng Goan (Nat'l Taiwan Univ.), Chih Long Chou (Chung Yuan Christian Univ.), Pochung Chen (Nat'l Tsing Hwa Univ.), Der-San Chuu (Nat'l Chiao Tung Univ.), Zheng-Yao Su (Nat'l Center for High-Performance Computing), Chopin Soo (Nat'l Cheng Kung Univ.)

Objectives

Quantum Information Science (QIS) is a very new emerging research and education frontier that has generated a great deal of interest and stimulated novel potential applications in the last few years. It combines and draws on the disciplines of physical science, mathematics, computer science, and engineering. Its aim is to understand how certain fundamental laws of quantum physics can be harnessed to dramatically improve the storage, processing and transmission of information.

Quantum physics, information theory, and computer science are among the crowning intellectual achievements of the past century.

The QIS focus program supported by National Center for Theoretical Science will build a platform of communication for researchers in this area. We have established associations and cooperation other researchers all over Taiwan; and will seek to establish links and exchanges other QIS researchers and activities worldwide. We believe this national program will be joined by many other local researchers in the near future. Although Taiwan has yet to make its mark on the subject internationally, many local researchers are already working on areas bordering on QIS, both theoretically and experimentally. We believe with strong support and encouragement; with the appropriate alignment of theoretical and experimental personnel, by learning from others, by exchanging scholars and information with other institutions; and last but not least - by closely integrating QIS research with Taiwan's commitment, we will be able to ramp up quickly to realize Taiwan's potential in QIS, and to compete on equal footing with other nations in this exciting frontier.

To achieve the above objectives, a program committee has been formed for the year of 2005. Its mission includes selection of research topics, budget allocation, and invitation of long-term visitors and recommendation of candidates for exchange programs. The current members and their specializations are:

Wei-Min Zhang (NCKU), quantum dot quantum computers (Theory)

Hsi-Sheng. Goan (NTU), silicon-based quantum computer, decoherence (Theory)

Chih Long Chou (CYCU), quantum communication (Theory)

Pochung Chen (NTHU), quantum dot quantum computer (Theory)

Der-San Chuu (NCTU), cavity QED, quantum dot (Theory & Experiment)

Zheng-Yao Su (NCHC), quantum algorithms (Theory)

Chopin Soo (NCKU) quantum entanglement, fundamental quantum physics (Theory)

The committee meeting will be held once every two month. The first committee meeting was in April at National Cheng Kung University. The Second committee meeting held in June at National Taiwan University.

Outlines of Activities

With the budget of about 2 million TWD for the academic year 2004-2005, the committee has decided to support for a post-doc researching position. This position had granted to Dr. Lee, Min-Chung. He is current working on the theory of decoherence process. The budge for this hiring is about 850,000 TWD.

In order to provide a communication platform from QIS researchers in Taiwan, we plan to

have a small workshop every two months. The first workshop was held on June 10 and 11 at national Taiwan University, hosted by Hsi-Sheng Goan. The second workshop was held in September 23 at National Tsing Hwa University. Pochung Chen and Zeng-Yao Su hosted this workshop.

We are planning a QIS winter school in December 2005. The list of candidates of inviting speakers including Prof. Lu Jeu Sham (UC San Diego, USA), Prof. Hoi-Kwong Lo (U. Toronto, Canada), Prof. Bei Lok Hu (U. Maryland, USA), Prof Artur Ekert (NUS, Singapore) and Prof. Francesco Petruccione (South Africa).

Progress

1. The first workshop was held on Jun 10 – 11 at National Taiwan University hosted by Hsi-Sheng Goan. The inviting speakers and their topics were:

- Prof. Todd A. Brun (University of Southern California)
"Weak Quantum Measurements Are Universal"
- Prof. Bei-Lok Hu (University of Maryland)
"Non-Markovian Quantum Decoherence and Error Correction -- the regime which really counts for quantum computer designs"
- Dr. Chung-Hsien Chou (Academic Sinica)
"Non-Markovian Dynamics of Quantum Decoherence and Disentanglement"

The following shows the speakers and part of the participants of this workshop.



2. The second workshop was held on September 23 at National Tsing Hua University hosted by Pochung Chen and Zeng-Yao Su. The inviting speakers and their topics were:

- Prof. Ray-Kuang Lee (NTHU)
"Continuous-Variable Entangled Solitons"
- Dr. Kentaro Kato (Tamagawa University, Japan)
"Quantum Cryptography"
- Prof. Pochung Chen (NTHU)
"Non-Markovian approach to the quantum open system"

3. Seminars on QIS held in NCTS/South

Date	Speaker	Title
2005/02/22	Prof. Min-Sheng Wang Department of Physics, National Central University	Validity of the postulates of quantum mechanics - A study based on von Neumann measurement theory
2005/03/07	Prof. Ite Albert Yu Department of Physics, National Tsing Hua University	Storage and retrieval of photonic information - from electromagnetically induced transparency to reduction of the light speed
2005/03/14	Prof. Shun-Jen Cheng Department of ElectroPhysics, National Chiao Tung University	Excitonic artificial atoms: Photoexcited self-assembled semiconductor quantum dots
2005/03/16	Photon Entanglement Topical Discussion	Three Photon Entanglement
2005/03/21	Prof. Chuan-Pu Liu Department of Material Science and Engineering, NCKU	QIS group meeting on Quantum Dots experiments
2005/03/22	Photon Entanglement Topical Discussion	The properties of optical components for preparing an entanglement photon pair
2005/03/23	Prof. Zheng-Yao Su National Center for High-performance Computing	QIS Theory Group Discussion : Algebraic invariants their applications in QIS
2005/03/28	Prof. Chi-Shung Tang National Center for Theoretical Sciences	From Dynamical Transport to Spin Quantum Bits
2005/03/29	Photon Entanglement Topical Discussion	Entanglement Photon from femtosecond laser

2005/04/11	張文豪 博士 Department of Physics, National Central University	Single-mode single-photon sources based on single quantum dots in photonic crystal nanocavities
2005/04/18	Quantum Dots Group Meeting	The latest experimental progress
2005/04/19	劉如芬 同學 Department of Physics, NCKU	Photon Entanglement Topical Discussion : Introduction to mixed state entanglement - the basic
2005/04/26	Prof. Po-Chung Chen Department of Physics, National Tsing Hua University	Dynamical Decoupling for Pedestrians
2005/05/02	Dr. Shu-Hui Tsai Institute of Physics, Academia Sinica	Noise measurement in qubits readout
2005/05/03	Photon Entanglement Topical Discussion Department of Physics, NCKU	Current status of photon down-conversion
2005/05/16	Prof. Ikai Lo Department of Physics, National Sun Yat-Sen University	Application of GaN-based Semiconductors in Spintronics: Spin-polarized Field Effect Transistor
2005/05/23	Prof. Watson Kuo Department of Physics, National Chung Hsing University	Toward single charge detection
2005/05/30	Prof. Hsi-Sheng Goan Department of Physics, National Taiwan University	Quantum Technology
2005/06/06	QIS Group Meeting : 林俊鈺同學 Department of Physics, NCKU	Decomposition of the Density Matrix
2005/06/13	Prof. Bei-Lok Hu University of Maryland	Non-Markovian Decoherence and Error Prevention by Dynamical Decoupling
2005/06/20	Prof. Todd Brun University of Southern California	Quantum trajectories and the flow of information
2005/06/29	Quantum Dots Group Meeting	Quantum Dots Group Meeting

2005/09/19	Prof. Pi-Gang Luan Institute of Optical Sciences, National Central University	Anomalous refraction in photonic crystals
2005/09/21	Quantum Dots Group Meeting	The latest experimental progress
2005/09/26	Prof. Wei-Min Zhang Department of Physics, NCKU	Free Spin Quantum Computer
2005/10/03	Dr. Ying-Cheng Chen Institute of Atomic and Molecular Sciences, Academia Sinica	Exploring the ultracold world
2005/10/13	Prof. Jaw-Shen Tsai Laboratory Head, Macroscopic Quantum Coherence Lab, Riken; & Research Fellow, Fundamental Research Laboratories, NEC, Japan	Josephson Multi-Qubit Systems

4. “Quantum Decoherence in Solid-state qubits” Reseach report by Ming Tsung Lee

My research interests are primarily in the related field of quantum information physics containing: Physical realizations of quantum information, mechanism and control of quantum decoherence, and quantum measurement. This field has attracted much attention for practical applications in quantum information science in recent years. Quantum decoherence is mainly induced by the interaction of a microscopic system coupled with its environment. The non-unitary evolution of the system destroys the purity of quantum states, quantum interference and quantum entanglement, and leads to information loss toward the environment.

Recently, some investigations of quantum decoherence have been focused on the decoherence induced by quantum measurements and the controls of quantum decoherence. For the implementation of realistic quantum information processors, these studies become the most champion works in the field. In the solid-state quantum computer with charge qubits, qubit measurements can be realized by the charge qubit coupled with sensitive electrometers such as quantum point contacts (QPC) and single-electron transistors. I have been researching on the quantum measurement of a single-electron in coupled quantum dots (a charge qubit) by a QPC and the dynamical non-equilibrium effect of the QPC on the decoherence of the charge qubit.

To study the quantum decoherence induced by quantum measurement, the condition of the perfect heat bath is usually introduced to simplify the problem in literatures. However, practically, this condition is not guaranteed at mesoscopic scale. The non-equilibrium effect from the heat bath should be taken into account. For the QPC, the non-equilibrium effect could be induced by

the electron accumulation (EA) in reservoirs. I have developed a perturbation scheme to take the EA effect into account [1]. The character of the EA in terms of the analytic EA number and the quantum decoherence of the measured single electron in coupled dots under the EA effect are studied in the framework. The theory shows that the EA can induce an extra relaxation to the qubit decoherence. However, the influence of the EA effect to the decoherence rate depends on the bias-assistance in the QPC.

■ 2006 Workplan

1. 2006 QIS workshop:

National-wide every two-year QIS workshop will be held by QIS focus group in 2006. Estimated participants are around 150 people.

2. International and national exchange visitors on QIS.

- a. Short-term (within a week) international visitors: 4 to 6 people
- b. Summer (two-months) visitors in NCTS/south
- c. Support students and Postdocs to attend the second Asia-pacific conference on QIS held in Korean in 2006

3. Postdoc for QIS

Dr. Ming-Tsung Lee, will be hired continuously as a NCTS/south Postdoc for one more year. His research field: quantum decoherence and quantum dot quantum computer. We also hope to recruit one more postdoc. to strengthen and cultivate the young scientist in this field.

4. Participants (anyone else who is working on QIS and would like to join the group is very welcome)

Chia Chu Chen (NCKU), quantum optics and photon entanglement (Th.)

Ching Cheng (NCKU), quantum dot quantum computer (Th.)

Chien-Er Lee (NCKU), quantum teleportation (Th.)

Chuan Pu Liu (NCKU), quantum dot quantum computer (Exp.)

Yan-Ten Lu (NCKU), quantum dot quantum computer (Th.)

Chopin Soo (NCKU), quantum entanglement, quantum dots (Th.)

Chin Chun Tsai (NCKU), photon entanglement and optical lattice (Exp.)

Wei-Min Zhang (NCKU), quantum dot quantum computers (Th.)

Chi-Yee Cheung (AS), quantum cryptography (Th)

Chii-Dong Chen (AS), quantum single electron transistors (Exp.)

Pochung Chen (NTHU), quantum dot quantum computer (Th.)

Yueh Nan Chen (NCTU) cavity QED, quantum dot quantum computer (Th.)

Der-San Chuu (NCTU) cavity QED, quantum dot quantum computer (Th. & Exp.)

Jin-Yuan Hsieh (MHUST) Quantum algorithms (Th)

Li-Yi Hsu (CYCU), quantum communication (Th.)

Chih Long Chou (CYCU), quantum communication (Th.)

Zheng-Yao Su (NCHP), quantum algorithms (Th.)

Hai-Sheng. Goan (NTU), silicon-based quantum computer, decoherence (Th.)

Waston Kuo (NCCU), Superconducting quantum computer (Exp.)

Dian Jiun Han (CCU), Optical Lattice quantum computer (Exp.)

Note: 1) weekly seminars mainly for two groups located in south and north, respectively.

2).monthly meetings and mini-workshops are national-wide. All participants have the responsibility to organize these activities.

3.2.2 Focused Group: Low-Dimensional Systems and Nanostructures

Committee members: Ching Cheng (Nat'l Cheng Kung Univ., chairman), Min-Fa Lin (Nat'l Cheng Kung Univ.), Tsan-Chuen Leung (Nat'l Chung Cheng Univ.), Shioh-Fon Tsay (Nat'l Sun Yat-sen Univ.)

Objectives

The main purpose of the focus group on low-dimensional systems and nanostructures is to promote interaction and collaboration among members (as well as their graduate students and postdoctors) of this group towards possible integration of the available research methods as well as manpower in exploring low-dimensional systems and nanostructures. In spite of a great diversity of the systems covered by the low-dimensional systems and nanostructures, the focuses of the group are mainly on, but not restricted to, the physical properties of nanostructures, e.g. the carbon related nanostructures, and their confinements in a 2D potential, e.g. the assembly of nanoparticles on surfaces or trapped atoms in a 2D optical lattice. The formation of this focus group was especially urged by the previously already existing collaborations between some participants of the group to activate a wider and stronger scope of interactions through both regular and well-designed meetings.

Outlines of activities

The supported budget for this focus group is 500K TWD. As this is the first year of the focus group, some of the activities are designed to promote interactions between the researchers in the field. The activities held by the group include 1) either regular talks or a series of talks on a focused topic 2) study-group meetings on specialized topics 3) mini-school 4) workshops 5) short-term visitors. The subjects of the workshops and mini-school have attracted many more interested participants than we originally expected. The group members benefit much from the enthusiastic discussions in the meetings. Due to the limit on both time and budget, extension of the interactions and possible collaboration with distinguished overseas groups will be one of the objectives of the group in the next year. The activities are summarized in the following:

Short-term visitors

Four short-term visitors to the NCTS(South) were offered to promote interactions and collaboration between members of the group. Two are in the field of nanocarbon systems, i.e. Cheng-Peng Chang of Tainan Woman's College of Arts & Technology and Rong-Bin Chen of National Kaohsiung Marine Univ., and the other two are in the field of quantum transport theory for nanosystems, i.e. Yueh-Nan Chen of Nat'l Chiao-Tung Univ. and Shih-Jye Sun of Nat'l Univ. of Kaohsiung while the former (YN Chen) also specializes in applying nanoscale systems to the possible implementations of quantum computers. Their visiting time was focused in July and August in order to promote intensive interactions and establish possible collaboration.

Workshop of "Low-dimensional nanomaterial physics for Young researchers"

We have held a *workshop of "Low-dimensional nanomaterial physics for Young researchers"* (organized by Min-Fa Lin) to provide the opportunities for young researchers in this field, not restricted to the theoretical ones, to get to know each other's works and establish possible links. Seventeen speakers were invited from groups all over the country which work on Low-dimensional and nanomaterials in this two-day workshop while the number of participants went up to 86 as many members in the speakers' research groups also took part in the meeting. The workshop therefore provides a great opportunity of exchanging research ideas and methods between different groups in this field.

Nanocarbon workshop

A "*Nanocarbon workshop*" (organized by Min-Fa Lin) will be held in early September. Sixteen invited speakers, including both experimental and theoretical ones, whose expertise is on the nanocarbon systems will present their latest research products. The emphasis is not only on the interactions between theoretical researchers of the field but also on those between the experimental and theoretical ones as strong interactions and possible collaboration between the experimental and theoretical workers usually leads to high-quality works.

Mini-school on photonic crystal

There have been regular study-group meetings on the topic of photonic crystals for a few months and they called for a "*Mini-school on photonic crystal*" (organized by Tsan-Chuen Leung) that was held in mid-August. The school consists of four one-hour lectures given by prof. Pi-Gang Luan (Nat'l Center Univ.) distributed in two half-day sessions which allows participants to have chances of discussions in between as well as with the lecturer. This mini-school, to our surprise, has attracted more than one hundred registrations. The four lectures have been designed to cover subjects from introductory and necessary background materials to the in-depth discussions of the latest research topics in the field, e.g. the fundamental theory and debates for the systems with negative refraction index and their possible applications through nanoscale systems.

■ 2006 Workplan and Budget

● Members of the focus group

林明發 (coordinator)	Min-Fa Lin	成功大學物理系	mflin@mail.ncku.edu.tw
張振鵬	C. P. Chang	台南女子技術學院通識中心	t00252@ms.twcat.edu.tw
陳榮斌	R. B. Chen	高雄海洋大學通識中心	rbchen@mail.nkmu.edu.tw
鄭靜	Ching Cheng	成功大學物理系	ccheng@phys.ncku.edu.tw
李進榮	Chin-Rong Lee	中正大學物理系	phycrl@ccu.edu.tw
李道聖	T. S. Li	崑山科技大學電機系	tsli@mail.ksut.edu.tw
梁贊全	Tsan-Chuen Leung	中正大學物理系	tleung@phy.ccu.edu.tw
林財鈺	Chai-Yu Lin	中正大學物理系	lincy@phy.ccu.edu.tw
盧炎田	Yin-Tin Lu	成功大學物理系	ytlu@mail.ncku.edu.tw
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孫士傑	Shih-Jye. Sun	高雄大學應物系	sjs@nuk.edu.tw
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蔡炎熾	Yan-Chr Tsai	中正大學物理系	tyan@phy.ccu.edu.tw
蔡秀芬	Shiow-Fon Tsay	中山大學物理系	tsaysf@mail.nsysu.edu.tw

● Topics of focus

1. Carbon-related nanostructures

The discovery of C_{60} and carbon nanotubes is one of the most exciting achievements in material science for the late 20th century. Not only are the structures beyond the previous conventional conjectures, the elastic, electronic, optical, and thermal properties of these carbon phases are also very different from the familiar bulk materials. They can be seen as the prototypes of low-dimensional systems. Symmetry also plays an extremely important role in deciding the physical properties of the systems. The nanosizes of these systems provide the best candidates for studying collective excitations, which are more pronounced, and their special geometries, e.g. the tubes and toroids, support extra quantum numbers, e.g. the quantum flux. Some of the members of the focus groups (MF Lin, CP Chang, RB Chen, TC Leung, FL Shyu, SJ Sun) are experienced in the study of the electric, quantum transport, field-emission, optical, and magnetic properties of carbon-related nanostructures, e.g. nanotubes and CN compounds. The focus group should promote interaction and collaboration among members of this group for integrating the available research methods as well as manpower in exploring carbon-related nanostructures.

2. Nanoparticles on semiconductor surfaces and in bulks

Nanoparticles on semiconductor surfaces form various interesting phases. It is resulted from the complex many-body effects between nanoparticles and the surfaces as well as between nanoparticles on the surfaces. In addition to the order and disorder phases, it has long been recognized that the 2D incommensurate phases can frequently be induced in

these systems involving restructuring of the supporting surfaces. This is, again, due to the competing interactions between the nanoparticles-surface and the nanoparticle-nanoparticle factors. The systems can be even more interesting when the nanoparticles carry magnetic moments and the additional degree of freedom, spin, comes into play.

Nanoparticles in semiconductor bulks are usually denoted as quantum dots. Quantum dots, in addition to the applications for the on-going semiconductor devices, e.g. LED and Laser, are considered as one of the most promising candidates for quantum devices in quantum computers. However, studies for most of the intrinsic physical properties, e.g. incoherent time, of quantum dots as well as those when quantum dots are under designed conditions for implementing quantum-gate processes are still in the early stage. In this part of focus, close interactions and collaborations with the Quantum-Information focus group will be established to benefit both groups on the possible applications of the quantum dots for the quantum devices.

● **The planned activities and budget estimate**

1. .a program-wide workshop for the focused group on low-dimensional systems and nanostructures
2. short-term visits of 2 distinguished foreign scientists and the corresponding mini-schools
3. short-term and/or long-term visits of domestic scientists
4. 2 study-group meetings
5. two mini-schools
6. Funding for traveling: 3 junior members to attend international workshop or school

3.2.3 Program: Phenomenology and Methods of gauge field theories

Coordinator: Chuan-Hung Chen

Activities

The main activities of the theoretical group of NCTS/South are performed by the style of regular seminars weekly. The invited speakers contains various areas in theories and experiments, such as those who work on the theory of relativity related, the experiment of neutrino, astrophysical tau neutrinos, cosmology, black holes, jet physics, chiral dynamics in hadron, string theories and symmetries etc. The information could be found at <http://www.ncts.ncku.edu.tw/>.

Since this year is the world year of physics for commemorating the pioneering contributions of Albert Einstein in 1905, we organized a series of lectures on general/special relativity so that the students could have the opportunity to understand the work of A. Einstein in 1905. We invited Dr. Xiao-Ning Wu, who is a postdoctor of NCU and an expert on this area, to give 6 lectures to introduce the theory of relativity to the undergraduate and graduate students. Since most audiences

are students and the people those who are not familiar with general relativity, the lectures are forced on introductory level. The contents of lecture include a brief historical introduction, elements of special relativity, elements of general relativity, exact solution and a special topic. For the special topic, Dr. Wu gave an example concerning the thermodynamics of black hole as the ending. The lecture notes could be found at <http://www.ncts.ncku.edu.tw/phys/lecture.htm>.

In summer, we had 4 short-term visitors. They are Prof. Yaw-Hwang Chen (KSUT) and Prof. I. C. Yang (NTTU) who both work on biophysics and his collaborator is Prof. Su-Long Nyeo (NCKU); Prof. Tsung-Wen Yeh (NTTC) and Prof. Chien-Wein Hwang (NKNU) who both work on B physics, the former studies the PQCD approach and the latter uses the light front relativistic quark model. Prof. Yang and Prof. Yeh only stayed NCTS for two weeks and one week, respectively. The remains will visit NCTS for three months.

Progresses

Since the puzzled polarization fractions of $B \rightarrow \phi K^*$ decays are observed at BELLE and BABAR, many mechanisms have been proposed to solve the problem in the literature. Prof. Chuan-Hung Chen and his collaborator Prof. Chao-Qiang Geng proposed that a new scalar interaction with flavor changing neutral current could enhance the transverse polarization so that the branching ratios and polarization fractions could match with the experimental data. The paper has been published in Physical Review D.

To search the other possible anomaly polarizations in B decays, Prof. Chuan-Hung Chen, Prof. Chao-Qiang Geng, Dr. Y-K Hsiao and Dr. Z-T Wei studied the cases in the production of p-wave axial vector bosons such as $B \rightarrow K_1 \phi$ decays where K_1 could be $K_1(1270)$ and $K_1(1400)$, by the generalized factorization approach. They find that the branching ratios of $B \rightarrow K_1^* \phi$ are similar to those of $B \rightarrow K \phi$ while the branching ratios of $B \rightarrow K_1(1270) \phi$ and $B \rightarrow K_1(1400) \phi$ are $O(10^{-5})$ and $O(10^{-6})$, respectively. In terms of the observation of $B \rightarrow K_1(1270) \gamma$ by BELLE, we can remove the sign ambiguity in the mixing angle for physical states $K_1(1270)$ and $K_1(1400)$. In addition, They analyze annihilation contributions in the decays $B \rightarrow K_1 \phi$ and conclude that the effects could be neglected. The results have been published in Physical Review D.

Prof. Yaw-Hwang Chen and Prof. Su-Long Nyeo are studying the simple limiter on controlling chaos. The generator of chaos was implemented by metal-oxide-semiconductor negative-differential resistance MOS-NDR) circuit. With a simple limiter, the chaotic electronic circuit will go into a stable periodic trajectory. Therefore, it is a frequency divider. In addition, Prof. Chen and Prof. Nyeo are also working on the diffusion entropy method to analyze Human's DNA sequences. The diffusion entropy analysis (DEA) is able to yield the correction scaling, even when the observed diffusion process is not Gaussian. Under the DNA walk model they use the DEA to study the scaling properties of human DNA sequence. They find that the scaling characters of human DNA sequences is different from Gaussian and the long-time scale is Levy.

3.2.4 Program: Biosensor

Coordinator: Min-Hsiung Tsai, Department of Physics, National Sun Yat-Sen University

Invited Visitors: Daniel Murray, Associate Professor of the University of British Columbia, Okanagan, British Columbia, Canada from 7/7/2005 to 7/14/2005.

Klaus H. Ploog, Director, Paul Drude Institute for Solid State Electronics, Berlin, Germany 10/3/05.

Achim Trampert, Professor of Paul Drude Institute for Solid State Electronics, Berlin, Germany 10/3/05.

Michael Heuken, Vice President, AIXTRON company. 10/4/05.

Volker Haerle, Head of the R&D Department, OSRAM company. 10/4/05.

Progresses:

1. Calculations of the electronic structures of the self-assembled monolayer (SAM) of molecules of symmetric disulfides of benzoic acid:

(1) An inter-molecular separation of 11.7\AA :

This inter-molecular separation is chosen to reduce lateral couplings between molecules. The extended abstract of this study given in the following has been accepted for presentation in the International Conference of Computational Methods in Sciences and Engineering 2005 at Loutraki, Korinthos, Greece, 21-26 October 2005.

Electronic structures of self-assembled monolayer of molecules of symmetric disulfides of benzoic acid

Y. -H. Tang and M. -H. Tsai

Department of Physics, National Sun Yat-Sen University, Kaohsiung, 80424 Taiwan

The electronic properties of the self-assembled monolayer (SAM) of molecules of symmetric disulfides of benzoic acid with functional elements of H, F and Br have been studied by the first-principles calculation method. This study found that the electronic structure and the dipole moment of this SAM depend strongly on the electronegativity and size of the functional element. The variations of charge transfer among constituent ions and the dipole moment are approximately linear with respect to the external electric field even though there is a gap between the highest-occupied-molecular-orbital (HOMO) and the lowest-unoccupied-molecular-orbital (LUMO) bands. This finding suggests that the conductance of SAM may not vanish when the bias is smaller than the energy gap.

(2) An inter-molecular separation of 7.81\AA :

This smaller inter-molecular separation is chosen to elucidate the effect of lateral couplings between molecules. The dipole moment and effective charges of the various ions as functions of the applied electric field are given in the following figures. These figures show that when the functional

element is the fluorine the response of the charge distribution in terms the dipole moment and effective charges of constituent ions to the applied electric field is no longer linear. The nonlinear response can be understood to be due to couplings between F ions in neighboring molecules.

2. Calculation underway

The electronic structure and ferroelectric property of the system, which has a self-assembled monolayer of molecules of symmetric disulfides of benzoic acid on top of the nanometer-scale barium titanate (BaTiO₃) film.

3. Planned activities:

兩岸四校(南京、中山、成大及高師大)凝態物理研討會於 94 年 12 月 7 日於中山大學物理系。

3.3 Activities of on site scientists

3.3.1

■ Conferences, Workshops and Schools

Time	Conferences, Workshops & Schools	Place
94/06/12-94/06/28	Lecture on Special/General Relativity Lecturer: Xiao-Ning Wu (NCU) Organizers: Chuan-Hung Chen (NCKU), Hwei-Jang Yo (NCKU)	NCTS, NCKU
94/06/10-94/06/11	Mini-Workshop on Quantum Coherence Phenomena Organizer: His-Sheng Goan (NTU)	NTU
94/06/27-94/08/05	Comtemporary Condensed Matter Physics Lecture: Wu-Pei Su (Houston University) Organizer: I-Min Jiang (NSYSU)	NSYSU
94/06/30-94/08/11	Lectures on Low-Dimensional Material Physics Organizers: Min-Fa Lin (NCKU), Ching Cheng (NCKU)	NCTS, NCKU

Time	Conferences, Workshops & Schools	Place
94/08/04-94/08/05	Low-Dimensional Nanomaterial Physics for Young Researchers Organizers: Min-Fa Lin (NCKU), Ching Cheng (NCKU)	NCTS, NCKU
94/08/18-94/08/19	Mini School on Photonic Crystal Organizers: Tsan-Chuen Leung (CCU), Ching Cheng (NCKU)	CCU
94/09/08-94/09/09	Nanocarbon Workshop Organizers: Min-Fa Lin (NCKU), Ching Cheng (NCKU)	NCTS, NCKU
94/09/23	QIS Mini Workshop Organizer: Po-Chung Chen (NTHU)	NTHU
94/012/07	凝態物理研討會 Organizer: Min-Hsiung Tsai (NSYSU)	NSYSU
95/01/05-95/01/07	QIS Winter School Organizers: Wei-Min Zhang (NCKU), Yan-Ten Lu (NCKU)	NCKU

■ **Scientists supported by NCTS Sub-Project II to attend conferences abroad**

Name	Affiliation	Time	Visit
Chin Chun Tsai	NCKU	2005/05/17-2005/05/24	2005 Annual Meeting of the American Physical Society's Division of Atomic, Molecular, and Optical Physics, Lincoln, Nabraska, USA

Li-Yi Hsu	CYCU	2005/08/20-2005/08/31	Workshop on Quantum Communication Theory and the Related Topics & ERATO Conference on Quantum Information Science 2005, Tokyo, Japan
Rong-Bin Chen	NKMU	2005/07/09-2005/07/16	The 16th International Conference on Electronic Properties of Two-Dimensional Systems, NEW Mexico, USA

■ Visitors

Name	Field of Interest	Period of Visit
Shunsuke Teraguchi 國家理論科學研究中心(北區)	Particles and Fields	2005/04/28
蔡安邦 日本東北大學	Condensed Matter Physics, Computational Physics	2005/05/05
Antal I. Jakli 美國俄亥俄州肯特州立大學	Physical Properties of Anisotropic Materials	2005/05/18-2005/05/26
黃政哲 美國明尼蘇達大學	Condensed Matter Physics, Computational Physics	2005/05/20
伍法岳 美國東北大學	Condensed Matter	2005/05/20
Roh-Suan Tung 中國科學院理論物理所	Particles and Fields	2005/05/26
Hao-Sheng Lin Institute of Astronomy, University of Hawaii	Particles and Fields	2005/06/09
胡比樂 University of Maryland	Quantum Information Science	2005/06/13
Todd Brun University of Southern California	Quantum Information Science	2005/06/08-2005/06/28
Edna Cheung Perimeter Institute, Canada	Particles and Fields	2005/06/22-2005/06-23
Cheng Peng Chang TWCAT	Condensed Matter Physics	2005/07/01 - 2005/09/12

Name	Field of Interest	Period of Visit
Yaw-Hwang Chen KSUT	Particles and Fields	2005/07/01 - 2005/08/31
Rong-Bin Chen NKMU	Condensed Matter Physics	2005/07/01 - 2005/09/12
Ping-Hung Kuo NCU	High Energy Astrophysics, Galaxy Clusters	2005/07/04 - 2005/07/08
I- Ching Yang NTTU	Particles and Fields	2005/07/08 - 2005/07/22
Chien Wen Hwang NKNU	Particles and Fields	2005/07/11 - 2005/09/10
Daniel Murray Okanagan University College	Molecular dynamics simulation, nanoparticles	2005/07/07-2005/07/14
Ching-Hwa Kiang Rice University	Astronomy, Bioengineering	2005/07/14
Yueh-Nan Chen NCTU	Quantum Information Science	2005/07/18 - 2005/08/16
Tsung Wen Yen NTCU	Particles and Fields	2005/07/28 - 2005/08/02
Shih-Jye Sun NUK	Condensed Matter Physics	2005/08/01 - 2005/08/31
何大韜 揚州大學物理系	Nonlinear Science, Solid State Physics	2005/08/09
Yuk-Tung Liu Department of Physics, University of Illinois at Urbana-Champaign	Particles and Fields	2005/08/19
John D. Barrow Department of Applied Mathematics & Theoretical Physics, Cambridge University	Particles and Fields	2005/09/09-2005/09/10
Liu Chen UC, Irvine	Plasma Physics	2005/09/15-2005/09/17

■ Postdoctors

Name	Field	Period
Ming-Tsung Lee	Quantum Information Science	2004/12/20-2005/12/20
Zhengtao Wei	Particles Physics	2005/04/01-2006/03/31

3.3.2 Reports of Post Doctors

I. Ming-Tsung Lee (postdoc., 2004/12/20~2005/12/20. Supported by NCTS Sub-Project II)

My research interests are primarily in the related field of quantum information physics and quantum transport theory of mesoscopic system. In this year, I concentrate on the investigation of quantum decoherence, electrical read-out scheme and spin transport based on quantum electronic devices.

(1) Quantum decoherence of a solid-state qubit measured by the quantum point contact

(i) Background and motivation

The topic of quantum decoherence has attracted much attention for practical applications in quantum information science in recent years. Quantum decoherence is mainly induced by the interaction of a microscopic system coupled with its environment. The non-unitary evolution of the system destroys the purity of quantum states, quantum interference and quantum entanglement, and leads to information loss toward the environment. Recently, some investigations of quantum decoherence have been focused on the decoherence induced by quantum measurements and the controls of quantum decoherence. For the implementation of realistic quantum information processors, these studies become the most champion works in the field. In the solid-state quantum computer with charge qubits, qubit measurements can be realized by the charge qubit coupled with sensitive electrometers such as quantum point contacts (QPC) and single-electron transistors. I have been researching on the quantum measurement of a single-electron in coupled quantum dots (a charge qubit) by a QPC and the induced quantum decoherence [1].

(ii) Non-equilibrium effect of the QPC on the decoherence of the charge qubit

To study the quantum decoherence induced by quantum measurement, the condition of the

perfect heat bath is usually introduced to simplify the problem in literatures. However, practically, this condition is not guaranteed at mesoscopic scale. The non-equilibrium effect from the reservoir should be taken into account. For the QPC, the non-equilibrium effect could be induced by the electron accumulation (EA) in reservoirs. I have developed a perturbation scheme to take the EA effect into account [1]. The character of the EA in terms of the analytic EA number and the quantum decoherence of the measured single electron in coupled dots under the EA effect are studied in the framework. The theory shows that the EA can induce an extra relaxation to the qubit decoherence. However, the influence of the EA effect to the decoherence rate depends on the bias-assistance in the QPC.

(2) Electrical read-out scheme

(i) An electrical read-out scheme based on QPC with the longest decoherence time

The information readout of a single electron in the coupled dots through the QPC detection is studied. Literaturesly, the QPC with large bias has been designed as an efficient read-out device, since the read-out current (the variation rate of electron number) of the QPC is significant to characterize the information of qubit. However, according to our theory [1], a large bias makes the decoherence rate of the measured qubit linearly increasing and with a significant noise from the EA effect for the read-out current. This does not benefit some applications in fundamental researches of the quantum mechanical effect. I propose an alternate scheme to design the electrical measurement without bias [2], under which the decoherence rate of the measured qubit could become much smaller and without background noise due to the EA. Here, the EA becomes a resource to achieve this scheme, and our theory provides a very useful tool for this scheme. The theoretical result is shown in Fig.1. It can be found that, after rescaling the curve amplitude of the QPC read-out current, which coincides with the curve of the total reduced density matrix of the charge qubit. That is, the site and the oscillation frequency of the single electron in the coupled dot can be encoded in this scheme through the read-out current of the QPC.

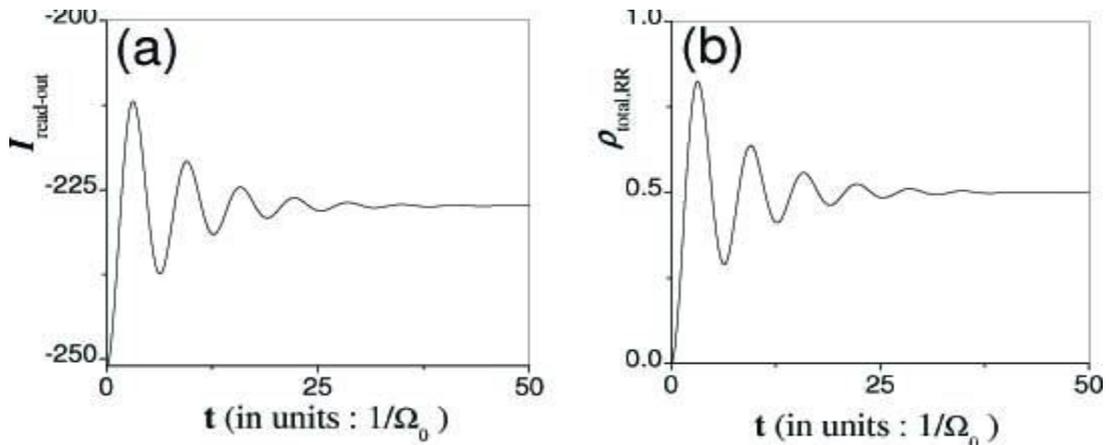


Fig1. (a) The read-out current of the QPC. (b) The reduced density matrix of the charge qubit with electron on the right dot.

(ii) An read-out scheme for single electron spin state

The research topic of the readout of single electron spin state is one of the most challenging works in spin-based quantum computation science. Recently, the electrical readout of single electron spin state has been developed by an experiential group in Delft University of Technology. Basically, they used spin-to-charge conversion of a single electron in a dot to achieve single spin state readout, in which the single electron charge is detected through the QPC. In collaboration with Prof. W.M. Zhang from National Cheng Kung University, who proposed a quantum computation scheme within semiconductor nano-structures, the quantum-dot cellular automata (QCA), we have been studying a single-shot readout of spin states in QCA by using the spin-to-charge conversion. Our theoretical calculation shows different patterns for spin-up and -down states, which can be used to distinguish spin state of single electron in the QCA, see Fig.2.

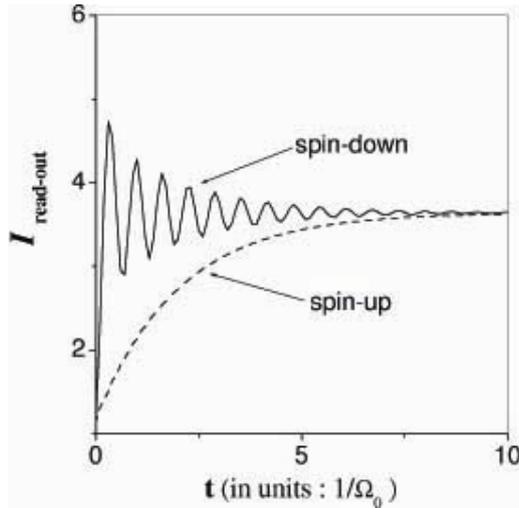


Fig2. The read-out current of the QCA. The solid (dash) curves correspond to the output electron with spin-down (spin-up) state, respectively.

(3) Spin transport in Rashba-type spintronic devices

The topic of exploiting the spin degree of freedom of charge carriers in electronic devices is widely studied recently. Some theoretical models have been developed for spin-based quantum computer based on spintronic devices. For practical applications, it is required to manipulate spin polarization at local points within an electrical circuit by using an electrical measurement. For the purpose, several schemes for tunable spin filter have been proposed. In collaboration with Prof. W.M. Zhang, I have been studying the spin transport in Rashba-type spintronic

devices, which will be used to develop a new method for spin filters and spin coherent of electrons in electric devices. In addition, theoretically, we are interested in the intrinsic mechanism of dissipation and decoherence in 2 dimension electron gas. The spin Hall effect in Rashba-type spintronic devices is due to spin-orbit interaction, which generates a dissipationless spin current. The time reversal symmetry of the system leads to this dissipationless transport phenomenon. I will study the related fields of the decoherence from this point of view.

Other academic activities:

I organized a weekly seminar: the Joint Journal Club Meetings of the Quantum Information Science at CQIS & NCTS/NCKU.

References:

[1] M. T. Lee and W. M. Zhang, *Decoherence induced by electron accumulation in quantum measurement of charge qubits*, in preparation.

[2] M. T. Lee and W. M. Zhang, *An electrical read-out scheme based onr QPC with the longest decoherence time*, in preparation.

II. Zhengtao Wei (postdoc., 2005/04/01~2006/03/31. Supported by AS)

■ **Curriculum Vitae**

1. Name : Zhengtao Wei				
2. Date of Birth: 19/07/1972				
3. Nationality : People´s Republic of China				
4.Current Appointment and/ or Status: Postdoc				
5.Academic Degree Doctor				
Type	Ph.D.		Date Obtained 01 / 11 / 2000	
Field	Theoretical Physics			
Institute : Institute of High Energy Physics, Chinese Academy of Sciences (Country) China				
6. Higher Education (start from the latest one)				
Name of University / Institution	Location	Degree	Field	Completion Date (Month, Year)

Institute of High Energy Physics	Beijing, China	Ph.D.	Particle Physics	07 / 2000
Institute of High Energy Physics	Beijing, China	M.S.	Accelerator Physics	07 / 1997
North China University of Technology	Beijing, China	B.S.	Fluid Dynamics	07 / 1994
7. Previous Employment(start from the latest one)				
Name of Institution	Location	Position	From – To	
Institute of Theoretical Physics	Beijing, China	Postdoc	07 / 2000 – 03 / 2002	
Institute of Physics	Taipei, Taiwan	Postdoc	03 /2002 – 03/2003	
University of Valencia	Valencia, Spain	Postdoc	03 / 2003 – 03/2005	
NCTS(South) and Institute of Physics	Taiwan	Postdoc	04/2005 – now	

■ List of Publications

* Articles in journal

1. Space-like penguin effects in Bc decays, Dong-Sheng Du and Zheng-Tao Wei, Eur. Phys. J. C5 (1998) 705-709.
2. Inelastic final state interactions of $B \rightarrow VV \rightarrow \pi K$ processes, Dong-Sheng Du, Xue-Qian Li, Zheng-Tao Wei and Bing-Song Zou, Eur. Phys. J. A 4 (1999) 91-96.
3. Final state interactions in $D^0 \rightarrow K^0 \bar{K}^0$, You-Shan Dai, Dong-Sheng Du, Xue-Qian Li, Zheng-Tao Wei and Bing-Song Zou, Phys. Rev. D60 (1999) 014014.
4. Test of CPT symmetry in cascade decays, Dong-Sheng Du and Zheng-Tao Wei, Eur. Phys. J. C14 (2000) 479-485.
5. Test of T violation in neutral B decays, Dong-Sheng Du and Zheng-Tao Wei, Phys. Lett. B477 (2000) 130-136.

6. Sudakov effects in BBNS approach, Dong-Sheng Du, Chao-Shang Huang, Zheng-Tao Wei and Mao-Zhi Yang, Phys. Lett. B**520** (2001) 50-58.
7. The systematic study of $B \rightarrow \pi$ form factor in PQCD approach and its reliability, Zheng-Tao Wei and Mao-Zhi Yang, Nucl. Phys. B**642** (2002) 263-289.
8. Phenomenological study of Sudakov effects in the pion form factor, Zheng-Tao Wei and Mao-Zhi Yang, Phys. Rev. D**67** (2003) 094013.
9. The SCET(II) and factorization, Zheng-Tao Wei, Phys. Lett. B**586** (2004) 282-290.
10. Productions of $K^*(1430)$ and $K(1)$ in B decays, Chuan-Hung Chen, Chao-Qiang Geng, Yu-Kuo Hsiao and Zheng-Tao Wei, Phys. Rev. D**72** (2005) 054011.
11. Sudakov form factor in effective field theory, Zheng-Tao Wei, arXiv: hep-ph/0403069, submitted to Nucl. Phys. B.
12. The QCD factorization in $B \rightarrow DKK$ decays, Zheng-Tao Wei, arXiv: hep-ph/0301174, submitted to Phys. Lett. B.
13. Exploring CPT Violation in $B \rightarrow J/\psi K$ decay using kaon regeneration, Zheng-Tao Wei, arXiv: hep-ph/0011171 (unpublished).
14. Factorization and polarization in two charmed-meson B decays, Chuan-Hung Chen, Chao-Qiang Geng and Zheng-Tao Wei, hep-ph/0507295.

*** Contributions to conference**

1. The factorization in exclusive B decays: a critical look, Zheng-Tao Wei. Talk given at QCD @ Work 2003: 2nd International Workshop on Quantum Chromodynamics: Theory and Experiment, Conversano, Italy, 14-18 Jun 2003. Published in eConf C030614:025,2003, e-Print Archive: hep-ph/0310173.
2. An improved lattice for BTCF storage ring, N. Huang, L. Jin, W. Liu, D. Wang, J. Wang, Z. Wei, C. Yu, for 1st Asian Particle Accelerator Conference (APAC 98), Tsukuba, Japan, 23-27 Mar 1998. In *Tsukuba 1998, Particle accelerator* 423-425.
3. The design study of the BTCF lattice, N. Huang, L. Jin, W. Liu, D. Wang, J. Wang, Z. Wei, C. Yu, Talk given at 14th Advanced ICFA Beam Dynamics Workshop: Beam Dynamics Issues for $e^+ e^-$ Factories (ICFA 97), Frascati, Italy, 20-26 Oct 1997. In *Frascati 1997, Beam dynamics issues for $e^+ e^-$ factories* 469-476.

■ Researches

The researches during my recent stay in NCTS (2005.4—2005.10) are concentrated on B

physics and light-front QCD. The below collects some illustrations of the main works.

1. In collaboration with Chuan-Hung Chen, Chao-Qiang Geng and Yu-Kuo Hsiao, we study the productions of p-wave mesons $K^{*0}(1430)$, $K_1(1270)$ and $K_1(1400)$ in B decays [1]. By the generalized factorization approach, we find that the branching ratios of $B \rightarrow K^{*0}(1430) \phi$ are similar to those of $B \rightarrow K \phi$ while the branching ratios of $B \rightarrow K_1(1270) \phi$ and $B \rightarrow K_1(1400) \phi$ are $O(10^{-5})$ and $O(10^{-6})$, respectively. In terms of the observation of $B \rightarrow K_1(1270) \gamma$ by BELLE, we can remove the sign ambiguity in the mixing angle for physical states $K_1(1270)$ and $K_1(1400)$. In addition, we analyze annihilation contributions in the decays $B \rightarrow K_1 \phi$ and we conclude that they could be neglected.
2. In collaboration with Chuan-Hung Chen, Chao-Qiang Geng, we provide a comprehensive test of factorization in the heavy-heavy B decays motivated by the recent experimental data from BELLE and BABAR collaborations [2]. The penguin effects are not negligible in the B decays with two pseudoscalar mesons. The direct CP asymmetries are found to be a few percent. We give estimates on the weak annihilation contributions by analogy to the observed annihilation-dominated processes. The N_c insensitivity of branching ratios indicates that the soft final state interactions are not dominant. We also study the polarizations in $B \rightarrow D^* D_{(s)}^*$ decays. The power law shows that the transverse perpendicular polarization fraction is small. The effects of the heavy quark symmetry breaking caused by the perturbative QCD and power corrections on the transverse polarization are also investigated.
3. After the researches of [1] and [2], I devoted to the study of light-front QCD which provides a promising analytic non-perturbative analysis of strong interactions. The study is still on the way and it includes: heavy quarkonium system [3], radiative B decays [4], heavy-to-light transitions [5]. These researches are expected to be finished in this year.
 - a. Productions of $K^{*0}(1430)$ and $K(1)$ in B decays, Chuan-Hung Chen, Chao-Qiang Geng, Yu-Kuo Hsiao and Zheng-Tao Wei, Phys. Rev. D72 (2005) 054011.
 - b. Factorization and polarization in two charmed-meson B decays, Chuan-Hung Chen, Chao-Qiang Geng and Zheng-Tao Wei, hep-ph/0507295.
 - c. Heavy quarkonium in covariant light-front approach, Chien-Wen Hwang and Zheng-Tao Wei, in preparation.
 - d. Radiative B decays in light-front approach, Chuan-Hung Chen, Chien-Wen Hwang and Zheng-Tao Wei, in preparation.
 - e. Heavy-to-light transitions on the light-front, Zheng-Tao Wei, in preparation.

3.4 Publications

■ In Preparation

1. M. T. Lee and W. M. Zhang, “*Decoherence induced by electron accumulation in quantum measurement of charge qubits*”. in preparation.
2. M. T. Lee and W. M. Zhang, *An electrical read-out scheme for QPC with the longest decoherence time*, in preparation.
3. Y.H. Chen and S.L. Nyeo, “Frequency Divider Using A Chaotic Oscillator under the simple limiter”, in progress.
4. Y.H. Chen and S.L. Nyeo, “The diffusion entropy method analyze Human’s DNA sequences ”, in progress.

■ Submissions

1. Y.Y. Liao, Y.N. Chen and D.S. Chuu, “Entanglement of two coupled molecules” (submitted).
2. C.M. Li, Y.N.Chen, C.W.Luo,J.Y.Hsieh and D.S. Chuu, “Effect of cavity photons on the generation of multi-particle entanglement”, (submitted).
3. C.M. Li, Y.N.Chen, C.W.Luo,J.Y.Hsieh and D.S. Chuu, “W state generation and effect of cavity photons on the purification of dot-like single quantum well excitons”, (submitted).
4. C.M.Li, L.Y.Hsu, W.Y. Lin, Y.N. Chen, D.S. Chuu and T. Brandes,” Correlation Criteria for the Bell Inequality and Detection of Multiparticle Entanglement”, (Submitted).

■ Accepted Papers

1. Yin-Zhong Wu and Wei-Min Zhang, ‘*Implementing controlled-Not gate based on free spin qubits with semiconductor quantum dot array*’ Europhys. Lett. 71, 524 (2005)
2. Jianhui Dai and Wei-Min Zhang, “*Quantum Nonlinear Sigma Model for Arbitrary Spin Heisenberg Antiferromagnets*”, Phys. Rev. Lett. (2005, accepted)
3. Wei-Min Zhang, Yin-Zhong Wu and Chopin Soo, “*Free spin quantum computation with semiconductor nanostructures*”, quant-ph/0502002

4. Y.N. Chen, C.M. Li, D.S. Chuu, T. Brandes, "Proposal for teleportation of charge qubits via superradiance", Accepted by New J. of Physics, xxx xxx-xx (2005).
5. Jin-Yuan Hsieh, Che-Ming Li, Der-San Chuu, "Hamiltonian and measuring time for analog quantum search", Accepted by J. OF Phys. Soc. of Japan xx, xxx-xx (2005).
6. Y.N. Chen, D.S. Chuu, and T. Brandes, "Current noise of a quantum dot p-i-n junction in a photonic crystal", Phys. Rev. B xxx, xxxxxx-xx (2005).
7. Y.N. Chen, D.S. Chuu, and S.J. Cheng, "Shot noise of quantum ring excitons in a planar microcavity" Phys. Rev. B. XXXX, xxxxxx-xx (2005)
8. C.H. Chen and C.Q. Geng, Phys. Rev. D 71, 115004 (2005).
9. C.H. Chen, C.Q. Geng, Y.K. Hsiao and Z.T. Wei, Phys. Rev. D 72, 054011 (2005).
10. C.H. Chen, C.Q. Geng and A.K. Giri, Phys. Lett. B 621, 253 (2005).
11. C.H. Chen, C.Q. Geng and Z.T. Wei, "Factorization and polarization in two
12. Y. -H. Tang and M. -H. Tsai, "Electronic structures of self-assembled monolayer of molecules of symmetric disulfides of benzoic acid", International Conference of Computational Methods in Sciences and Engineering 2005 at Loutraki, Korinthos, Greece, 21-26 October 2005.
13. C. P. Chang, C. L. Lu, F. L. Shyu, R. B. Chen; M. F. Lin, "Magnetoelectronic properties of AB-stacked graphite", Carbon 43, 1424-1431 (2005).
14. C. P. Chang, Y. C. Huang, C. L. Lu, J. H. Ho, T. S. Li; M. F. Lin, "Electronic and optical properties of a nanographite ribbon in an electric field" Carbon 43, (2005).
15. S. C. Chen, W. C. Hsieh, and M. F. Lin "Charge screening of single-walled carbon nanotubes in a uniform transverse electric field", Phys. Rev. B (November, 2005).
16. R. B. Chen, C. P. Chang, J. S. Hwang, D. S. Chuu, and M. F. Lin, "Magnetization of finite zigzag carbon nanotubes", J. Phys. Soc. Jpn. 74, 1404-1407 (Letter, 2005).
17. T. S. Li, and M. F. Lin, "Impurity states in semiconducting carbon nanotubes", J. Phys. Soc. Jpn. 74, 425-429 (2005).
18. C. W. Chiu, Y. H. Chiu, F. L. Shyu, C. P. Chang, D. S. Chuu; M. F. Lin,

- "Temperature-dependent carrier dynamics in metallic carbon nanotubes", *Phys. Lett. A* (2005).
19. C. H. Lee, C. W. Chiu, F. L. Shyu, and M. F. Lin, "Magnetoplasmons in a pair of armchair carbon nanotubes", *J. Vac. Sci. Tech. B* (December, 2005).
 20. C. P. Chang, C. L. Lu; M. F. Lin, "Magnetoelectronic properties of nanographite ribbons", *Physica E* 27, 82-97 (2005).
 21. C. C. Tsai, S. C. Chen, F. L. Shyu, C. P. Chang, and M. F. Lin, "Curvature effect and critical magnetic field on magnetization of carbon nanotubes", *Physica E*, (2005).
 22. Li-Yi Hsu, "Building nonlocal machines using GHZ states", *Phys. Lett. A*, 342, 368 (2005).
 23. Li-Yi Hsu and Che-Ming Li, "Quantum secret sharing using product states" *Phys. Rev. A* 71, 022321 (2005).

4. Conferences, Workshops and Schools

Time	Conferences, Workshops & Schools	Place
94/06/12-94/06/28	Lecture on Special/General Relativity Lecturer: Xiao-Ning Wu (NCU) Organizers: Chuan-Hung Chen (NCKU), Hwei-Jang Yo (NCKU)	NCTS, NCKU
94/06/10-94/06/11	Mini-Workshop on Quantum Coherence Phenomena Organizer: His-Sheng Goan (NTU)	NTU
94/06/27-94/08/05	Comtemporary Condensed Matter Physics Lecturer: Wu-Pei Su (Houston University) Organizer: I-Min Jiang (NYSU)	NSYSU
94/06/30-94/08/11	Lectures on Low-Dimensional Material Physics Organizers: Min-Fa Lin (NCKU), Ching Cheng (NCKU)	NCTS, NCKU
94/08/04-94/08/05	Low-Dimensional Nanomaterial Physics for Young Researchers Organizers: Min-Fa Lin (NCKU), Ching Cheng (NCKU)	NCTS, NCKU
94/08/05-94/08/06	Seminar in Coloring Organizers: Xuding Zhu (NSYSU), Li-Da Tong (NSYSU)	NSYSU
94/08/18-94/08/19	Mini School on Photonic Crystal Organizers: Tsan-Chuen Leung (CCU), Ching Cheng (NCKU)	CCU
94/08/23	Seminar in Quantum Algorithm Organizers: Xuding Zhu (NSYSU), Li-Da Tong (NSYSU)	NSYSU
94/08/24-94/08/27	International Workshop on Semi-Infinite Programming Organizer: Soon-Yi Wu (NCKU)	NCTS, NCKU

Time	Conferences, Workshops & Schools	Place
94/09/08-94/09/09	Nanocarbon Workshop Organizers: Min-Fa Lin (NCKU), Ching Cheng (NCKU)	NCTS, NCKU
94/09/23	QIS Mini Workshop Organizer: Po-Chung Chen (NTHU)	NTHU
94/10/21-94/10/24	6th Taiwan-Philippine Symposium on Analysis Organizer: Ngai-Ching Wong (NSYSU)	NSUSU
94/012/07	凝態物理研討會 Organizer: Min-Hsiung Tsai (NSYSU)	NSYSU
95/01/05-95/01/07	QIS Winter School Organizers: Wei-Min Zhang (NCKU), Yan-Ten Lu (NCKU)	NCKU

5. Visiting Scientists

■ Mathematics Division

Name	Field of Interest	Period of Visit
Koichiro Harada Ohio State University	Algebra	2005/02/18-2005/03/18
Sally Shao Cleveland State University	Differential Equations	2005/04/30-2005/05/07
Willian Ziemer (Emeritus) Indiana University	Algebra	2005/05/16
Ming Mei Dept. of Mathematics & Statistics Concordia University	Differential Equations	2005/05/09-2005/06/06
Jane (Juan-Juan) Ye University of Victoria, Canada	Optimization	2005/05/16-2005/05/28
Xinfu Chen Dept. of Mathematics, Univ. of Pittsburgh	Differential Equations	2005/05/31-2005/06/05

Name	Field of Interest	Period of Visit
丁協平 四川師範大學數學系	Optimization	2005/06/09
李文卿 美國賓州州立大學	Algebra	2005/07/25
Gerhard Wendt Johannes Kepler University Linz, Austria	Algebra	2005/07/26-2005/08/07
Huber Kiechle University Hamburg	Algebra	2005/07/28-2005/08/09
郭曉峰 廈門大學數學系	Applied Mathematics	2005/08/03
Lisheng SHU Department of Mathematics, Anhui Normal University	Analysis	2005/08/11
Christian Neumaier Institute F"Ur Algebra, Johannes Kepler Universit" At Linz, Austria	Analysis	2005/08/16
S. Gustafson University of Stavanger Norway	Optimization	2005/08/23-2005/08/27
H. Th. Jongen RWTH Aachen University	Optimization	2005/08/23-2005/08/27
O. Stein University of Duisburg-Essen	Optimization	2005/08/23-2005/08/27
Marco Lopez Alicante University	Optimization	2005/08/23-2005/08/27
K. L. Teo Hong Kong Polytechnic University Curtin University of Technology	Optimization	2005/08/23-2005/08/27
Liqun Qi Hong-Kong Polytechnic University	Optimization	2005/08/23-2005/08/27
J. J. Ruckmann Universidad de las Americas	Optimization	2005/08/23-2005/08/27
Georg Still University of Twente The Netherlands	Optimization	2005/08/23-2005/08/27
E. Polak University of California at Berkeley USA	Optimization	2005/08/23-2005/08/27

■ **Physics Division**

Name	Field of Interest	Period of Visit
Shunsuke Teraguchi NCTS (North)	Particles and Fields	2005/04/28
蔡安邦 日本東北大學	Condensed Matter Physics	2005/05/05
Antal I. Jakli 美國俄亥俄州肯特州立大學	Physical Properties of Anisotropic Materials	2005/05/18 - 2005/05/26
黃政哲 美國明尼蘇達大學	Condensed Matter Physics, Computational Physics	2005/05/20
伍法岳 美國東北大學	Condensed Matter	2005/05/20
Roh-Suan Tung 中國科學院理論物理所	Particles and Fields	2005/05/26
Hao-Sheng Lin Institute of Astronomy, University of Hawaii	Particles and Fields	2005/06/09
胡比樂 University of Maryland	Quantum Information Science	2005/06/13
Todd Brun University of Southern California	Quantum Information Science	2005/06/08-2005/06/28
Edna Cheung Perimeter Institute, Canada	Particles and Fields	2005/06/22-2005/06-23
Cheng Peng Chang TWCAT	Condensed Matter Physics	2005/07/01 - 2005/09/12
Yaw-Hwang Chen KSUT	Particles and Fields	2005/07/01 - 2005/08/31
Rong-Bin Chen NKMU	Condensed Matter Physics	2005/07/01 - 2005/09/12
Ping-Hung Kuo NCU	High Energy Astrophysics, Galaxy Clusters	2005/07/04 - 2005/07/08
I- Ching Yang NTTU	Particles and Fields	2005/07/08 - 2005/07/22
Chien Wen Hwang NKNU	Particles and Fields	2005/07/11 - 2005/09/10

Name	Field of Interest	Period of Visit
Daniel Murray Okanagan University College	Molecular dynamics simulation, nanoparticles	2005/07/07-2005/07/14
Ching-Hwa Kiang Rice University	Astronomy, Bioengineering	2005/07/14
Yueh-Nan Chen NCTU	Quantum Information Science	2005/07/18 - 2005/08/16
Tsung Wen Yen NTCU	Particles and Fields	2005/07/28 - 2005/08/02
Shih-Jye Sun NUK	Condensed Matter Physics	2005/08/01 - 2005/08/31
何大韜 揚州大學物理系	Nonlinear Science, Solid State Physics	2005/08/09
Yuk-Tung Liu Department of Physics, University of Illinois at Urbana-Champaign	Particles and Fields	2005/08/19
John D. Barrow Department of Applied Mathematics & Theoretical Physics, Cambridge University	Particles and Fields	2005/09/09-2005/09/10
Liu Chen UC, Irvine	Plasma Physics	2005/09/15-2005/09/17

6. 國外差旅報告

■ 數學組

◇ 報告者: 吳順益教授 (國立成功大學數學系)

出國日期: 94年5月13日至5月22日

我在5月16日前往加拿大 University of Victoria 的 Department of Mathematics and Statistics 訪問。在此訪問期間主要是與 Dr. Xiaoming Yuan 討論一些有關 semi-infinite programming 的算法應用在生物統計的問題上，以解決一些生物統計的問題。我們已有討論出一些成果。我在5月23日搭機回台南。

◇ 報告者: 江孟蓉助理教授 (國立成功大學數學系)

出國日期: 94年5月21日至5月29日

I was invited to attend the BIRS Workshop on Moment Maps in Various Geometries. The Ban. International Research Station is located in a beautiful and secluded setting. The facilities include lecture rooms, discussion rooms, high-speed internet, library, as well as accommodation and dining facilities on site. All participants live, work and eat together. The great intensity of interaction makes it a premier place for research. If in Taiwan we can provide a cost-effective conference facility in Kenting or Shitou, it will no doubt attract the best mathematicians from around the world and further enhance the profile of mathematical research in Taiwan. The goal of this workshop at Ban. International Research Station is to obtain a better understanding of moment maps and related areas in various geometries such as symplectic, contact, Sasakian, Kähler, 3-Sasakian, and HyperKähler geometry. Experts including Victor Guillemin, Shlomo Sternberg, Charles Boyer, Roger Bielawski, Georgios Daskalopoulos, Hiroshi Konno, and many others have attended the

workshop. The talks given in the workshop were all inspiring. For example, Victor Guillemin described an object for families of symplectomorphisms whose properties encode many of the main features of moment geometry. Anton Alekseev produced a canonical Ginzburg-Weinstein diffeomorphism between $U(n)$ and $u(n)$ in such a way that it intertwines the linear and nonlinear Gelfand-Zeitlin systems. Vestislav Apostolov discussed the classification of compact Kähler manifolds admitting a Hamiltonian 2-form. Combining the notion of rigid Hamiltonian torus action and orthotoric geometry, new examples of extremal Kähler metrics on geometrically ruled complex manifolds were constructed. Miguel Abreu described Donaldson's general moment map geometry for the action of a symplectomorphism group on the corresponding space of compatible almost complex structures. For the rational ruled surfaces, this suggested a new approach to study the topology of their symplectomorphism groups and spaces of compatible complex structures. At Ban. Center, vivid interaction among mathematicians were stressed. Time and space were set aside for discussion. The discussion with Henrique Bursztyn, Lisa Jeffrey, Eugene Lerman, Yael Karshon, Liviu Mare, Susan Tolman, and others, had lead to several interesting questions. The topics of discussion included Kirwan surjectivity in different settings, orbifold cohomology, topological aspects of moment map theory, and so on. For example, Kirwan surjectivity can not work for contact quotients. Nevertheless, it is still interesting to understand the kernel and cokernel. It would also be interesting to ask under what conditions a contact Kirwan surjectivity would hold. There may be a class of spaces for which surjectivity would hold in the 3-Sasakian case, perhaps with the assumption that the Kirwan map is surjective up to the middle dimension. There is a more subtle issue concerning Kirwan surjectivity over the integers. The choice of cohomology theory for the reduced space would need to be addressed. It is different using Chen-Ruan orbifold cohomology or that of Haefliger. Overall, this was a very rewarding workshop. I deeply appreciate the support from the NCTS (south), Math Division.

◇ 吳佼佼博士(國立中山大學應用數學系)

出國日期: 94年6月26日至6月30日

參加這次 2005 年圖論與組合學際學術會議暨第三屆海峽兩岸圖論與組合學學術會議，對我來說收穫很多。首先，在台灣做圖論與組合學的人，並不是很多，所以很少跟自己做相同問題的人，而這次的會議，有 300 多人參加，很多學者，做各式各樣的問題，我也遇見了跟自己做相似問題的人，終於有互相交流的機會，也可以得知別人最近感興趣的問題。其次，有許多大會邀請的學者，給我們講一些他們在研究的課題，是非常好的演講，例如：圖的圈著色數和 Kneser graph 相關的一些問題，一來可以知道這些問題的來龍去脈，又可以知道最新的發展，還有一些新的猜想，等著我們去解決。另外，有一些我之前就很感興趣的問題 ($L(2, 1)$ -labeling 和圖的 square 的著色數)，也有一些學者在研究這方面的問題，雖然因為時間的關係，大部分都沒辦法聽到很完整的證明，但是也給了我們一些很好的想法去考慮那些問題，也有許多未解決的問題，還有未來的發展，回來之後，我會仔細的想想那些問題，看看有沒有一些新的結果。最後，我覺得很多來參加研討會的人，都非常的認真，我覺得真的是很值得效法的，在台灣很少看見研討會討論的很熱絡，在這個研討會確是很不一樣的，大家都對別人的問題很感興趣，有很多的交流，我覺得很不錯，目前我對別人的一些問題，研究的還不夠多，以後會加緊努力研究其他的問題，希望以後的研討會自己能夠有更多與別人交流的機會。

◇ 董立大教授 (國立中山大學應用數學系)

出國日期: 94 年 6 月 22 日至 7 月 1 日

6 月 22~25 日至上海華東師範大學訪問洪淵與呂長虹教授，與呂長虹研討 oriented geodetic number 與 geodetic number 在 2-connected 圖上的性質，獲得一些新的成果。6 月 25 至 7 月 1 日到浙江金華參與第三屆兩岸圖論與組合學暨國際研討會，此次國內外參與人數約 320 人，演講約 80 場。攜回數篇論文，並獲知一些新的研究進展。

◇ 姚任之教授 (國立中山大學應用數學系)

出國日期: 94 年 9 月 1 日至 9 月 8 日

這次承蒙南部理論中心的補助，本人得以於 94 年 10 月 17 日至 94 年 10 月 23 日前往義大利比薩大學數學系訪問 F. Giannessi 教授，Giannessi 教授是世界知名之優化理論學者，他的一些想法及所提出之數學模型，如 1980 年所提出之向量變分不等式等到如今都仍然是國際上很熱門的研究領域，本人與 Giannessi 教授交換了許多寶貴的研究心得及看法，另外本人也與其他相關的研究學者進行了學術交流，比較有可能進行的共同研究主題大致上為平衡問題之缺函數及其應用，值域空間分析，這兩大研究主題都是目前各國專家學者所有興趣的研究項目，本人也帶回來一些相關論文資料，相信近期之內就可以展開合作之研究。

另外，Giannessi 教授也安排本人至比薩大學應用數學系給了一場專題演講，頗受好評。總而言之，這次比薩之行讓本人在學術研究路上受益良多，也再次感謝南部理論中心的大力補助。

◇ 方永富助理教授（國立成功大學數學系）

出國日期: 94 年 6 月 24 日至 9 月 10 日

This is the report regarding the 2005 summer visit at the University of Maryland of Yung-Fu Fang. On the day June 24 2005, Fang flew to the University of Maryland at College Park. Since then Fang frequently met with Professor Grillakis to discuss and work on some partial differential equation problems, including Dirac-Klein-Gordon equations and Cubic Schrodinger equation. The period for the visit was from June 24 to September 10.

Fang also discussed some related problems with Professor Machedon. Through this period of time some work has been most promising. One of the problems is regarding the existence of global solution for Dirac-Klein-Gordon equations in 1+1 dimensions. An interesting case for the initial data of the spinor field in L^2 and that of the scalar field in $H^{1/2}$, which is a natural space for the existence of invariant measure induced by the flow from the point of view of the corresponding Hamiltonian. Another problem is to obtain a better result than that by Tao etc. for the cubic Schrodinger equation in 1+2 dimensions. Due to the availability of a correlation estimate, we can obtain a better result of global solution for even rougher data of the equation.

The research done during this period of time also indicates a new direction for new work. The technique and idea can be applied to some other equation such as Boussinesq equation. Another problem is the Cauchy problem for Dirac-Klein-Gordon equations in 1+3 dimensions. Using conformal transformation it is possible to argue that small data with low regularity implies global solution, thus scattering result can also be discussed.

Finally Fang wants to express his gratitude to committee members of NSC, particular the chairman for their support which made this visit possible, including the fruitful results done during the visit.

◇ 夏杼副教授 (國立成功大學數學系)

出國日期: 94 年 8 月 17 日至 8 月 21 日

I attended the Third Pacific Rim conference on Mathematics which was held in Shanghai, China from Aug. 17, 2005 to Aug. 21, 2005. During the conference I gave a 45 minute presentation on the dynamics of the mapping class group action on moduli spaces in the session Algebraic Aspects of Lie Theory and Geometry.

I was also a visitor at the Institute of Mathematics at Fudan University for the week of Aug. 29 at the invitation of Professor Hong Jia Xing.

■ 物理組

◇ 蔡錦俊副教授 (國立成功大學物理系)

出國日期: 94 年 5 月 17 日至 5 月 24 日

此次前往美國 Nebraska 州 Lincoln 市參加 2005 年美國物理學會原子分子及光學年會，同時參訪了 University of Colorado 及 JILA。此會議是原子物理最重要的會議。在會議中，我們口頭報告了我們實驗室最近的成果"鈉分子由罕德耦合轉移造成 Lambda 雙重態的分離"。報告進行得非常順利，另外在和 University of Colorado 的研究群討論中，我們也建立了些管道，其中來自

Wieman Research Group 的 Juan Pino:

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phone:720-989-7608

Cornell Research Group 的 Shih-Kuang Tung:

email:Tung3@Colorado.edu

目前 Carl Wieman's Lab 做的是以 Feshbach Resonance 來做 ^{85}Rb 與 ^{87}Rb 混合之原子冷凝，希望經由 ^{87}Rb 的 BEC 來冷卻 ^{85}Rb 原子。而 Eric Cornell's Lab 則觀測了 Square Vortex Lattices 在 Rotating Spinor BEC 中，是一個較新的結果。

這次的會議，BEC 基本特性，應用 BEC、BCS 間的關係探討，冷原子碰撞，低溫原子的光結合還是會議的主軸。當然在其它方面也有很不錯的結果，例如高磁場快速光源上，與會中的報告已提出了 100 Attoseconds(10^{-18}sec)的 Laser pulse。

DAMOT meeting 在 JILA 的研究員 Deborah Jin 的 Fermi Condensates 的演說中揭開序幕。Jin 的研究群藉由調變 Fermi gas 之間作用力的強弱，可以實驗控制 Fermi gas 的 Condensate。在 Condensate 中 Fermi gas 有如 cooper pairs 的結合，這系統對了解 BEC 和 Fermi Superfluidity 有很大的幫助。

另外，在原子的 Cooling，低溫碰撞和 BEC 上仍有許多發展，其中 BEC 和 BCS 的 Cross over 還是大家有興趣的，而全光聚的 BEC 也有不錯的突破，其中 Georgia Institute of Technology 和 JILA Cornell's group，更能在 3 秒內就產生一個約 3×10^5 個原子的

Condensate 來研究 spinor BEC 的特性。

在會中，來自 Kansas State 的林啟東每次都十分熱心的關心國內 AMO 研究的動態，尤其去年我們在他和台大的推動下，在中正大學辦了一場很成功的 AMO Workshop，今年他也一再鼓勵推動，我也邀請他在芝加哥大學的金政博士如果暑假能來台灣，我們可以配合他們的時間討論 AMO 的 Workshop。第二天晚餐和來自 Argon National Lab 的人和張圖南老師一起吃飯，互相討論目前 AMO 在國內外的發展，這是一次愉快的聚會。

總之此次的原子分子與光學研討會，共有 AMO 的學者專家六、七百人參加，報告了各實驗室的最後結果，我們也報告了我們的研究成果，如附件，同時也提供了大家一個面對面討論的機會，雖然很累，但也很充實，謝謝南部理論物理中心與國科會的支持。

以下附會議發表論文及行程:

會議名稱: 美國物理學會原子分子及光學物理 2005 年會(2005 Annual Meeting of the American Physical Society s Division of Atomic, Molecular, and Optical Physics)

發表之論文題目:

中文: 鈉分子由罕德耦合轉移造成 Lambda 雙重態的分離

英文: Splitting of Lambda doubling in the transition of Hund's coupling cases in sodium molecule

摘要: Splitting of Lambda-doubling in the transition of Hund's coupling cases in sodium molecule

Chin-Chun Tsai, Ray-Yuan Chang, Thou-Jen Whang, and Chuen-Ping Cheng

Department of Physics, National Cheng-Kung University, Tainan 70101, Taiwan

Department of Chemistry, National Cheng-Kung University, Tainan 70101, Taiwan

The phenomenon of orbital angular momentum L-uncoupling from its internuclear axis is observed in the sodium dimer by using high resolution cw optical-optical double resonance spectroscopy.

This L-uncoupling removes the degeneracy of Σ -type doubling. In the case of Na_2 , however, such Lambda-type doubling only reported in the B^1_u state with large speed of rotation and without significant dependence on the vibrational quantum number v . In this study, the splitting of Σ -doubling in the 4^1_g and 5^1_g states of Na_2 is directly measured under our experimental resolution. This splitting caused by the transition of Hund's coupling from case (a) to case (d) is due to L-uncoupling from its internuclear axis. The observed energy levels with e/f parities are assigned to the 4^1_g and 5^1_g states and the Σ -type splitting constants q_0 , q_v and m are globally fitted to a standard deviation of σ less than 0.03 cm^{-1} .

◇ 陳榮斌副教授 (高雄海洋科技大學)

出國日期: 94 年 7 月 9 日至 7 月 16 日

一、 會議名稱

16th International Conference on Electronic Properties of Two-Dimensional Systems

第十六屆二維系統電子性質的國際研討會

二、 會議地點、時間

地點: Hyatt Regency Albuquerque, New Mexico USA

美國新墨西哥州 Albuquerque

時間: July 10-15, 2005

2005 年 7 月 10 日 至 2005 年 7 月 15 日

三、 會議性質

The EP2DS traditionally covers the fundamental physics of electronic and optical properties of systems based on semiconductor hetero-structures and other low-dimensional electronic systems.

低維半導體電子系統內電與光的物理特性.

包括: 量子霍爾效應、金屬半導體間的傳輸、量子結構的電與光的性質

、有機導體、奈米結構... 等等.

四、學術地位或重要性

The Proceedings of [EP@DS-16](#) will be published as a special issue of Physica E: Low-Dimensional Systems & Nanostructures.

這會議論文將被發表在 Physica E 特別專冊

五、實際日程

1. 七月十日台北至洛杉磯，再轉機至美國新墨西哥州 Albuquerque
2. 七月十日至七月十五日在 Albuquerque 出席國際會議，而後返回台北

◇ 徐立義助理教授（國立中原大學物理系）

出國日期: 94 年 8 月 20 日至 8 月 31 日

此次日本之行自八月二十日至八月三十日。十天的行程中參加兩個量子資訊的學術會議：八月二十二、二十三兩天之中，在玉川大學(Tamagawa University)參加量子通訊及相關議題研討會（Workshop on Quantum Communication Theory and the Related Topics）；二十六日至三十日則是在日本未來科學館，參加 ERATO 會議。

玉川大學的研究團隊，是以教授(Osamu Hirota)為首，底下有五位副教授，其背景分別為電腦科學、物理及數學等等。其研究著重於量子密碼中的Y-00通訊協定的實作。與西北大學的Horace Yuen有非常密切的合作，並獲得Panasonic 的贊助。之前三年的研究有三億日圓，接下來的五年有四億日圓的經費。此協定目前仍有許多爭議，主要爭議點在於此協定是否為量子密碼。許多人認為此協定之安全性是基於計算之複雜性上，而非量子物理之基本原則。此會議希望釐清此爭議，並討論未來合作之可能。筆者於二十三日發表邀請演講，講題為：Two Quantum Secret Sharing Schemes。主要是介紹近兩年之工作。除此之外，另兩位邀請講員分別為V. P. Belavkin (UK)以及E. Corndorf (USA)。綜觀玉川大學的研究，真正是所謂的跨領域的合作，且目標明確。是可學習之處。此外，亦邀請Dr. Kentaro Kato(21st century COE program, Chuo University, Japan)參加二十三日之研討會。

八月二十六日至三十日，參加ERATO（Exploratory Research for Advanced Technology）conference on quantum information science。此次會議中的報告，大多屬於理論部分的進展。實

驗方面的報告並不多。甚至只有一場邀請演講，是有關於實驗方面的報告。而在理論方面的報告中，又集中於量子密碼方面以及量子演算法方面。在量子密碼部分，多屬於破解方法的探討，或是對於目前已提出的通訊協定提出修改。例如我們是否能修改BB84通訊協定，使得在缺乏單光子光源的狀況下，量子密碼是否仍有絕對的安全性。這是一個值得探討的方向。量子演算方面，並沒有令人興奮的突破，主要是對於一些已知的問題，如hidden subgroup方面，做不同的嘗試。其他在傳統量子資訊的問題，如additivity conjecture、量子糾纏、量子糾錯碼等等，也有不同程度的探討。其中還有一個parallel session，專門探討量子資訊的相關數學問題。在壁報論文的部分，絕大多數也是理論部分的探討。故綜觀而言，今年的會議缺乏實驗方面的報告，是令人很驚訝的。

再這四天的會議中，筆者與來自各國的學者進行交流，收穫頗為豐碩。明年的 ERATO 會議，將於九月於北京舉行。而2nd Asia-Pacific Conference on Quantum Information Science，可能於明年六月於韓國漢城舉行。