

The 2023 Annual Report
National Center of Theoretical Sciences
Division of Mathematics

Contents

1	Overview	3
1.1	Report from the Director	3
1.1.1	Introduction	3
1.1.2	Scientific Highlights	4
1.1.3	Academic Activities	5
1.1.4	Postdoctoral Program	6
1.1.5	NCTS Education and Outreach	7
1.1.6	Future Plans	10
1.2	Summary of Data	13
1.2.1	Committees and Members	14
1.2.2	Workshops, Conferences, and Special Events	17
1.2.3	Seminars	18
1.2.4	Courses	19
1.2.5	Visitors	20
1.2.6	Summary of publication data	22
2	Topical Programs	23
2.1	Program A. Number Theory and Representation Theory	23
2.1.1	Core Members	23
2.1.2	Program Overview	23
2.1.3	Research Highlights	24
2.1.4	Highlights of Events	28
2.1.5	Future Plans	29
2.2	Algebraic Geometry	31
2.2.1	Core Members	31
2.2.2	Program Overview	31
2.2.3	Research Highlights	31
2.2.4	Highlights of Events	33
2.2.5	Future Plans	35
2.3	Differential Geometry and Geometric Analysis	38
2.3.1	Core Members	38
2.3.2	Program Overview	38
2.3.3	Research Highlights	39
2.3.4	Highlights of Events	43
2.3.5	Future Plans	46
2.4	Differential Equations and Stochastic Analysis	49
2.4.1	Core Members	49
2.4.2	Program Overview	49
2.4.3	Research Highlights	49

2.4.4	Highlights of Events	54
2.4.5	Future Plans	56
2.5	Scientific Computing	58
2.5.1	Core Members	58
2.5.2	Program Overview	58
2.5.3	Research highlight	58
2.5.4	Activities at NCTS from August 2022 to September 2023 . .	66
2.5.5	Future Plans	68
2.6	Program F: Interdisciplinary Studies	73
2.6.1	Core Members	73
2.6.2	Program Overview	73
2.6.3	Research Highlights	73
2.6.4	Highlights of Events	79
2.6.5	Future Plans	80
3	Host University Commitment	82
3.1	Space of NCTS	82
3.2	Logistic support of NTU	82
4	Appendix	85
4.1	Committee Members	86
4.2	List of Workshops, Conferences and Special Events	88
4.3	Seminar Talks	94
4.4	Courses	105
4.5	List of Visitors	109
4.6	Publications	118
4.6.1	Publications of Key Members	118
4.6.2	Publications of Postdoctoral Fellows	122
4.7	Undergraduate Research and Summer Research Program	129
4.7.1	URP	129
4.7.2	USRP	131

1 Overview

1.1 Report from the Director

1.1.1 Introduction

The NCTS Mathematics Division, hereinafter referred to as the Center, strives to be a research center of excellence in Asia. Its aim is to promote and enhance research in all important disciplines in mathematical sciences in Taiwan, and at the same time also to encourage new promising research directions that may have impact in the future development of mathematics.

Another important aim of the Center is for it to play a leading role in fostering talents in mathematical sciences and in helping to train the next generation of scientific leaders in Taiwan. Although the Center is located on the campus of the National Taiwan University, the NCTS, as its name infers, is foremost a national center. It therefore needs to serve the mathematical community of all of Taiwan and provides a national platform for research collaboration. At the same time the Center is to be an international meeting place for stimulating discussions and exchange of new developments and ideas. To achieve this goal, the Center also endeavors to establish, cooperate and collaborate with other international research institutions. It has maintained close connections with many leading mathematical research institutions, e.g., SLMath (formerly MSRI) in Berkeley, RIMS in Kyoto, OCAMI in Osaka, KIAS in Seoul, PMI in Pohang, BMS in Berlin, PIMC in Vancouver and the Fields Institute in Toronto.

In the first two years of Phase V of the NCTS, the Mathematics Division faced many challenges because of the pandemic. The number of international visitors dropped substantially compared to the pre-pandemic years and many international conferences and workshops had to be either postponed, cancelled, held in hybrid format or moved entirely online. Fortunately, things are back to normal at the NCTS this year. Not only have some international conferences and workshops resumed after being delayed for three years, many more additional academic activities have been arranged. As a result, the numbers of conferences, workshops, courses and lectures even exceed those in the pre-pandemic years. Most of the NCTS activities are in person now. But we still take advantage of the convenient online software to connect mathematicians around the world, and continue to run the excellent iGMT seminar and other webinars. The number of international visitors is also back to normal. Moreover, the Center has hosted several long-term visitors this year, and many others are planned for the near future.

From August 13 to 14, the Center held its annual NCTS Review and Strategic Development Meeting with its core members in Xitou. This is a new tradition from Phase V, and participants include the executive, academic, program committee members, Center Scientists, and Young Theoretical Scientists along with the administrative staff members of the Center. The main purpose of the meeting is for the core members

to share their experiences and make constructive suggestions to the administration of the Center. It is essential for the Center to review and fine-tune its operations so that it can continuously improve and adapt itself. In this year's meeting, we also discussed the preparation for NCTS International Advisory Committee (IAC) meeting and NSTC review next year as well as the NCTS proposal for Phase VI. A new research abroad program for students has been launched after the meeting.

1.1.2 Scientific Highlights

The research achievements of the core members in the third year of this phase continue to be outstanding. Many of the results obtained by core members appear in some of the most prestigious mathematical journals, e.g., *Annal of Math.*, *Algebraic Geometry*, *JEMS*, etc., and some in the most prestigious interdisciplinary journals, e.g., *Science Advance*, *Food Chem.*, etc.

We are also pleased that close affiliates of the Center who have been very actively involved in its operation continue to receive recognition for their research achievements. Prof. Jungkai Chen from National Taiwan University was awarded the National Chair Professorship by the Ministry of Education at the end of 2022. Prof. Chen has served as the Phase IV director of the Mathematics Division of the NCTS and has played an influential role in the growth of the Center. He is currently the chair of the Program Committee of the NCTS Scientific Program Algebraic Geometry.

Also, Prof. Kung-Chien Wu of the National Cheng-Kung University received the 2023 Outstanding Research Award from NSTC. Prof. Wu received the NCTS Young Theoretical Scientist Award in 2013 and also held the appointment of an NCTS Center Scientist for the period from 2015 to 2019. He has been involved in planning and organization of scientific activities at the NCTS, and is currently the chair of the Program Committee for the NCTS Scientific Program Partial Differential Equations and Stochastic Analysis.

Prof. Ye-Kai Wang of the National Yang Ming Chiao Tung University received the 2023 Wu Ta-You Memorial Award from NSTC. Prof. Wang has received the NCTS Young Theoretical Scientist Award in 2018 and was appointed an NCTS center scientist from 2022-2023. He is currently an affiliated member of the NCTS Scientific Program Differential Geometry and Geometric Analysis.

The NCTS postdocs received several honors as well. Drs. Yen-An Chen, Brian Harvie, and Yasuhiro Terakado were awarded the 2023 NSTC Academic Award for Postdoctoral Fellows. The recipients of the award in mathematics were all from the NCTS Mathematics Division this year. Besides, Dr. Shih-Hsin Chen received the 2023 Excellent Postdoctoral Research Scholar Award by the Foundation For The Advancement of Excellent Scholarship (FAOS).

Recently, Profs. Chih-Whi Chen and Wei-Fan Hu have received the 2023 Luo Jia Lun Outstanding Young Researcher Award of the National Central University. The

award is given this year to three NCU faculty members. Both Profs. Chen and Hu have been recipients of the Wu Ta-You Memorial Award of the NSTC and the NCTS Young Theoretical Scientist Award in the past. Over the years, both have been actively involved in participating and organizing scientific events at the Center, and both are currently NCTS Center Scientists. Prof. Hu is also currently on the Program Committee of the NCTS Scientific Program Scientific computing.

1.1.3 Academic Activities

In the first two years of Phase V of the NCTS, academic activities in the Mathematics Division were largely affected by the pandemic. Things have improved a lot and have been back to normal this year since the lift of travel restrictions in Taiwan. The East Asia Core Doctoral Forum in Mathematics was resumed at the NCTS during January 9-12, 2023, after being cancelled in 2021 and 2022. A big conference 2023 NCTS Higher Dimensional Algebraic Geometry: Minicourses and Workshops were also resumed during March 13-24, 2023 after being delayed for three years. This conference was very well attended and received. Besides local participants, there were more than 40 international participants from Belgium, China, Germany, Italy, Japan, Korea, Russia, Singapore, USA and UK, including many world-renowned mathematicians such as the Fields Medalist Caucher Birkar, Mihnea Popa from Harvard University, Chenyang Xu from Princeton University, Paolo Cascini and Alessio Corti from Imperial College of London, Yujiro Kawamata from the University of Tokyo, etc. Many participants acknowledged that this was their best conference ever considering the quality of the talks and the organization.

The 2022 International Conference on Recent Developments of Theory and Methods in Mathematical Biology was scheduled to take place at the NCTS last year, but was moved to Paris in the last minute due to the restrictive covid measures in Taiwan. The 2023 conference is back to Taiwan and will take place at the Center during October 23-27, 2023. Conferences that had to be held in hybrid format during the pandemic were also successfully converted into in person meetings this year. Many more additional academic activities have been arranged in 2023. This year a total of 44 conferences and workshops were organized and hosted by the Center, in addition to 160 seminar talks at the time of writing. The figure does not include the 11 special events. In contrast, the total number of conferences and workshops last year was 29.

Given the convenience and power of online software to connect mathematicians around the world, the NCTS continues to host several excellent webinars. We also provide an online option for other regular seminars when needed. The seminar organizers are free to invite speakers even if they could not visit Taiwan in persons. In this way, it gives more choices of speakers and widens the spectrum of seminars at the NCTS.

The NCTS International Geometric Measure Theory Seminar, initiated in the end

of 2020, is a seminar organized jointly by NCTS affiliated member Ulrich Menne (who was an NCTS Center Scientist from 2019 to 2022), and faculty members from University of Cambridge, University of Pisa and Tokyo Institute of Technology, and it is held every two months. The seminar continues to attract, among the speakers, some of the world's foremost leading experts in the field. The Seminar of Algebraic Geometry in East Asia, which was another excellent online activity hosted by the NCTS during the pandemic, will be converted to a physical biannual conference that takes place rotationally among the participating countries.

1.1.4 Postdoctoral Program

A highly diverse and international postdoctoral program is essential for the Center to thrive and achieve its long term goals. The outstanding research environment that the Center has been able to provide for its postdoctoral fellows is essential for their mathematical growth. Such an international program also greatly benefits the Taiwanese postdoctoral fellows at the Center and plays an important part in the Center's mission to foster the next generation of scientists in Taiwan. The Center is pleased to report that its postdoctoral program remains strong; indeed this year several of its postdoctoral fellows were awarded the 2023 NSTC Academic Award for Postdoctoral Fellows and the 2023 Excellent Postdoctoral Research Scholar Award by the Foundation For The Advancement of Excellent Scholarship (FAOS). And this year several were successful in finding their second postdoc positions in prestigious institutions, including Harvard University in US, Imperial College London, University of Bath and King's College London in UK, IBS in Korea, and faculty position in Tokyo Denki University in Japan.

The program continues to be very international, with Taiwanese forming a minority as in the past years. The current international postdocs stationed at the Center come from the US, Japan, Germany, Italy, Korea, Vietnam and India. Besides meeting with their mentors and participating in activities in their topical programs, the NCTS postdocs are actively involved in the biweekly Taipei Postdoc Seminar which the Center jointly runs with the Institute of Mathematics Academia Sinica. The speakers are chosen from the large pool of postdoctoral fellows in the larger Taipei area and the lectures are given in an informal relaxed atmosphere. Other activities such as Meeting with Directors, NCTS Postdoc Symposium and individual interviews are also arranged. The newly established NCTS Postdoc Symposium is a one-day event in the fall, in which every postdoc is asked to give a talk on their recent works. The deputy director conducts an individual interview with every postdoc every half a year to update on the progress and check on their needs.

The term of postdoctoral fellows at the NCTS is usually two years and extendable to another year. The NCTS used to have the review process after the Spring Day. From this year, we moved the review to September, so that there would be enough time for

those whose terms are not extended to find their next position. This year we therefore had the 2023 NCTS Postdoc Symposium on September 4. The Symposium would also serve as a welcome activity for new NCTS postdocs where they have a good chance to know the NCTS and its postdoctoral program. In the future, the NCTS Spring Day will be mainly for the annual NCTS Young Theoretical Scientist award ceremony.

To assist foreign postdocs of the Center integrate better into the Taiwan community, the Center also provides financial support for their Chinese language lessons. Some postdocs give short courses in the Center, serve as TAs for USRP or other courses, or teach Calculus at NTU. These not only help them merge better into local mathematics community, but also offer additional manpower for us. There are already a few former international postdocs of the Center that now work in universities in Taiwan.

The NCTS Postdoctoral Program faces new challenges. Because our postdocs are doing very well in finding their next positions, some resigned from positions in the Center before the end of their terms. And probably also because there are more opportunities available, the number of postdoctoral fellows at the NCTS has been shrinking substantially. We had 20 fellows in the year of 2021 to 2022, 15 fellows in the year 2022 to 2023, and from 2023 there are only 12 fellows. We have to work hard to resolve the problem and we hope things can be improved next year.

1.1.5 NCTS Education and Outreach

An important aim of the Center is for it to play a leading role in fostering talents in mathematical sciences and in helping to train the next generation of scientific leaders in Taiwan. The NCTS hosts several programs for students. The USRP (Undergraduate Summer Research Program) as the name suggests, is a 6-week program in the summer in which 1-2 faculty members supervise a group of 2-4 undergraduate students to do original research in a topic agreed upon. An important factor in research in mathematics is the ability to absorb new materials in a non-linear fashion, and the USRP and its counterpart URP (Undergraduate Research Program) are designed partially with this in mind to help undergraduate students reach this stage and introduce them to the process of solving original problems under the guidance of professional mathematicians. If combined with the URP of National Science and Technology Council (NSTC), it can provide motivated undergraduate students two years of very solid training.

This year's USRP was held from July 3–August 11. It consists of 9 research programs which cover a wide spectrum of topics in mathematical sciences, from pure subjects such as curvature equation with singularities and representative theory to applied topics such as Physics-informed Neural Networks, online portfolio selection and its quantum generalization, etc. There were in total 32 student, 9 TA and 14 professor participants in this year's USRP. A two-day offsite activity in Tamsui was arranged at the beginning of the program this year. The purpose was to give an introduction and overview of the 9 projects to all participants and also to provide an opportunity for

them to meet each other. Another change in this year was that the Center has been able to provide accommodation for needed students.

In URP, a group of 1–3 undergraduate students carry out an original research project under the guidance of a professional mathematical scientist. The duration of this program is 9 months. The URP program starting in fall 2022 ended on June 30, 2023, and consisted of 8 groups. This year the Center held two one day activities for the participants of its URP and RA programs: NCTS URP/RA Winter Research Reports and NCTS URP/RA Summer Research Reports on February 9 and June 29, 2023, respectively. The URP starting in fall 2023 consists of 7 groups. The topics of this year cover a wide range of fields from pure to applied mathematics to deep hedging. We are very pleased that the number of female students in both USRP and URP have been increasing in recent years.

Courses and Lectures are a very essential part of training students. The NCTS Taiwan Mathematics School (TMS) offers credit courses to all students in Taiwan. The TMS program was initiated in 2017 with the aim of improving the quality of graduate mathematics education in Taiwan. Most TMS courses and NCTS mini-courses have been videotaped. These online videos have become a very valued and wonderful resource for all to learn new topics. For instance, the videos for the NCTS TMS course “An Introduction to Geometric Measure Theory” taught by Leon Simon during March 5 - May 11, 2018 have been widely viewed in the world. Many learnt the subject from these videos and we still receive gratitude even now for providing these wonderful lectures. The TMS program was paused this year. The NCTS took the opportunity to review and fine-tune related things. During the year, we double checked all the links and videos in the NCTS Media Archive, which were dated from 2015. We also make a better distinction between TMS courses and other NCTS short courses for future arrangement. TMS courses would usually be fundamental or important beginning courses for several fields, which target a wider audience and contain more lectures. Advanced and more specialized topics would appear in the form of mini-courses. This year a total of 32 courses and Lecture series with a wide variety of topics were organized and hosted by the Center, at the time of writing. In contrast, the total number of courses including TMS last year was 21.

The NCTS also provides support for students to attend summer/winter schools abroad as well as conducting research in oversea institutions. The Simons Laufer Mathematical Sciences Institute (SLMath), formerly MSRI, is one of the most prestigious mathematics institutions in the world. It hosts and organizes many conferences, workshops, summer and winter schools of the highest quality every year. It organizes a wide spectrum of two-week residential Summer Graduate Schools each year around the globe. The NCTS is a full member of the SLMath Academic Sponsoring Institutions, and as such, at least two of its nominations of summer school attendees will receive full local support in addition to travel support of up to USD700 from the SLMath every year. In 2023, we successfully recommended 3 SLMath supported stu-

dents plus 2 Fee students to attend these schools. The NCTS supported all expenses of the Fee students and also covered the difference for the SLMath supported students. There will be 12 SLMath Summer Graduate Schools in 2024. The Center is now calling for applications of interested students to determine NCTS Nomination for SLMath Summer Graduate School 2024.

The NCTS also collects information of other summer schools and opportunities around the globe for students and promote them to Taiwan students. In 2023, the Center supported one additional student to attend PCMI 2023 Undergraduate Summer School. She received support from PCMI, and the NCTS covered the difference of her expenses. The three-week residential PCMI summer programs are very well established and with long history. It consists of Graduate Summer program, Undergraduate Summer Program, Undergraduate Faculty Program, and Teacher Leadership Program on a chosen frontier research theme each year, which are held at the same time and same location in Park City. A two-week workshop also takes place in the same period of time. Participants in these programs can therefore meet and interact with mathematicians at different levels and with different backgrounds. The 2023 theme was Quantum Computation.

We started a new series: Gateway to the World-Student Presentations after Academic Visits Abroad. All the NCTS supported students were invited to share what they learned from the summer schools in mathematics, and also share other experiences. Their presentations were grouped into three half day activities. Students particularly enjoyed the open discussion and supportive atmosphere in these summer schools. These summer schools not only deepen and broaden their knowledge and research interests, but also provide an invaluable opportunity for the students to interact and make friends with international students and scholars from all over the world.

The NCTS has a research assistant (RA) program that is open to college graduates who are interested in pursuing graduate studies abroad. The aim of the program is to better prepare highly motivated Taiwanese students for their graduate studies. The duration of a typical research assistant appointment is usually one year. Currently, there are 8 research assistants at the NCTS. Every NCTS research assistant is assigned a Center affiliated mentor who provides guidance and closely oversees the assistant's scientific progress. Selection is based on the candidate's potential and ability to pursue and complete a doctoral program in mathematical sciences at a first-rate research university. This program has been quite successful, as many of the program's alumni have been admitted to top graduate schools.

We also try to connect NCTS visitors with students in Taiwan. For instance, activities such as Meet with Professor Tai-Peng Tsai (UBC), Meet with Prof. Yen-Hsi Richard Tsai (The University of Texas at Austin), Meet with Professor Horng-Tzer Yau (Harvard), and Meet with Professor Mu-Tao Wang (Columbia), have been arranged in the year. The NCTS will also continue to cooperate with other institutions and the Taiwan Mathematical Society on outreach activities such as International Day

of Mathematics, Salon de Mathématiques, Public Talks, etc.

The NCTS has played an important role in the training and development of scientists in Taiwan in the past, and we believe that the NCTS Education and Outreach program is key for the Center to continue to do so in the future. A new Research Abroad program for students has been launched recently and we are now calling for applications. We will explain more in Section 1.1.6.

1.1.6 Future Plans

Since the lift of covid measures and travel restrictions in Taiwan, the number of academic activities and the number of visitors at the NCTS have increased substantially this year. We expect it will keep improving next year and 2024 is going to be a busy year for the NCTS Mathematics Division.

Firstly, we are going to have an NCTS International Advisory Committee Meeting during June 27-28, 2024. The IAC is the highest supervisory board overseeing and advising the scientific directions and operations of the NCTS. The purpose of such a meeting is for the committee to have a better understanding of the overall operations of the NCTS and to make recommendations and suggestions for its future directions. Except Shing-Tung Yau, the other IAC members Robert Bryant, Russel Caflisch, Ching-Li Chai, Hélène Esnault, Horng-Tzer Yau will all be able to attend this meeting. The vision and guidance from the members will be very essential to the Center's future developments and for overcoming challenges.

One of our main goals in 2024 is to solidify and develop new collaborations with other international research institutions. After being affected by the pandemic for more than three years, many MOUs between the NCTS and its international partners have expired. In 2023, we reconnected with our international partners, and renewed those expired MOUs. In particular, new agreements have been signed this year with Fields Institute and PIMS in Canada, BMS in Germany, RIMS in Japan, KIAS and PMI in Korea. Because of the merger of The Osaka City University with other universities in Osaka, the MOU between the NCTS and OCAMI will also be re-signed this November.

Our collaboration with PMI has been very successful. A series of NCTS-Postech PMI joint workshop started in 2009, which first took place yearly rotating between the NCTS and PMI and later was changed to a biannual event. This series is mainly on number theory, and has excelled in strengthening mutual cooperation, advancing research, and nurturing the young generation of scholars. We would like to extend this model and experience to other international partners. In particular, a series of biannual NCTS- PIMS joint workshop with rotating locations and rotating fields has been planned and approved by both sides. The 2024 workshop will be held in the NCTS in the field of PDE. It is tentatively named NCTS-PIMS workshop in PDE (2024) and will takes place in early June. It is expected to have 6-8 speakers from Canada with additional 8-10 students and postdocs. The 2026 workshop will be held

in UBC in the field of Geometric Analysis. It is expected that 6-8 speakers from Taiwan with additional 8-10 students and postdocs will participate in this workshop in Vancouver. The two sides will fine-tune the series after two workshops. Mobility plans for students and scholars, including co-supervision are also under discussions. We had similar discussions with other institutions such as RIMS, Fields Institute, etc. and will continue to work on the detailed collaboration plans.

The NCTS has signed agreements with several partner institutions such as PIMS, RIMS, KIAS, Fields, and BMS, on scholar exchange and established International Exchange Program that gives selected mathematicians affiliated with Taiwanese institutions the possibility to visit these institutions for a duration of 1-3 months. Priority is given to junior mathematicians. However, there were not many applicants in the past, and we would like improve and strengthen the program. We have revised the page of international partners in the NCTS website and plan to include some information and highlights of their activities or thematic programs. We hope this and efforts on organizing joint activities can increase the interactions and collaborations with our international partners as well as promoting the international exchange program.

During the year, we also explored the idea of training students together and co-organizing summer/winter schools with institutions in Asia. The SLMath Summer Graduate Schools would be our model. Although the people we talked to were all very supportive and liked the idea, the funding in many countries seems not very flexible and comes with a lot of restrictions. Splitting the budget among participating institutions might not work. We will try to find other ways on carrying out the plan.

The collaboration between mathematicians in Taiwan and Japan has been very close. In 2023, the NCTS has organized and hosted several Taiwan-Japan joint conferences. There was one for Young Scholars in Applied Mathematics during March 1-3, and another one on Number theory during August 21-25. The Fourth Taiwan-Japan Joint Conference on Differential Geometry will take place during November 6-9, 2023. It is a biannual event and the location rotates between Taiwan and Japan. The joint conference on Number Theory has the same structure, while the one for Young Scholars in Applied Mathematics takes place yearly and was already 13th of the series. On December 9, 2023, we are going to host NCTS-Kyoto Mathematics Symposium which consists of Keynote talks, 4 parallel sessions and the poster session. A total of 25 participants come from Kyoto University that include 15 faculty, 9 students and one supporting staff. We are very looking forward to this event and collaboration with Kyoto University.

In this November, besides the Taiwan-Japan Joint Conference on Differential Geometry, there is also the 2023 NCTS Interdisciplinary Two-Day Workshop: Population Dynamics and Related Topics, November 13-14, 2023. In December, besides the NCTS-Kyoto Mathematics Symposium, there are Conference on Algebraic Representation Theory (CART) 2023, December 1-3, 2023, NCTS 2023 Conference on Differential Geometry and Geometric Analysis, December 16-18, 2023, Taipei Conference

in Representation Theory VII, December 18 - 22, 2023.

The Fifth Taiwan International Conference on Geometry that was postponed from 2020 will finally take place during January 12-19, 2024, at the NCTS. This series of conferences is held every 2-3 years and an important area in geometry is specified as the main theme each time. The topics of the fifth conference include the main research topics in geometric analysis such as General Relativity, Minimal Submanifolds and Geometric Evolution Equations. It also has two mini courses on January 12 and 14, respectively. Participants and speakers include important mathematicians Richard Schoen, Andre Neves, Peter Topping, Mu-Tao Wang, Alessandro Carlotto, Otis Chodosh, Ailana Fraser, etc. There is also Workshop on Mathematics of living systems, January 25-26, 2024 with important speakers such as Michael J. Shelley, Yoichiro Mori, etc. In January, there are also the 11th NCTS-Postech PMI Joint Workshop on Number Theory, and EACDFM that the NCTS co-organizes, but are not held in Taiwan.

Other NCTS conferences and workshops that have been planned in 2024 include Workshop on K-stability and its applications in February, Conference on Advanced Topics and Auto Tuning in High-Performance Scientific Computing in March which has been held yearly since 2013, a workshop related to derived geometry and physics in March, Workshop on Nonlinear Partial Differential Equations, April 8-10, Mini-workshop on algebraic cycles in April, 2024 Taiwan Probability Workshop in spring, 2024 NCTS International conference on scientific machine learning in May, NCTS-PIMS workshop in PDE in June, 2024 NCTS Workshop on Mathematical Biology in June, Workshop on Higher Codimensional Mean Curvature Flow in the summer, NCTS Workshop on Function Field Arithmetic in September, a conference on the Stein method, etc.

The NCTS also holds regular workshops such as NCTS Number Theory Day, Taiwan Geometry Symposium, NCTS Young Dynamics Day, NCTS Workshop on Dynamical Systems, NCTS South-Taiwan Workshop on Scientific Computations, Differential Equations and Application, NCTS Student Workshop on Scientific Computing, NCTS Workshop on Computational Mathematics and Scientific Computing for Young Researchers, NCTS Postdoc Symposium, etc. Other workshops associated with international visitors and the research interests of our groups will also be organized.

The NCTS usually have several international visitors staying for the whole summer. There are some additional long-term visitors planned in 2024. Currently, we have Willie Wai-Yeung Wong from Michigan State University who has been visiting the Center since Aug. 15, 2023 and will be staying for a year. He is giving a course on “Mathematical General Relativity: Evolutionary and Causal Aspects”, and will offer another course next semester. From February, 2024, Loring W. Tu from Tufts University will visit the NCTS for one semester, and will teach a course on “Differential Forms in Algebraic Topology”. Tu also had visited the Center for one semester from February to May in 2017. During that visit, he offered a course on “An Introduction

to Equivariant Cohomology” that led to the publication of his book “Introductory Lectures on Equivariant Cohomology”, Annals of Mathematics Studies vol. 204, Princeton University Press, 2020. Haruzo Hida from UCLA will also visit the NCTS from March to June in 2024. He will be an NCTS Distinguished Scholar from January 1, 2024 for three years. During his visit, Hida will give a series of 13 lectures on “Adjoint L-Values and Tate Conjectures”. Finally, we will have the visit of Martin Guest from Waseda University from September, 2024 for a year and he plans to teach a course in each semester. A possible 3-month visit of Mu-Tao Wang from Columbia University in the spring of 2025 is also under arrangements.

In order to invite outstanding researchers to visit the NCTS for a longer period and to promote international cooperation, we established the NCTS (Distinguished) Scholar program. The NCTS Scholars are expected to visit the Center for up to six months within a 3-year period of time. Because of the travel restrictions during the pandemic, the program did not function well in the past three years. We will restart the selection process of new NCTS Scholars starting January 1, 2024 and reinforce the program again. Another program we like to promote more in the coming year is the NCTS Research in Pairs. The program aims to invite groups of excellent mathematicians to work on research projects of substantial impact at the NCTS. A Research Pair may consist of two to four members, and can spend two to eight weeks in NCTS to conduct their joint research. The members must not be all affiliated with the same institution. We have recently reviewed and revised regulations of the program. We hope that there will be more successful cases in the future.

A new research abroad program for students has been launched recently. The program will support up to 10 students a year to work with professors in international institutions for a period of 2 to 4 months. It aims to strengthen Taiwan students’ abilities in research, to enhance their vision and competitiveness, and to provide opportunities for international experience. This is part of our efforts on fostering talents in mathematical sciences in Taiwan. The program is now calling for students’ applications until November 30, 2023, and the visit should be made during June of 2024 to May of 2025.

1.2 Summary of Data

This section gives a structural overview of the Center. More complete and detailed information can be found in the Appendix. The appointment of a Center Scientist is for two years a term and may be renewed for another term. Young Theoretical Scientists can be appointed only once, and it is also for two years. The data of publication by members in Section 1.2.6 reflect those available to the Center by August 30, 2023.

1.2.1 Committees and Members

We also refer to Section 4.1 for Chinese names of the committee members when applicable.

International Advisory Committee: Robert Bryant (Duke University), Russel Caflisch (New York University), Ching-Li Chai (since August) (University of Pennsylvania), Hélène Esnault (Freie Universität Berlin), Shigefumi Mori (until July) (RIMS), Horng-Tzer Yau (Harvard University), Shing-Tung Yau (Harvard University).

Executive Committee: Chiun-Chuan Chen (NTU), Shun-Jen Cheng (AS), Ming-Lun Hsieh (NTU), Yng-Ing Lee (NTU), Wen-Wei Lin (until July) (NYCU), Dong-Ho Tsai (NTHU), Mao-Pei Tsui (NTU).

Academic Committee: Yi-Fan Yang (NTU), Jungkai Chen (NTU), Nan-Kuo Ho (NTHU), Kung-Chien Wu (NCKU), Tsung-Ming Huang (NTNU), Tai-Chia Lin (NTU).

Topical Program Committees:

- (A) *Number Theory and Representation Theory:* Yifan Yang (NTU, chair), Chieh-Yu Chang (NTHU), Chun-Ju Lai (AS), Fu-Tsun Wei (NTHU)
- (B) *Algebraic Geometry:* Jungkai Chen (NTU, chair), Ching-Jui Lai (NCKU), Hsueh-Yung Lin (NTU), Jeng-Daw Yu (NTU).
- (C) *Differential Geometry and Geomtric Analysis:* Nan-Kuo Ho (NTHU, chair), River Chiang (NCKU), Chun-Chi Lin (NTNU), Chung-Jun Tsai (NTU).
- (D) *Differential Equations and Stochastic Analysis:* Kung-Chien Wu (NCKU, chair), Jung-Chao Ban (NCCU), Chun-Hsiung Hsia (NTU), Hsin-Yuan Huang (NYCU), Yuan-Chun Sheu (NCYU), Chun-Yen Shen (NTU).
- (E) *Scientific Computing:* Tsung-Ming Huang (NTNU, chair), Wei-Fan Hu (NCU), Matthew M. Lin (NCKU), Ming-Cheng Shiue (NCTU), Suh-Yuh Yang (NCU).
- (F) *Interdisciplinary Studies:* Tai-Chia Lin (NTU, chair), Te-Sheng Lin (NYCU), Je-Chiang Tsai (NTHU), Feng-Bing Wang (CGU).

Center Scientists:

- ◇ Chun-Yen Shen (NTU), Hao-Wei Huang (NTHU), Yung-Ning Peng (NCKU), Ye-Kai Wang (NYCU) (all until July 31).
- ◇ Hsin-Yuan Huang (NYCU), Wei-Fan Hu (NCU), Hsueh-Yung Lin (NTU), Feng-Bin Wang (Chang Gung U.)

◇ Chih-Whi Chen (NCU), Jin-Cheng Jiang (NTHU), Gi-Ren Liu (NCKU), Chang-Hong Wu (NYC) (all starting August 1).

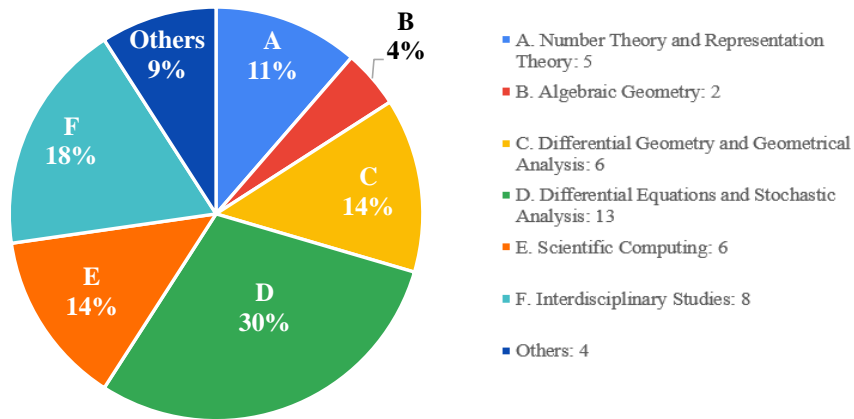
Young Theoretical Scientists: Jia-Yuan Dai (NCHU), Adeel Khan (AS), Ting-Jung Kuo (NTNU), Chun-Ju Lai (AS), Mei-Heng Yueh (NTNU).

NCTS Scholars: Yujiro Kawamata (University of Tokyo), Nikolaos Zygouras (University Warwick), Horng-Tzer Yau (Harvard University), Fan Chung Graham (UC San Diego), Paolo Cascini (Imperial College), Richard Schoen (UC Irvine), Kaoru Ono (Kyoto University), Keiji Oguiso (University of Tokyo).

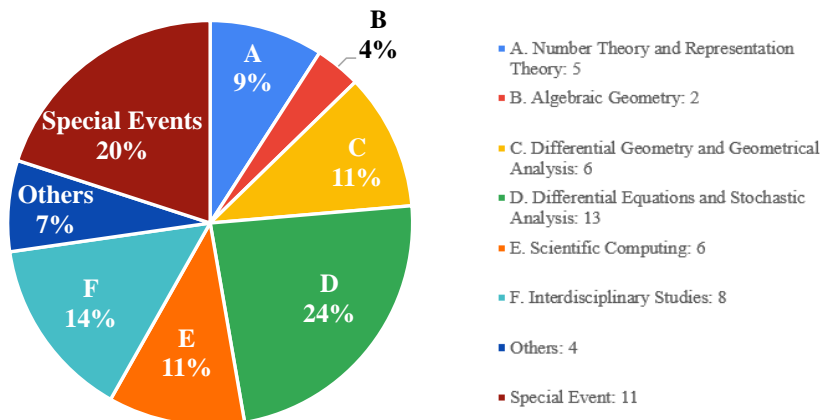
1.2.2 Workshops, Conferences, and Special Events

2023 Conferences, Workshops and Special Events	
A. Number Theory and Representation Theory	5
B. Algebraic Geometry	2
C. Differential Geometry and Geometrical Analysis	6
D. Differential Equations and Stochastic Analysis	13
E. Scientific Computing	6
F. Interdisciplinary Studies	8
Others	4
Special Events	11
	55

2023 Conferences and Workshops (without Special Events)

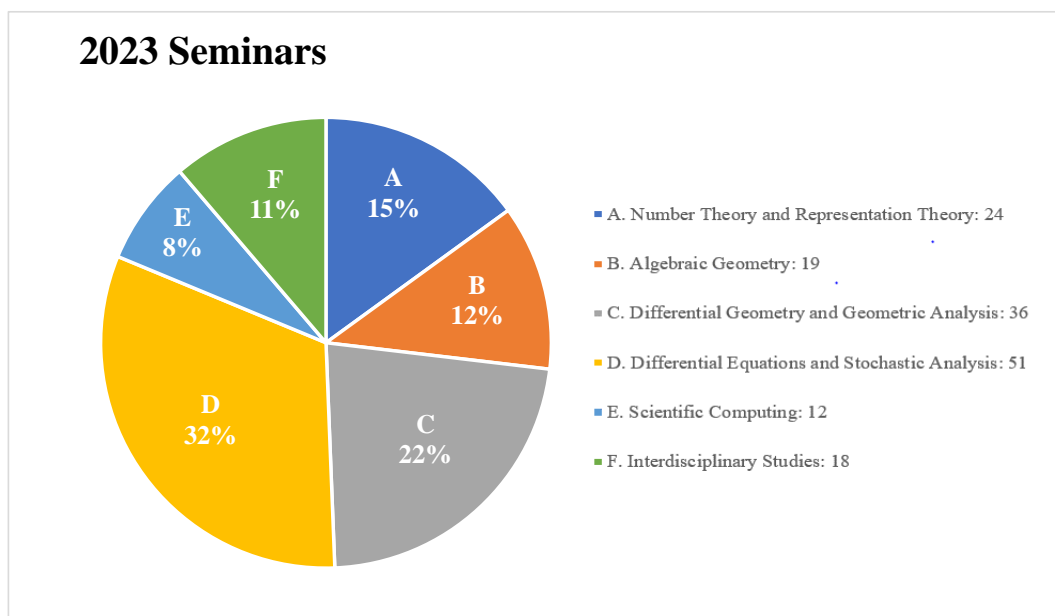


2023 Conferences, Workshops and Special Events



1.2.3 Seminars

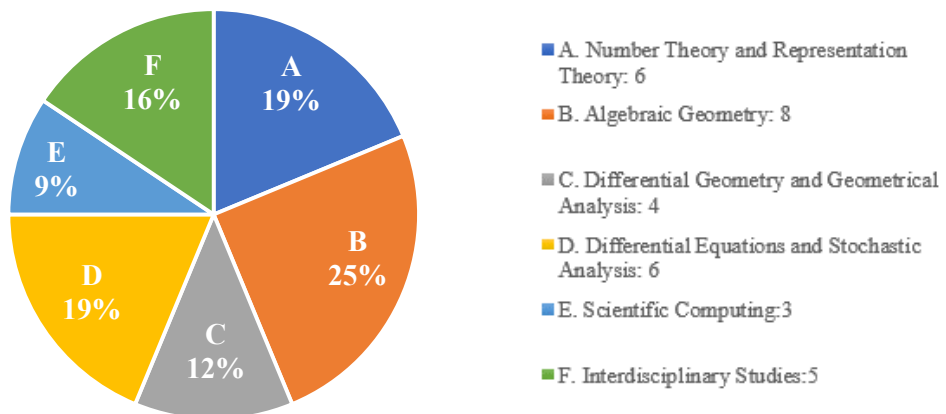
2023 Seminars	
A-Number Theory and Representation Theory	24
B-Algebraic Geometry	19
C-Differential Geometry and Geometric Analysis	36
D-Differential Equations and Stochastic Analysis	51
E-Scientific Computing	12
F-Interdisciplinary Studies	18
	160



1.2.4 Courses

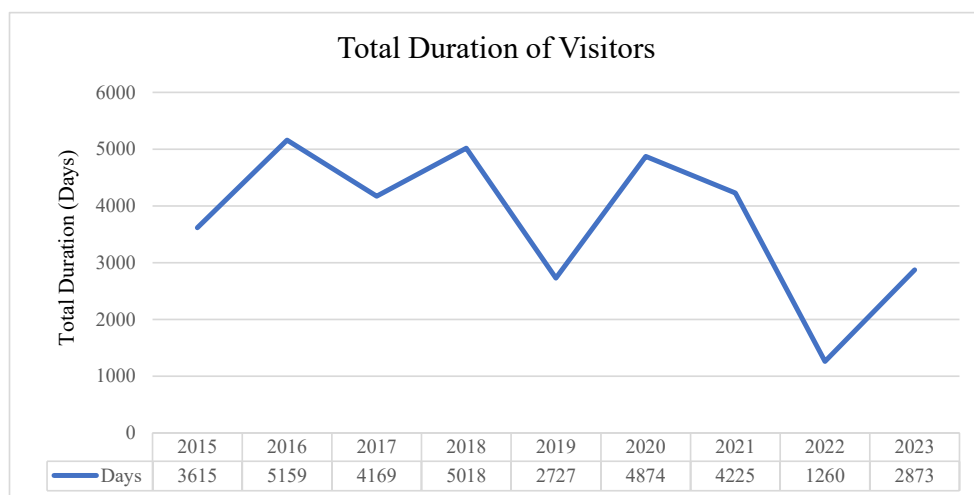
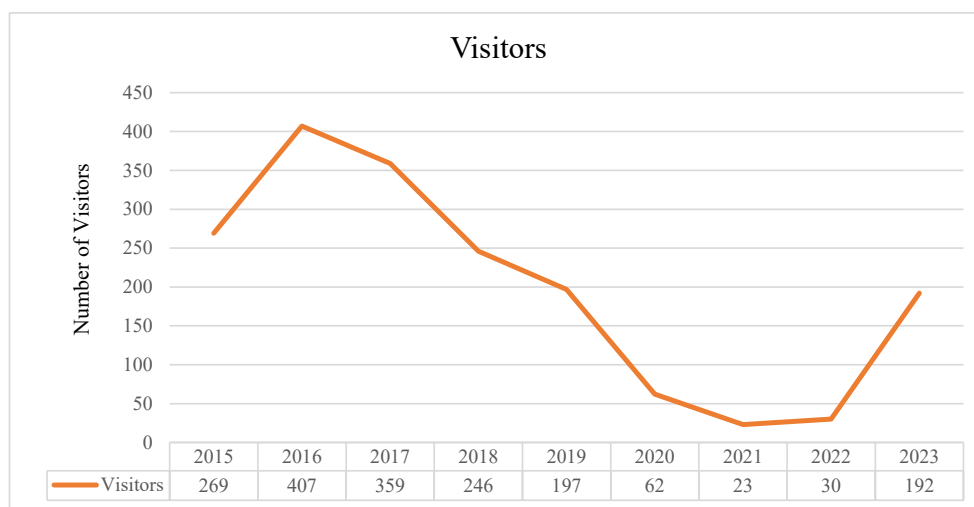
2023 Courses (without TMS)	
A. Number Theory and Representation Theory	6
B. Algebraic Geometry	8
C. Differential Geometry and Geometrical Analysis	4
D. Differential Equations and Stochastic Analysis	6
E. Scientific Computing	3
F. Interdisciplinary Studies	5
	32

Courses & Lectures without TMS



1.2.5 Visitors

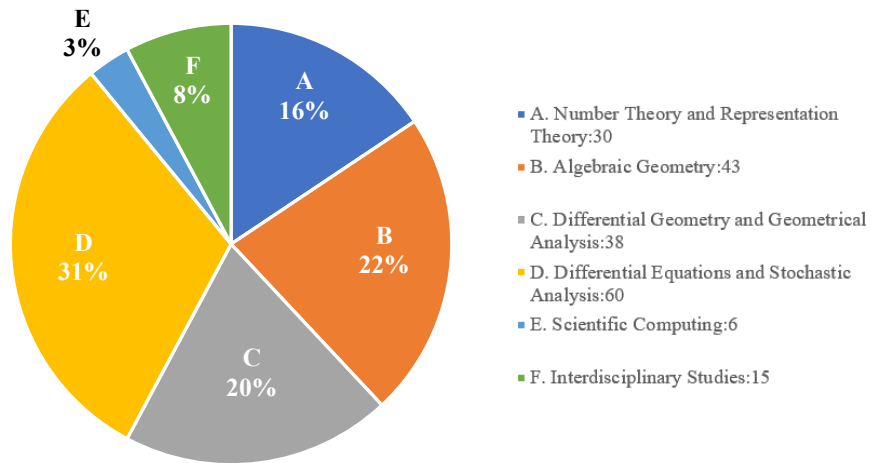
Year	2015	2016	2017	2018	2019	2020	2021	2022	2023
Number of Visitors	269	407	359	246	197	62	23	30	192
Total Duration Days	3615	5159	4169	5018	2727	4874	4225	1260	2873



Visitors from Abroad

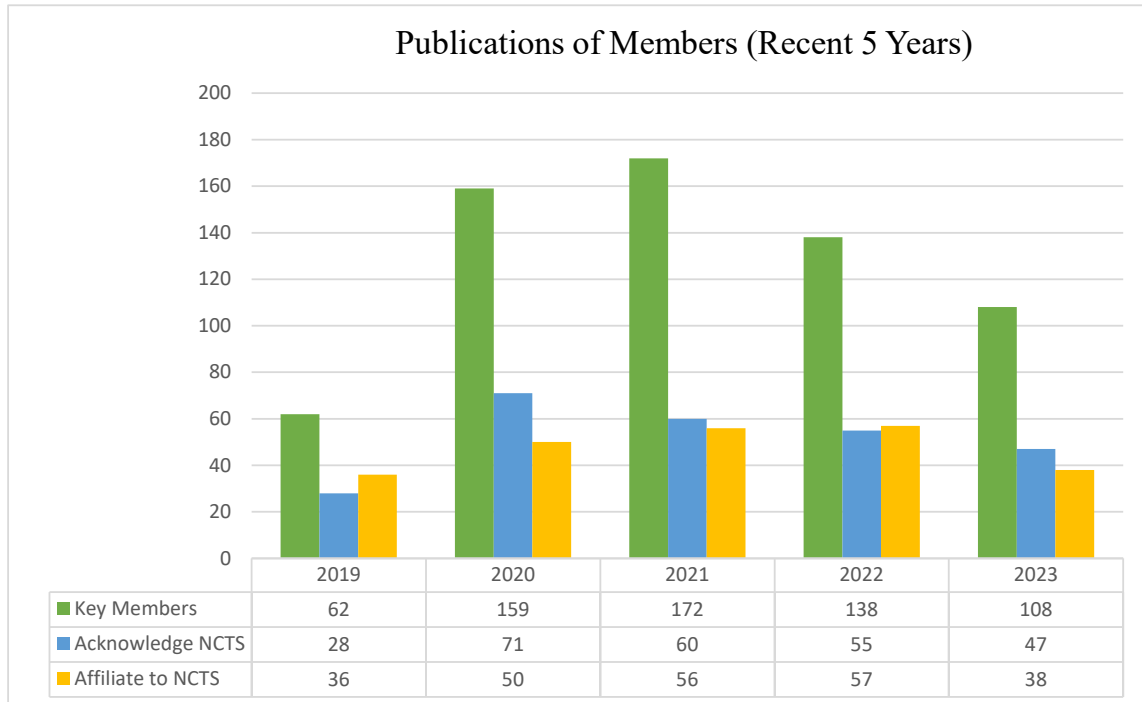
2023 Visitors		
A. Number Theory and Representation Theory	30	16%
B. Algebraic Geometry	43	22%
C. Differential Geometry and Geometrical Analysis	38	20%
D. Differential Equations and Stochastic Analysis	60	31%
E. Scientific Computing	6	3%
F. Interdisciplinary Studies	15	8%
	192	100%

2023 Visitors by Topical Program



1.2.6 Summary of publication data

The 2023 publications below are counted until July.



2 Topical Programs

2.1 Program A. Number Theory and Representation Theory

2.1.1 Core Members

1. Program Committee Members: Chieh-Yu Chang (NTHU), Chun-Ju Lai (AS), Fu-Tsun Wei (NTHU), Yifan Yang (NTU, chair).
2. Affiliated Faculty Members: Yao Cheng (Tamkang), Jia-Wei Guo (NSTC independent researcher based at NTU), Liang-Chung Hsia (NTNU), Ming-Lun Hsieh (AS), Ping-Che Hung (SCU), Ming-Hsuan Kang (NYCU), Adeel Khan (AS), Nobuo Sato (NTU), Tzu-Yue Wang (AS), Chia-Fu Yu (AS), Chih-Whi Chen (NCU), Shun-Jen Cheng (AS), Shih-Chang Huang (NCKU), Chun-Ju Lai (AS), Ching Hung Lam (AS), Yung-Ning Peng (NCU), Wei-Hsuan Yu (NCU).
3. Postdoctoral Fellows: Chien-Hua Chen (NCTS), Harrison Chen (AS), Shih-Yu Chen (AS), Sheng-Fu Chiu (AS), Huy Quoc Dang (NCTS), Oguz Gezmis (NCTS), You Hung Hsu (AS), Jiun-Wen Peng (NCTS), Daniel Tsai (NTU).

2.1.2 Program Overview

The purpose of the number theory and representation theory program at NCTS is to assist domestic number theorists and algebraists to continue developing active and promising research topics, and create opportunities for international cooperation as well as cultivating young researchers and students. Our research topics cover a wide spectrum of algebra and number theory from various perspectives. In the past year, our members focus on the following areas:

1. Iwasawa theory and p -adic methods in algebraic number theory and automorphic forms.
2. Special values over function fields and related topics.
3. Arithmetic and geometry of moduli spaces and explicit methods.
4. Arithmetic dynamical systems and Diophantine problems.
5. Lie superalgebras.
6. Vertex operator algebras (VOAs).
7. Hecke algebras and Cherednik algebras.
8. Geometric representation theory.

We run this program by having regular seminars on number theory, arithmetic geometry, and representation theory, summer/winter schools and hosting some international workshops and conferences. NCTS Number Theory Seminars are held in Taipei on Fridays and in Hsinchu on Wednesdays. Seminars on arithmetic geometry are organized by C.-F. Yu and they were held in Taipei. Seminars on representation theory are organized by Chun-Ju Lai. These regular seminars provide a platform for research exchanges and discussions, and an opportunity for young scholars to broaden their horizons.

2.1.3 Research Highlights

Below are some of the highlights and breakthroughs in 2022 and 2023.

1. Special values over function fields, by *C.-Y. Chang*.

My most important published results in the last five years are the joint paper with Y. Mishiba published in *Inventiones* 2021 [2], and the joint paper with Y.-T. Chen (my PhD student) and Y. Mishiba published in *Cambridge Journal of Mathematics* 2022 [3]. In the former paper, we proved a function field analogue of Furusho's conjecture. More precisely, we showed that there is a well-defined linear map from the v -adic multiple zeta values (abbreviated as MZV's) to the v -adic MZV's with kernel containing the one-dimensional vector subspace spanned by the signal zeta value when the weight is " q "-even. In the later one, we further generalized the above work in the sense that the map is indeed an algebra homomorphism. Our ultimate goal is to prove the challenge that the kernel of the homomorphism is generated by the single zeta value at $q - 1$ as is inspired by the spirit of Grothendick's period conjecture for real and p -adic multiple zeta values.

2. Representations of Lie superalgebras, by *C.-W. Chen and S.-J. Cheng*.

In [6], we continued our study of the irreducible character problem for the exceptional finite-dimensional simple Lie superalgebras. In earlier works, we have computed together with Weiqiang Wang the irreducible characters of the two exceptional simple Lie superalgebras $G(3)$ and $D(2|1, \zeta)$ in the BGG category \mathcal{O} in the case of modules with integral weights. In the sequel to these works, we have investigated the BGG categories for modules of non-integral weights for the Lie superalgebras $G(3)$ and $D(2|1, \zeta)$ in two separate joint papers with Li Luo. In [4], we computed the irreducible character of non-integral highest weight modules for $D(2|1, \zeta)$. In a subsequent joint work, we investigated the non-integral weight module category for $G(3)$. We first classify blocks in the BGG category of modules of non-integral weights for the exceptional Lie superalgebra $G(3)$. We then compute the characters for tilting modules of non-integral weights in \mathcal{O} . Reduction methods are established to connect non-integral blocks

of $G(3)$ with blocks of the special linear Lie algebra $\mathfrak{sl}(2)$, the exceptional Lie algebra G_2 , the general linear Lie superalgebras $\mathfrak{gl}(1|1)$, $\mathfrak{gl}(2|1)$ and the orthosymplectic Lie superalgebra $\mathfrak{osp}(3|2)$.

In [5], we study the category of Whittaker modules for type I Lie superalgebras in the framework of categories with stratified structures. These categories extend the notion of highest weight categories and indeed provide a convenient setting to study Whittaker modules over Lie algebras and Lie superalgebras. We show that certain subcategories of the category of Whittaker modules have such stratified structures and furthermore these categories include all the standard and simple objects of the Whittaker category. We furthermore study these categories in detail and prove that they are certain Serre quotients of the BGG category and have (stratified) tilting objects as well. In the case of the general linear Lie superalgebra and integral central character, we construct a q -symmetric Fock space on which an infinite rank quantum group of type A acts and furthermore this Fock space has canonical and dual canonical bases as defined by Lusztig. A main result is that this Serre quotient category categorifies this q -symmetric Fock space and under this categorification the canonical and dual canonical basis elements correspond to the tilting and irreducible Whittaker modules.

3. p -adic methods in algebraic number theory and automorphic forms, by *Ming-Lun Hsieh* and *Yao Cheng*.

In [1], we used the factorization of certain p -adic triple product L -series in our earlier work to prove that the diagonal cycle class of an elliptic curve is non-vanishing if and only if the p -Selmer rank of this elliptic curve is two. This work provides the first examples of the conjecture of Darmon and Rotger and suggests that these diagonal cycle classes, although non-motivic, potentially serve the role of Heegner points on elliptic curves of rank one in the rank two case. This work opens the door to BSD conjecture for rank two elliptic curves.

In [7], we explicitly computed the Rankin-Selberg integrals attached to newforms and oldforms (for $\mathrm{SO}(2n+1)$) under the assumption that the newform conjecture for $\mathrm{SO}(2n+1)$ proposed by Gross and Tsai. Especially when $n = 1$ and 2 , our results hold unconditionally due to the works of Casselman ($n = 1$) and Roberts-Schmidt ($n = 2$). We expect that these results will have some arithmetic applications such as establishing explicit formulae for special L -values, which can be used to study the L -values. Our method is based on Tsai's thesis, which has roots in the work of Jacquet-Piatetski-Shapiro-Shalika. Another main ingredient is the work of Jiang-Soudry, which proves the gamma factors defined via various methods agree.

4. Affine Hecke algebras, by *Chun-Ju Lai*.

The 104-page research monograph [8] is dedicated to the canonical basis the-

ory of the quantum symmetric pair (or, i-quantum groups) of affine type using techniques from the theory of affine Hecke algebras. This is the algebraic enhancement of my earlier work appearing also in the Memoirs of the American Mathematical Society, which deals with geometry of affine flag varieties and counting over finite fields. This in turn provides an affinization of Bao-Wang’s foundational work on quantum symmetric pairs and i-quantum groups which leads to the 2020 AMS Chevalley Prize as well as a 2022 ICM talk. While there are 5 authors, a large portion of the main text of [8] is based on my PhD thesis regarding the non-trivial multiplication formulas with tridiagonal generators.

5. Diophantine problems, by *Tzu-Yueh Wang*.

In [9], we apply the GCD results developed in an earlier work to show a complex version of Pisot’s d -th root conjecture. We also formulate a boundary case of the Green-Griffiths-Lang conjecture for projective spaces with moving targets. In [13], we use Ru-Vojta’s theorem to study integral points for some quasi-projective varieties and use the results to study special varieties and divisibility properties.

6. Arithmetic of function fields, by *Fu-Tsun Wei*.

In a series of joint work with Mihran Papikian (Penn State University), we use the Eisenstein ideal of the Hecke algebra on Drinfeld modular Jacobians with square-free levels to compare their rational torsion subgroups with its subgroup generated by the cuspidal divisors. This enables us to produce explicit examples of Jacquet-Langlands isogenies. Our results are stronger than what is currently known about the analogues of these problems over \mathbb{Q} . In [12], we explore the phenomenon in the higher rank case. We start with the prime level case, and explicitly determine the structure of the corresponding cuspidal divisor groups. This is accomplished by examining the Fourier coefficients of the harmonic 1-cochains in higher rank case, with the help of my earlier work on the Kronecker limit formula.

In the paper [10], our goal is to describe class number relations in terms of intersection numbers of “Heegner divisors” on Drinfeld-Stuhler modular surfaces. Moreover, we derive Gauss-type mean value formula for the masses over CM points on Drinfeld-Stuhler modular curves and also definite Shimura curves over global function fields. This formula, in particular, provides “new” class number relations over function fields, which does not occur in the classical settings.

7. Arithmetic of Shimura varieties, by *Chia-Fu Yu*.

In [14], we show that the systems of prime-to- p Hecke eigenvalues arising from automorphic forms (modulo p) associated to an algebraic group G/\mathbb{Q} of Hodge type agree with those arising from algebraic modular forms (modulo p) associated to an inner form of G . This extends previous results by Serre and Gross. In

particular, the former had proved that the systems of prime-to- p Hecke eigenvalues arising from modular forms (modulo p) are the same as those arising from locally constant functions $f : D^\times \backslash (D \otimes_{\mathbb{Q}} \mathbb{A}_f)^\times \rightarrow \overline{\mathbb{F}}_p$, where D is the quaternion algebra ramified at p and ∞ , and \mathbb{A}_f is the ring of finite adèles.

In addition, in our previous works, we studied the classification of superspecial abelian surfaces over finite fields. In particular, we established in Part II a formula for computing the number $|\mathrm{SSp}_2(\mathbb{F}_q)|$ of isomorphism classes of superspecial abelian surfaces over any finite field \mathbb{F}_q of even degree over the prime field \mathbb{F}_p . With conditions on possibly excluding $p = 2, 3$, or 5 , explicit formulas are given for each summand for counting $|\mathrm{SSp}_2(\mathbb{F}_q)|$ based on the isomorphism types. In [15], we complete the computation of these excluded cases.

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- [12] M. Papikian and **F.-T. Wei**. Drinfeld discriminant function and Fourier expansion of harmonic cochains, Drinfeld discriminant function and Fourier expansion harmonic cochains. *Mathematische Annalen*, 2023.
- [13] E. Rousseau, A. Turchet, and **T.-Y. Wang**. Divisibility of polynomials and degeneracy of integral points. *Math. Ann.*, 2023.
- [14] Yasuhiro Terakado and **Chia-Fu Yu**. Hecke eigensystems of automorphic forms (mod p) of Hodge type and algebraic modular forms. *Math. Ann.* 382:69–102, 2022.
- [15] J. Xue, **Chia-Fu Yu**, and Yuqiang Zheng. On superspecial abelian surfaces over finite fields III. *Res. Number Theory*, Paper No. 9, 22 pp, 2022.

2.1.4 Highlights of Events

Seminars

1. NCTS seminar on arithmetic geometry and representation theory.
Organizer: Chia-Fu Yu.
2. NCTS seminar on number theory.
Organizers: Chieh-Yu Chang, Ming-Lun Hsieh, Fu-Tsun Wei, and Yifan Yang.
3. NCTS seminar on representation theory.
Organizer: Chun-Ju Lai.

Lectures and Courses

1. NCTS short course on representation theory: minicourse on double affine Hecke algebras.
Organizer: Chun-Ju Lai.
2. Winter short course on algebraic geometry.
Speaker: Chia-Fu Yu.
3. Spring course: introduction to t -motives and related topics.
Speaker: Chia-Fu Yu.

4. NCTS Short Course on Representation Theory: Lecture series on Quantum Wreath Products.
Speaker: Chun-Ju Lai.
5. The Filtration Method in Diophantine Approximation and K- Stability.
Speaker: Min Ru.
6. Uniformity Results in Diophantine Geometry.
Speaker: Amos Turchet.
7. Lecture Series: Congruences of Modular Forms and Galois Representations.
Speaker: Jacques Tilouine.

Conferences and Workshops

1. NCTS Workshop on Function Field Arithmetic.
Organizers: Chieh-Yu Chang and Fu-Tsun Wei.
2. The 10th NCTS–POSTECH-PMI Joint Workshop on Number Theory.
Organizers: Sungmun Cho, YoungJu Choie, and Chia-Fu Yu.
3. NCTS Number Theory Day.
Organizer: Ming-Lun Hsieh.
4. NCTS One-day Combinatorics Workshop.
Organizer: Wei-Hsuan Yu.
5. Fifth Japan-Taiwan Joint Conference on Number Theory.
Organizers: Masataka Chida, Ming-Lun Hsieh, and Fu-Tsun Wei.

2.1.5 Future Plans

Conferences and workshops:

1. Conference on Algebraic Representation Theory 2023. *December 1–3, 2023*.
Organizers: Shun-Jen Cheng, Susumu Ariki, Satoshi Naito, Jae-Hoon Kwon, Hebing Rui, Fan Qin, Toshiaki Shoji.
Local Organizers: Yung-Ning Peng, Ngau Lam, Ching Hung Lam, Chun-Jui Lai, Cheng-Chiang Tsai
2. Taipei Conference on Representation Theory VII. *December 18–22, 2023*.
Organizers: Shun-Jen Cheng, Weiqiang Wang

3. 11th NCTS–POSTECH-PMI Joint Workshop on Number Theory, to be held in *January, 2024*.
4. NCTS Workshop on Function Field Arithmetic.
5. NCTS Number Theory Day.
6. Sixth Japan-Taiwan Joint Conference on Number Theory, to be held in *2025*.

Seminars

1. NCTS seminar on arithmetic geometry and representation theory.
Organizer: C.-F. Yu.
2. NCTS seminar on number theory.
Organizers: C.-Y. Chang, M.-L. Hsieh, F.-T. Wei, and Y. Yang.
3. NCTS seminar on representation theory.
Organizer: Chun-Ju Lai.

Courses and lectures:

1. We plan to invite several international renowned experts to visit NCTS and give lectures or short courses. One visitor who has tentatively confirmed is Professor Haruzo Hida. To better prepare students for Professor Hida's lectures, we plan to arrange some short courses.
2. We plan to continue our tradition of offering regular courses/summer or winter courses/short courses on analytic number theory, algebraic number theory, automorphic representations, arithmetic geometry, representation theory, and combinatorics.

2.2 Algebraic Geometry

2.2.1 Core Members

1. Program Committee Members: Jungkai Chen (NTU), Hsueh-Yung Lin (NTU), Jeng-Daw Yu (NTU), Ching-Jui Lai (NCKU)
2. Affiliated Faculty Members: Shin-Yao Jow (NTHU), Jiun-Cheng Chen (NTHU), Frank Jia-Ming Liou (NCKU), Ting-Yu Lee (NTU), Jheng-Jie Chen (NCU)
3. Postdoctoral Fellows: Iacopo Brivio (NCTS), Bin Nguyen (NCTS), Chih-Wei Chang (NCTS, then NTU), Hsin-Ku Chen (KIAS), Yen-An Chen (NCTS)

2.2.2 Program Overview

The aim of this program is to investigate higher dimensional algebraic geometry, focusing on theory of singularities, special varieties, birational invariants, and their applications. On one hand, we aim to foster frontier research around the aforementioned topics; and on the other hand, we aim to build up a research team of international level. Thus we also spent quite some efforts on student training programs.

1. varieties with extremal invariants
2. motivic invariants and other birational invariants
3. geometry of algebraic fiber spaces
4. geometry of algebraic foliation
5. singularities in dimensions 2, 3, and higher
6. minimal model program

2.2.3 Research Highlights

Below are some of the highlights and breakthroughs in 2022 and 2023.

1. Motivic invariants of birational maps, *by Hsueh-Yung Lin*
Together with E. Shinder, Hsueh-Yung Lin worked on the so-called motivic invariants. First type of question is to compare the motivic invariants between birational models, especially for birational self-maps. In [7], they proved that the blowup center and the blowdown center are isomorphic for any weak factorization of smooth surfaces. This result is trivial over algebraic closed field but highly non-trivial over non-closed fields.

In [6], they defined an invariant $c(f)$ for any birational map $f : X \dashrightarrow Y$. They proved a crucial property that $c(f \circ g) = c(f) + c(g)$. They consider this invariant for Cremona transformation, i.e., the birational automorphism group of projective spaces. In particular, they proved that the Cremona group is non-simple for many cases, e.g. dimension ≥ 5 and over infinite fields. As a consequence, Cheltsov's conjecture and Dolgachev's question have negative answers in those cases of their theorem. This work is to appear in *Ann. Math.*.

2. Movable cone of Calabi-Yau threefolds, by *Ching-Jui Lai*

The geometry of Calabi-Yau threefolds is an important but challenging branch in the study of higher dimensional geometry. Together with Ito and Wang, Ching-Jui Lai is able to describe explicitly the chamber structure of the movable cone of certain Calabi-Yau threefolds. More precisely, they work on general complete intersection Calabi-Yau threefold in $n + 4$ -dimensional \mathbb{P}^n -ruled Fano manifold of Picard number two (cf. [5]).

This work is related to the well-known Cone Conjecture proposed by Morrison and Kawamata, which asserts the following: There is a finite rational polyhedral cone which is a fundamental domain for the action of the birational automorphism group on the movable effective cone.

3. Log canonical thresholds of some surfaces of general type, by *Jheng-Jie Chen and Nguyen Bin*

The canonical and pluri-canonical divisors are regarded as the most important divisors of a given variety. Many birational invariants are computed by certain behavior of canonical or pluri-canonical divisors. In [2], Jheng-Jie Chen (CCU) and our postdoc Bin Nguyen collaborate to work to determine the lct on Burniat surfaces. These are the beginning step of their joint project to understand the geometry of surfaces through the divisors in pluricanonical system. The success of their project will be very helpful to the study of fiber spaces with 2 dimensional general fibers.

4. Positivity of anti-canonical divisors in positive characteristic, by *Chi-Kang Chang, Iacopo Brivio, and Marta Benozzo*

Chi-Kang proved the inequality $\kappa(-K_X) \leq \kappa(-K_Y) + \kappa(-K_F)$ under some mild necessary conditions in characteristic zero in a previous excellent work. It is natural to ask if the inequality holds in positive characteristic or not. Our postdoc Iacopo Brivio and, Marta Benozzo, a student in Imperial College London, were able to prove an analogous version in positive characteristic under some additional necessary but mild conditions. Notice that in positive characteristic, there is no vanishing theorem and no resolution of singularities. Therefore, it is a highly non-trivial innovative work.

5. Foliated minimal model program, *by Chih-Wei Chang and Yen-An Chen*

The notion of foliations was originally introduced by differential geometers. It turns out to be a very useful tool in algebraic geometry, especially in the study of algebraic fiber spaces. It is thus important to consider foliated varieties and run the “foliated minimal model program.” In their preprint, they worked on foliated minimal model program for toric foliation on toric varieties. One key observation is the correct definition of “non-dicritical singularities”, which enables them to prove that a toric foliation with at worst non-dicritical singularities will remain non-dicritical after steps of minimal model program.

6. Some other initiatives

There are some more joint projects among our groups members in the beginning stages. To name some, Yen-An and Hsin-Ku start to work on factorization of threefold foliations; Jheng-Jie and Chi-Kang have worked on characterization of \mathbb{Q} -Fano threefolds with minimal anti-canonical volume.

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- [3] M. Benozzo, I. Brivio, C. K. Chang, $C_{n,m}^-$ for globally F -split algebraic fiber spaces, in preparation
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2.2.4 Highlights of Events

Seminars

1. NCTS Seminar in Algebraic Geometry
Organizer: J. K. Chen
2. Online Seminar on Algebraic and Complex Dynamics
Organizer: Hsueh-Yung Lin
3. Seminar of Algebraic Geometry in East Asia
Organizers: Y. Kawamata, J.H. Keum, J.K. Chen, H. Y. Lin, B. H. Fu, and more
4. Student Seminar in Algebraic Geometry
Organizer: J. K. Chen

Lectures and Courses

1. Birational Automorphism Groups of Holomorphic Symplectic Manifolds, *by Shigeru Mukai (RIMS)*
2. Rationality Problem for Conic Bundles *by Yuri Prokhorov (Steklov)*
3. Resolution of Singularities for Everyone *Dan Abramovich (Brown University)*
4. Mini-Courses on Computational Algebraic Geometry *Christopher Peterson (Colorado State University)*
5. Higher dimensional Fano varieties *by Joaquin Moraga (UCLA)*
6. Derived categories and rationality of Fano threefolds *by Alexander Kuznetsov (Steklov)*
7. Categorical Donaldson-Thomas theory, wall-crossing and applications *by Yuki-nobu Toda (IPMU)*
8. On the Minimal Model Program for foliations *by Paolo Cascini (Imperial College London)*

Conferences and Workshops

1. 2023 NCTS Higher Dimensional Algebraic Geometry Minicourses and Workshop, March 13-24, 2023
Organizers: C. Birkar, J.K. Chen, K. Oguiso, Y. Kawamata

This event of HDAG was a continuation of the series HDAG initiated in 2004. After that it was held every three years or so. Originally, we planned to have HDAG in the year of 2019. Because of Covid-19 it was postponed twice. We were very happy that we can finally have an in-person meeting after the Covid

this March from 3/13-3/24. In the first week (3/13-3/17), we make it a week of mini-courses. In the second week (3/20-3/24), we make it a week of workshop. In total, we have 23 speakers, 4 organizers, another 20 international participants and about 20 to 30 local participants. We have about 100 registrations at the beginning. Among those invited speakers, more than half of them kindly pay their airfare by their own grant. Thanks to their contribution, we are able to allocate some budget to support international young scholars. Also, most of international participants come by using their own sources of funding.

We believe that our local members, especially students, benefit a lot from such an international meeting. And also, many participants acknowledge that this is their best conference ever considering the quality of the talks and the organization.

2. Modern Perspectives on Birational Geometry, July 29-August 4, 2023

Organizers: J.K. Chen, H.Y. Lin, E. Shinder

This event focuses on modern aspects of birational geometry. We have 20+ invited speakers and mini-course lecturers. Most of the speakers are promising young talents in the field, many of them are postdocs. With such an arrangement, we are able to see a lot of most up-to-date researches. In the first two days, we make it series of mini-courses. In the remaining 5 days, we make it a week of workshop. The size of the event is about 70 people, which includes 20+ speakers and organizers, 20 more foreign participants, and about 20 to 30 local participants.

It happened that there was a typhoon on Thursday of that week. We are forced to make some emergency arrangement of the venue and for the visitors.

2.2.5 Future Plans

Conferences and workshops: In the coming two years, we plan to organize two international workshops and several smaller workshops. The first one will be a continuation of Modern Perspectives on Birational Geometry that was held in the summer of 2023. Thanks to the success of the first one, we plan to organize an international workshop with the similar style in two years. Again, we will focus on new developments and we will mostly invite young active researchers as we did in 2023. The second one will be the next Algebraic Geometry in East Asia (AGEA) conference after the upcoming one in Seoul in Nov. 2023. The first AGEA conference was held in 2001 in Kyoto, then hosted by participating countries every 2 or 3 years. Based on the previous rosters, Taiwan is considered to be the next hosting country. The arrangement will be confirmed in the meeting in Nov. 2023.

Other than those above-mentioned international workshops, we plan to organize smaller workshops depending on the schedule of international visitors and the research

interests of our groups. In Feb. 2024, we plan to organize a small workshop on K-stability, in the occasion of the visit of Ivan Cheltsov and Kento Fujita. Also, Claire Voisin is planing to visit in April 2024 and hence we are working on organizing a small workshop in algebraic cycles.

1. Modern Perspectives on Birational Geometry, 2025
2. Algebraic Geometry in East Asia, 2025
3. Workshop on K-stability and its applications, Feb. 2024.
4. Mini-workshop on algebraic cycles. Apr. 2024

Seminars

1. NCTS Seminar in Algebraic Geometry
Organizers: J. K. Chen, H. Y. Lin
2. Student Seminar in Algebraic Geoemtry
Organizer: J. K. Chen

Courses and lectures:

In the coming years, we plan to arrange the following courses, ranging from graduate courses to more specialized and advanced topic courses.

1. Algebraic surfaces
2. Applied and computational algebraic geometry
3. Jet scheme and arc spaces
4. Moduli spaces
5. Teichmüller spaces

Other than running seminars and organizing conferences, we will also continue to work on the following:

1. Training of students and postdocs.
2. Support domestic young researchers to attend international conferences and workshops.

We will continue to encourage young local researchers and graduate students to attend schools and international workshops or to have short/long term visits to major institutes in algebraic geometry around the world.

3. Recruit world leading experts.

We will continue to invite active experts as NCTS visitors. Other than that, we will also try to recruit world leading experts as NCTS scholars. With the help from NCTS scholars, we will continue to hold high quality activities as before. This will also attract more researchers to visit NCTS and build international research cooperations.

2.3 Differential Geometry and Geometric Analysis

2.3.1 Core Members

1. Program Committee Members: River Chiang (NCKU), Nan-Kuo Ho (NTHU, chair), Chun-Chi Lin (NTNU), Chung-Jun Tsai (NTU)
2. Affiliated Faculty Members: Jih-Hsin Cheng (AS), Chin-Yu Hsiao (AS), Siao-Hao Guo (NTU), Yng-Ing Lee (NTU), Mao-Pei Tsui (NTU), Ser-Wei Fu (NTU), Ting-Jung Kuo (NTNU), Ulrich Menne (NTNU), Mei-Heng Yueh (NTNU), Pak Tung Ho (TKU), Hsiao-Fan Liu (TKU), Rung-Tzung Huang (NCU), Mei-Lin Yau (NCU), Ye-Kai Wang (NYCU), Hung-Lin Chiu (NTHU), Hsuan-Yi Liao (NTHU), Chiung-Jue Anna Sung (NTHU), Dong-Ho Tsai (NTHU), Siye Wu (NTHU), Kuang-Ru Wu (NTHU), Sin-hua Lai (NCUT), Kuo-Wei Lee (NCUE), Jui-En Chang (CCU), Chih-Chung Liu (NCKU), Ryosuke Takahashi (NCKU), Eugene Zhu Xia (NCKU), Chung-I Ho (NCKU), Yen-Chang Huang (NUTN), Chih-Wei Chen (NSYSU), Yi-Sheng Wang (NSYSU), Chin-Tung Wu (NPTU).
3. Postdoctoral Fellows: Sheng-Fu Chiu (NTHU), Brian Harvie (NCTS), Simon-Raphaël Fischer (NCTS), Wei-Bo Su (NCTS), Nicolau Sarquis Aiex (NTNU), Sean McCurdy (NTNU), Yang-Kai Lue (NYCU)

2.3.2 Program Overview

The Program of Differential Geometry and Geometric Analysis covers a broad spectrum of themes, including a more analytic perspective as well as a more topological incarnation of modern geometry. Some examples of frontier directions are geometric flows, especially around scalar curvature rigidity, special geometric structures, especially around complex Hessian type equations, and moduli space problems, especially equations arising from physics such as Yang-Mills equations, Seiberg-Witten equations, and Kapustin-Witten equations. In recent years, some of our group members also investigate application of differential geometry, such as how discrete differential geometry can serve as a tool to represent manifolds with finite information so that issues can be formulated and solved as numerical optimization problems.

To be more precise, our current research topics can be characterized roughly into the following themes:

1. Minimal submanifolds, geometric flows and mathematical general relativity
2. Cauchy–Riemann geometry and spectral geometry
3. Geometric measure theory and geometric variational problems
4. Geometric PDEs (and metric structures)

5. Gauge theory, moduli space problems and mathematical physics
6. Symplectic and contact geometry
7. Discrete differential geometry and manifold learning theory (including image processing).

The aim of our program is twofold.

1. Create an engaging and thriving research environment for differential geometers in Taiwan: (a) To provide resources for interaction with international scholars for collaboration and developing future directions by holding special lecture series, international conferences, and hosting visitors. (b) To provide opportunity for interaction within the Taiwan community by holding regular seminars and symposiums that rotate their venues.

2. Create a friendly and exciting learning environment for young students. We wish to attract outstanding students to the field, and help them establish a solid foundation on the subjects as well as having some understanding of important topics in Geometry and Topology by providing high quality courses and lecture series on current research topics.

2.3.3 Research Highlights

Below are some of the highlights in 2022 and 2023 from our group members.

1. Mathematical general relativity

Ye-Kai Wang (NYCU)

Based on the computation of [12], in [10] and [9] they established the invariance of Chen-Wang-Yau angular momentum and center-of-mass with respect to the pure supertranslations defined at null infinity. It provides an interesting (may not be unique) answer to a long-standing puzzle in general relativity. In the follow-up paper [9], they generalized the invariance to conserved quantities defined by the generalized BMS vector fields that are under intensive investigation by physicists working in quantum gravity. In [8], they studied the limit of Wang-Yau quasi-local mass of off-center unit spheres $x^2 + y^2 + (z - d)^2 = 1$ as d approaches infinity in an asymptotically flat initial data set. It turns out that the mass is of a very low order $O(d^{-6})$. To reach such order, two new techniques for computing quasi-local mass were introduced: evolution formula of Brown-York mass and Jang's equation reduction.

2. Mean curvature flows

Chung-Jun Tsai (NTU) and Mao-Pei Tsui (NTU)

There are three main results in their joint project with Professor Mu-Tao Wang [14][15]:

1. A New Monotone Quantity in Mean Curvature Flow Implying Sharp Homotopic Criteria

A new monotone quantity in graphical mean curvature flows of higher codimensions is identified in this work. The submanifold deformed by the mean curvature flow is the graph of a map between Riemannian manifolds, and the quantity is monotone increasing under the area-decreasing condition of the map. The flow provides a natural homotopy of the corresponding map and leads to sharp criteria regarding the homotopic class of maps between complex projective spaces, and maps from spheres to complex projective spaces, among others.

2. Mean Curvature Flows of Two-Convex Lagrangians

They prove regularity, global existence, and convergence of Lagrangian mean curvature flows in the two-convex case. Such results were previously only known in the convex case, of which the current work represents a significant improvement. The proof relies on a newly discovered monotone quantity that controls two-convexity. The longtime convergence part is obtained through the blow up analysis and a Liouville Theorem for the ancient solution of the LMCF. Through a unitary transformation, same result for the mean curvature flow of area-decreasing Lagrangian submanifolds were established.

3. Entire solutions of two-convex Lagrangian mean curvature flows

Given an entire C^2 function u on R^n , they consider the graph of Du as a Lagrangian submanifold of R^{2n} and deform it by the mean curvature flow in R^{2n} . This leads to the special Lagrangian evolution equation, a fully nonlinear Hessian type PDE. They prove long time existence, and convergence results under a 2-positivity assumption of $(I + (D^2u)^2)^{-1}D^2u$. Such results were previously known only under the stronger assumption of positivity of D^2u .

3. Cauchy-Riemann geometry and spectral geometry

Chin-Yu Hsiao (AS) and Rung-Tzung Huang (NCU)

Let X be a compact connected orientable strongly pseudoconvex CR manifold of dimension $2n + 1$. Assume that X admits a connected compact Lie group G action and a transversal CR S^1 -action. In [1] they computed the coefficients of the first two lower order terms of the equivariant Szegő kernel asymptotic expansions with respect to the S^1 -action. In [2], they established the Morse inequalities for Fourier components of reduced L^2 -Kohn–Rossi cohomology with values in a rigid CR vector bundle over a CR covering manifold with a transversal CR S^1 -action. As an application, they recovered the Morse inequalities for

Fourier components of Kohn–Rossi cohomology on a compact CR manifold, a result of Hsiao-Li in 2016. In [3], they also studied the G -equivariant Szegő kernels and establish the associated Boutet de Monvel–Sjöstrand type theorems when the non-degenerate CR manifold admits a compact Lie group G action.

4. Derived differential geometry

Hsuan-Yi Liao (NTHU)

In geometry, there are two common sources of singularities, quotient and intersection/zero locus. The field of derived geometry is mainly concerned with spaces with singularities of the second type. Observe that both intersection and zero locus can be considered as fiber products of manifolds. Since fiber products of manifolds are not necessarily manifolds, the fundamental question is to extend the category of smooth manifolds in a nice way that one still has some kind of fiber products in this category.

Behrend, Liao, and Xu discovered that the category of dg manifolds of finite positive amplitude (or equivalently, L^∞ -bundles) is a nice candidate of such extended category. In [4], they established the theoretical foundations of L^∞ -bundles which indicate their importance in derived differential geometry. Recently, they improved [4] in two directions. In the first part [5], they proved that the category of L^∞ -bundles is a category of fibrant objects. As an application, they investigated derived intersections of manifolds. This part was submitted to Journal of the European Mathematical Society, and it is in the revision process. In the second part [6], they studied the étale fibrations of L^∞ -bundles. As applications, they proved an inverse function theorem for L^∞ -bundles and a theorem about weak equivalences. With their inverse function theorem, they also proved that the homotopy category of L^∞ -bundles has a simple description. This homotopy category is crucial in derived geometry.

5. Knot theory

Yi-Sheng Wang (NSYSU)

Handlebody-knot classification is a classical question in the study of knot theory. In recent years, Yi-Sheng Wang’s research is centered around this topic, in particular the classification via the JSJ decomposition and the Koda-Ozawa annulus classification. Moreover, he investigates a generalized Gordon-Luecke problem: To what extent the handlebody-knot exterior determines the handlebody-knot topology in terms of the annulus diagram defined in [17]; the investigation leads to the preprint [16].

Currently, joint with Y. Koda and M. Ozawa, Wang is focusing on classification of non-characteristic annuli in handlebody-knot exteriors. Handlebody-knots

whose exteriors contain a non-characteristic annulus have close relation to knots that admit a non-integral toroidal Dehn surgery, and may potentially lead to applications to classical knot theory, for instance, a new construction of Eudave-Munoz knots.

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2.3.4 Highlights of Events

The activities from September 2022 to July 2023 are summarized as follows:

Seminars

One of the goals of our program is to create an engaging environment for differential geometers in Taiwan. Thus, activities such as seminars are very useful for exchanging ideas and stimulating interaction:

1. NCTS iGMT seminar

Organizers: Giovanni Alberti (University of Pisa, Italy), Ulrich Menne (NTNU), Yoshihiro Tonegawa (Tokyo Institute of Technology, Japan), and Neshan Wickramasekera (University of Cambridge, UK).

This is an online seminar which is held bimonthly since 2020. It has been able to keep the quality of presentations high, because they, on purpose, keep the frequency of presentations low. The audience ranges from Japan, Taiwan, Europe to the East coast of the US. The seminar continues to secure speakers from first-rate institutions.

2. NCTS Differential Geometry seminar

Organizers: Siao-Hao Guo (NTU), Ulrich Menne (NTNU), Chung-Jun Tsai (NTU) and Mao-Pei Tsui (NTU).

Speakers include domestic researchers for on-site talks and international researchers for virtual talks.

3. AS-NCTS seminar on Geometry, organized by Jih-Hsin Cheng (AS) and Kuang-Ru Wu (AS).

Lectures and Courses

The aim of the lecture series is to provide opportunities for researchers to learn about current topics in a manageable time frame. As for cultivating and fostering outstanding students, NCTS has the *URP*, and *USRP* programs.

1. Lectures on Groupoids, by Camille Laurent-Gengoux (Université de Lorraine, France), November 2023.

Camille Laurent-Gengoux gave 3 hour lectures on groupoids. He introduced the concept of groupoids, how the idea came to be, examples, and some classic results.

2. Introduction to Extrinsic Geometric Flows, by Brian Harvie (NCTS), Spring 2023.

Brian Harvie gave a series of talks on extrinsic geometric flows. The goal is to introduce advanced undergraduates and early graduate students to current research in geometric flows, with a focus on mean curvature flow and inverse mean curvature flow in Euclidean space.

3. Meet with Professor Mu-Tao Wang, July 26, 2023.

In this lecture, Professor Wang talked about some recent advances in the mathematical theory of general relativity that are related to his current research. He

also shared his personal research experiences in geometric analysis and mathematical relativity.

4. Mini-course on Mathematics in Manifold Learning, by Yi-Sheng Wang (NSYSU), Chin-Hung Lin (NSYSU), Seçkin Gunsen (NSYSU), Liren Lin (NSYSU), July 2023.

Conferences and Workshops

The aim of conferences and workshops is to be a medium that connects the domestic researchers with the international researchers and provide opportunity for collaboration and interaction.

1. 2022 NCTS Workshop on Geometry and Physics, Dec 31, 2022.

This is a one-day workshop on Geometry and Physics, including Lie algebroids, higher structures and gauge theory. Higher structures refer to operations with several inputs and are important in the study of deformation quantization, deformation theory, dg manifolds, singular foliations, derived geometry, etc.

It is organized by Nan-Kuo Ho (NTHU), and Hsuan-Yi Liao (NTHU). Speakers include Simon-Raphael Fischer (NCTS), Noriaki Ikeda (Ritsumeikan University), Camille Laurent-Gengoux (Université de Lorraine), Seokbong Seol (Korea Institute for Advanced Study).

2. Perspectives in Geometric Analysis, Feb 18, Feb 20, and March 3, 2023.

The main goal of this activity is to bring together several experts in geometric analysis to present their research in submanifolds, CR geometry, Sasakian geometry or nonlinear PDE.

It is organized by Chung-Jun Tsai (NTU) and Mao-Pei Tsui (NTU). Speakers include Shu-Cheng Chang (NTU), Chih-Wei Chen (NSYSU), Qing-Ming Cheng (Fukuoka University), Pak Tung Ho (TKU), Yen-Chang Huang (NUTN), Ting-Jung Kuo (NTNU), Sin-Hua Lai (NCUT), Chien Lin (Mathematical Science Research Center, Chongqing University of Technology), Mao-Pei Tsui (NTU), Chin-Tung Wu (NPTU).

3. NCTS Workshop in Symplectic Geometry, March 22-23, 2023.

The goal of this workshop is to share recent developments and new ideas in symplectic geometry in the broad sense.

It is organized by River Chiang (NCKU) and Kaoru Ono (RIMS, Kyoto University). Speakers include Sheng-Fu Chiu (NCTS), Viktor Ginzburg (University of California, Santa Cruz), Martin Guest (Waseda University), Naichung Conan

Leung (The Chinese University of Hong Kong), Yan Lung Leon Li (The Chinese University of Hong Kong), Kaoru Ono (Research Institute for Mathematical Sciences), Xiao Zheng (The Institute of Mathematical Sciences, CUHK)

4. The 23rd and the 24th Taiwan Geometry Symposium, Dec 17, 2022 (NCTS) and May 13, 2023 (NTHU).

This is a series of regular meetings aiming to foster discussions and interactions within the geometry community in Taiwan. It is held once every semester.

It is organized by Chih-Wei Chen (NSYSU), River Chiang (NCKU), Nan-Kuo Ho(NTHU), Chun-Jun Tsai (NTU), and Mao-Pei Tsui (NTU).

5. Recent progress in special Lagrangian equations and deformed Hermitian-Yang-Mills equation, July 17-21, 2023.

This workshop brings together mathematicians from a variety of backgrounds to discuss two important nonlinear partial differential equations in mirror symmetry: Special Lagrangian equation and deformed Hermitian-Yang-Mills equation. These two fully nonlinear partial differential equations play a central role in mirror symmetry.

It is organized by Chung-Jun Tsai (NTU), Mao-Pei Tsui (NTU), and Mu-Tao Wang (Columbia University). Speakers include Yu Hin Chan (University of California, Davis), Shu-Cheng Chang (NTU), Adam Jacob (University of California, Davis), Chao-Ming Lin (University of California, Irvine), Yu-Shen Lin (Boston University), Chung-Jun Tsai (NTU), Mao-Pei Tsui (NTU), Mu-Tao Wang (Columbia University).

2.3.5 Future Plans

It will be a busy year for our group. In particular, we will have the fifth international differential geometry conference, which will have mini courses and a workshop with world-renowned speakers.

Conferences and workshops:

1. The Fifth International Conference on Differential Geometry, January 12-19 (January 2024)

This conference is a series of biennial international conferences on Differential Geometry in Taiwan. An important area in Geometry will be specified as the main theme each time. Our purpose is to create a discussion and interaction platform in the chosen area, and at the same time to foster future co-operations and introduce new people into the field. The topics for this fifth conference include General Relativity, Minimal Submanifolds and Geometric Evolution Equations.

It is organized by Yng-Ing Lee (NTU), Chung-Jun Tsai (NTU), Mao-Pei Tsui (NTU), and Mu-Tao Wang (Columbia University). This activity includes 2 mini courses and a conference.

Speakers for the mini-courses are Martin Man Chun Li (The Chinese University of Hong Kong) and Otis Chodosh (Stanford University). Speakers for the workshop include: Alessandro Carlotto (ETH Zurich), Jingyi Chen (University of British Columbia), Poning Chen (University of California, Riverside), Otis Chodosh (Stanford University), Jaigyoung Choe (Korea Institute for Advanced Study), Frederick Fong (Hong Kong University of Science and Technology), Ailana Fraser (University of British Columbia), Greg Galloway (University of Miami), Lan-Hsuan Huang (University of Connecticut), Dan Lee (Queens College, City University of New York), Chao Li (Courant Institute), Martin Man Chun Li (The Chinese University of Hong Kong), Chikako Mese (Johns Hopkins University), Pengzi Miao (University of Miami), Mario Micallef (University of Warwick), Andre Neves (University of Chicago), Luen Fai Tam (The Chinese University of Hong Kong)**, Peter Topping (University of Warwick), Mu-Tao Wang (Columbia University), Damin Wu (University of Connecticut), Sumio Yamada (Gakushuin University), Xin Zhou (Cornell University).

2. The Fourth Japan-Taiwan Joint Conference on Differential Geometry, November 6-9, 2023.

The purpose of the Taiwan-Japan Joint Conference on Differential Geometry is to develop collaboration, foster discussions and interactions between the differential geometry communities of Taiwan and Japan. The plan is to have this conference every two years and rotates the location between Japan and Taiwan. The first conference was held at Waseda University in December 2016, the second conference was held at NCTS in November 2019, and the third was held online in November 2021. The fourth conference will be held at NCTS on November 6-9, 2023.

It is organized by Shu-Cheng Chang (NTU), River Chiang (NCKU), Martin Guest (Waseda), Nan-Kuo Ho (NTHU), Yng-Ing Lee (NTU), Yoshihiro Ohnita (Waseda), Takashi Sakai (Tokyo Metropolitan University), and Mao-Pei Tsui (NTU).

3. 2023 Conference on Differential Geometry and Geometric Analysis (December 2023).

It is organized by Hung-Lin Chiu (NTHU), Chin-Yu Hsiao (AS), and Paul Yang (Princeton University).

4. The 25th Taiwan Geometry Symposium (Spring 2024).

5. Workshop related to derived geometry and Physics (March 2024).
6. Workshop related to Higher codimensional mean curvature flow or Lagrangian mean curvature flow (Summer 2024). It will be organized by Chung-Jun Tsai (NTU), Mao-Pei Tsui (NTU), and Mu-Tao Wang (Columbia University).

Seminars

1. NCTS international Geometric Measure Theory seminar (bimonthly)
Organizers: Ulrich Menne (NTNU), Giovanni Alberti (University of Pisa, Italy), Yoshihiro Tonegawa (Tokyo Institute of Technology, Japan), and Neshan Wickramasekera (University of Cambridge, UK).
2. NCTS Differential Geometry seminar (weekly)
Organizers: Siao-Hao Guo (NTU), Ulrich Menne (NTNU), Chung-Jun Tsai (NTU) and Mao-Pei Tsui (NTU).

Courses and lectures:

1. Taiwan Math School Course: Grassmann Algebra, by Ulrich Menne (NTNU), Fall 2023.
2. Lectures on KdV Theory and Related Subjects, by Chang Shou Lin (NTU), Summer 2023.
3. Lectures on various topics in symplectic and contact geometry and topology, November 2023. Organized by River Chiang (NCKU) and Kaoru Ono (RIMS, Kyoto University).
4. Mini courses on Integral Geometry and their connection with Cauchy-Riemann geometry, by Yen-Chang Huang (NUTN), Summer or Winter of 2024.

The first part of the courses will focus on theorems in the Euclidean spaces, covering topics such as Crofton's formula, containment problems, quermassintegral, average widths, and Cauchy surface area formula. Additionally, generalizations to homogeneous spaces will be explored. Moving on to the second part, the courses will provide a fundamental introduction to abstract CR manifolds, with a specific emphasis on the geometry of the Heisenberg groups, including the Fundamental Theorem of Curves and Surfaces. Lastly, the courses will explore some applications of Integral Geometry to the Heisenberg groups, which are related to the lecturer's recent works. These mini-courses are open to senior undergraduate and graduate students who are interested in both topics.

2.4 Differential Equations and Stochastic Analysis

2.4.1 Core Members

1. Program Committee Members: Yuan-Chung Sheu (NYCU), Chun-Yen Shen (NTU), Jung-Chao Ban (NCCU), Chun-Hsiung Hsia (NTU), Hsin-Yuan Huang (NYCU), Kung-Chien Wu (NCKU, Program chair).
2. Affiliated Faculty Members: Chiun-Chuan Chen (NTU), I-Kun Chen (NTU), Jenn-Nan Wang (NTU), Jong-Sheng Guo (TKU), Jann-Long Chern (NTNU), Jia-Yuan Dai (NCHU), Van Tien Nguyen (NTU), Chih-Hung Chang (NUK), Kuo-Chang Chen (NTHU), Cheng-Hsiung Hsu (NCU), Lung-Chi Chen (NCCU), Hao-Wei Huang (NTHU), Wai Kit Lam (NTU), Jhih-Huang Li (NTU), Daniel Spector (NTNU).
3. Postdoctoral Fellows: Yoshinori Kamijima, Prasun Roychowdhury, Shih-Hsin Chen, Kuan-Wei Chen.

2.4.2 Program Overview

The study of differential equations is one of the most traditional fields of mathematics in Taiwan. The NCTS Topical Program Differential Equations and Stochastic Analysis also aims to incorporate interdisciplinary research as one of its priorities, and its four main directions are: partial differential equations, dynamical systems, stochastic analysis and harmonic analysis. Partial differential equations are one of the most widely adopted mathematical tools in modern sciences. Members of this NCTS Topical Program group are interested in both the developments of the mathematical theory and scientific applications. This includes, for example, synchronization problem, kinetic theory, elliptic partial differential equations, fluid dynamics, inverse problem and reaction-diffusion equations. Interests of the research groups in dynamical systems include chaotic systems, ergodic theory, complex dynamical systems, group-dynamical systems and Sarnak conjecture. The research interests of harmonic analysis group include two weights problems for singular integrals, additive combinatorics and their connections to geometric measure theory. Probability theory plays an important role in many other areas of mathematics, such as partial differential equations, analysis, and combinatorics. It provides the theoretical basis for statistics. In stochastic analysis at the NCTS, the focus is placed on disordered systems (including long-range models, spin glass, FPP, etc.), SPDEs and heat kernels (stochastic analysis), Random signals with medical applications.

2.4.3 Research Highlights

Below are some of the highlights and breakthroughs in 2022-2023.

1. In the joint work with Francois Hamel and Chin-Chin Wu, **Jong-Shenq Guo** [1] considers a three-species predator-prey system involving two competing predators and one prey. The species diffuse with nonlocal dispersal kernels with possibly non-compact support, and they interact in a heterogeneous environment moving with a positive forced speed such that the environment is favorable to the prey in the absence of predators far ahead of the shifting boundary and it is unfavorable far behind. Such systems arise in the modeling of population dynamics under the effect of a shifting environment, such as climate change. They show, on the one hand, the existence of waves connecting the trivial state to the unique constant positive co-existence state for any value of the forced speed. On the other hand, they show the existence of critical positive speeds for the existence of waves connecting the trivial state to the states corresponding to the absence of one or two predators.
2. In the joint work with Takaaki Nishida, **Chun-Hsiung Hsia** [2] uses numerical methods to study the global bifurcation diagrams of the Benard convection problem. In their computations, they include a huge number of Fourier modes of stream function and temperature function so that their results reflect more reality of the dynamics of the Rayleigh Benard heat convection. Their results confirm that the period doubling scenario is a route to chaos.
3. In the joint work [3], Isabelle Schneider, Babette de Wolff, and **Jia-Yuan Dai** design suitable noninvasive feedback control to stabilize certain classes of Ginzburg-Landau spiral waves. Their tool for stabilization is a sophisticated modification of the symmetry-breaking control triple method invented by Dai's coauthor Dr. Schneider. Indeed, it is an equivariant generalization of the widely applied Pyragas control to the setting of PDEs. Their results provide stable spiral waves with an arbitrary number of arms and stimulate new scientific ideas for seeking numerical implementation and experimental realization for their feedback control.
4. In the joint work with Youngae Lee and Sang-Hyuck Moon, **Hsin-Yuan Huang** [4] obtains the existence and uniqueness of topological solutions with vortices and antivortices in the Maxwell-Chern-Simons $O(3)$ sigma model. The solutions of the equations have quite rich structures and various limits. In particular, they showed the nondegeneracy of linearized operator for entire solution holds even when the symmetry is broken. They also obtain the uniform bound of norm of nonlinearities with respect to large charge of electron.
5. In the joint work [5], Laurent Desvillettes and Ling-Bing He, and **Jin-Cheng Jiang** study spatially homogeneous Landau equation with Coulomb potential. The 2010 Fields medal recipient Villani already proved the global existence of the so-called H solution for this equation when the initial data has finite mass,

energy and entropy. People realized later that it is indeed a weak solution. A very challenging problem for the spatially homogeneous Landau equation with Coulomb potential is to answer whether the smoothness is propagated for all positive times, or if some blowup may occur after a finite time. If such a blowup appears, a further challenging issue is to understand what really happens at the blowup time (cf. Chapter 5 of Villani’s monograph). The main result of this paper provides new partial answers to the first question, while another result of this paper deals with the second question. Their results shed some new light on the competition between the dissipation and the nonlinearity (see more details at the end of this section) for Landau equation with Coulomb potential. More precisely, they proved that if the product of the entropy and H^1 norm of the initial data is smaller than a threshold value, then the global existence of the strong solution exists. If the product is larger than that value, then the possible blow-up time is finite, and after that time its product reduces to a value less than the threshold.

6. In the joint work [6], Yu-Chu Lin and Haitao Wang, and **Kung-Chien Wu** consider the Boltzmann equation with angular-cutoff for very soft potential case. They prove a regularization mechanism that transfers the microscopic velocity regularity to macroscopic space regularity in the fractional sense. The result extends the smoothing effect results of Liu-Yu (see “mixture lemma” in Comm. Pure Appl. Math. 57:1543–1608, 2004), and of Gualdani–Mischler–Mouhot (see “iterated averaging lemma” in Mém. Soc. Math. Fr. 153, 2017), both established the hard sphere case. A precise pointwise estimate of the fractional derivative of collision kernel, and a connection between velocity derivative and space derivative in the fractional sense are exploited to overcome the high singularity for very soft potential case. As an application of fractional regularization estimates, they prove the global well-posedness and large time behavior of the solution for non-smooth initial perturbation.
7. Topological entropy is an important statistical quantity which describes the complexity of a dynamical system. It relates to the tendency of growth rate of orbits with respect to time, and the existence of the limit is of interest. For a discrete dynamical system, the limit of topological entropy exists provided the underlying space is an amenable group. And the topological entropy is well-defined on any Følner sequence. However, it is uncertain if the limit exists for abstract underlying space. In the joint work with Yu-Liang Wu and Yu-Ying Wu, **Jung-Chao Ban** and **Chih-Hung Chang** [7] gave an affirmative answer for the case where the underlying space is a semigroup satisfying some conditions. To be more specific, the topological entropy is well-defined on the semigroup in which the relations of its generators can be described via a matrix. The authors in-

roduce a novel entropy called stem entropy that reflects, roughly speaking, the complexity in the coset of each generator. After demonstrating the existence of stem entropy in a class of semigroups, the authors establish that the topological entropy coincides with stem entropy and the limit of the topological entropy exists.

8. In the joint work with Hau-Tieng Wu, **Gi-Ren Liu** and **Yuan-Chung Sheu** [8] examine a generalization of the scattering transform (ST) that includes broad neural activation functions. This generalization is the neural activation scattering transform (NAST). NAST comprises a sequence of "neural processing units," each of which applies a high pass filter to the input from the previous layer followed by a composition with a nonlinear function as the output to the next neuron. Here, the nonlinear function models how a neuron gets excited by the input signal. In addition to showing properties like non-expansion, horizontal translational invariability, and insensitivity to local deformation, they explore the statistical properties of the second-order NAST of a Gaussian process with various dependence structures and its interaction with the chosen wavelets and activation functions. They also provide central limit theorem (CLT) and non-CLT results. Numerical simulations demonstrate the developed theorems. Their results explain how NAST processes complicated time series, paving a way towards statistical inference based on NAST for real-world applications.
9. In the joint work with Michael Damron, Julian Gold and Xiao Shenwe, **Wai-Kit Lam** [9] studies the geometry of a ball in first-passage percolation. They showed that a ball with radius t (where t is large) has Ct^{d-1} many holes, and its largest hole has size of order at least $\log t$. Under the unproven assumption that the limit shape is uniformly curved, we showed that in two dimensions, the largest hole has size of order at most $(\log t)^C$.
10. One of the difficult problems in the area of geometric measure theory is to study the behaviors of projections of fractal sets, in particular the radial projection of fractal sets. This problem has received lots of attentions by many mathematicians since the result has important applications to other famous open problems such as the Falconer distance problem. The problem is difficult due to its non-linear behavior and the first result was proved by Orponen in 2019 that shows there exists a point such that a planar fractal set E must have its radial projection to this point with Hausdorff dimension bigger than $\dim E/2$. The lower bound is conjectured to be $\dim E$ itself. In the joint work with Bochen Liu, **Chun-Yen Shen** [10] took the first step and used complete new ideas to make highly non-trivial progress that shows the lower bound can be $\dim E/2 + \epsilon$ for some $\epsilon > 0$. The key ingredient in their proof is to prove a stronger result about the incidence bounds between pencils that have more potential applications in other problems.

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2.4.4 Highlights of Events

Seminars

1. NCTS Nonlinear PDE Seminar. Organized by I-Kun Chen, Chun-Hsiung Hsia and Van Tien Nguyen.
2. NCTS Webinar on Nonlinear Evolutionary Dynamics. Organized by Jia-Yuan Dai, Chih-Chiang Huang and Chang-Hong Wu.
3. NCTS Seminar on Dynamical Systems. Organized by Jung-Chao Ban and Chih-Hung Chang.
4. European-Asian Joint Webinar on Dynamical Systems. Organized by Jung-Chao Ban and Chih-Hung Chang.
5. NCTS Probability seminar, Organized by Lung-Chi Chen.
6. Korea-Taiwan-Vietnam Joint Seminar in Combinatorics and Analysis, Organized by Chun-Yen Shen.

Lectures and Courses

1. Fractals in Diophantine Approximation by Meng Wu (University of Oulu) and Lingmin Liao (Université Paris-Est Créteil).
2. Distinguished Lecture Series in Dynamical Systems by Vadim Kaloshin (IST Austria).
3. Rigidity and Regularity of Diffeomorphism Groups by Sang-hyun Kim (Korea Institute for Advanced Study).
4. Markoff-Lagrange Spectrum and Symbolic Dynamics by Shigeki Akiyama (University of Tsukuba).
5. A Brief Discussion on Brownian Motion and Related Processes with Applications by Ju-Yi Yen (University of Cincinnati).
6. Number Theory Mini-Course: An Introduction to the Circle Method by Yu-Ru Liu (University of Waterloo).
7. Kleinian Groups and Rational Iteration by Russell Lodge (Indiana State University).
8. NCTS Mini-course on Dynamical Systems: Dynamics Meets Geometry by Lien-Yung Kao (George Washington University).

9. USRP: Central Limit Theorems and Steins Method for Gaussian Approximations by Yuan-Chung Sheu and Gi-Ren Liu.
10. USRP: Strichartz estimate for transport equation on the torus by Jing-Cheng Jiang.
11. URP: Stochastic Differential Equations and Time-delayed Equations for Synchronization Problems by Chun-Hsiung Hsia.

Conferences and Workshops

1. Fourth NCTS PDE Symposium. Organized by Chun-Hsiung Hsia, Jin-Cheng Jiang, Kung-Chien Wu. August 31, 2022.
2. 2022 Winter Workshop on Probability and Related Fields. Organized by Jyy-I Hong, Gi-Ren Liu. November 19, 2022.
3. NCTS Conference on Fractional Integrals and Related Phenomena in Analysis. Organized by Chun-Yen Shen, Daniel Spector. December 19 - 23, 2022.
4. 2022 NCTS Japan-Taiwan Joint Workshop on Dynamical Systems. Organized by Jung-Chao Ban and Chih-Hung Chang. December 30, 2022.
5. 2023 NCTS Young Dynamics Day. Organized by Jung-Chao Ban, Chih-Hung Chang, Kuo-Chang Chen, Cheng-Hsiung Hsu, Kung-Chien Wu. February 8, 2023.
6. The 13th Taiwan-Japan Joint Workshop for Young Scholars in Applied Mathematics. Organized by Chueh-Hsin Chang, Chiun-Chuan Chen, Yan-Yu Chen, Jann-Long Chern, Yung-Fu Fang, Elliott Ginder, Chih-Chiang Huang, Kota Ikeda, Mayuko Iwamoto, Tatsuki Kawakami, Shuichi Kinoshita, Hideki Murakawa, Hirokazu Ninomiya, Toshiyuki Ogawa, Yasuhisa Saito, Yuichi Togashi, Chang-Hong Wu. March 1 - 3, 2023.
7. 2023 Spring Probability Workshop. Organized by Ting-Li Chen, Lung-Chi Chen, May-Ru Chen, Shang-Yuan Shiu, Li-Hsien Leo Sun, Ju-Yi Yen. May 5 - 6, 2023.
8. 2023 NCTS PDE Conference on Recent Development of Fluid Dynamics and Kinetic Theory. Organized by Chueh-Hsin Chang, Chun-Hsiung Hsia, Kung-Chien Wu. June 5 - 9, 2023. October 23 - 27, 2023.
9. 2023 Symposium for Young Analysts. Organized by Hao-Wei Huang, Chun-Yen Shen, Daniel Eli Spector. June 8, 2023.

10. 2023 NCTS Workshop on Dynamical Systems. Organized by Jung-Chao Ban, Chih-Hung Chang, Kuo-Chang Chen, Cheng-Hsiung Hsu, Lien-Yung Kao. June 8 - 10, 2023.
11. Meet with Professor Horng-Tzer Yau. Organized by Mao-Pei Tsui. July 12, 2023.
12. The Korea-Taiwan-Vietnam Joint Meeting on Discrete Geometry and Geometric Measure Theory. Organized by Alex Iosevich, Le Minh Ha, Doowon Koh, Thang Pham, Chun-Yen Shen, Le Anh Vinh. July 17 - 19, 2023.
13. 2023 NCTS PDE Young Scholar Workshop. Organized by Chiun-Chuan Chen, Chih-Chiang Huang, Chun-Hsiung Hsia, Kung-Chien Wu. August 28 - 30, 2023.

2.4.5 Future Plans

Conferences and workshops:

1. 2023 International Conference on Recent Developments of Theory and Methods in Mathematical Biology. Organized by Chiun-Chuan Chen, Jong-Sheng Guo, Chun-Hsiung Hsia, Chang-Hong Wu.
2. 2024 NCTS and PIMS joint PDE conference. Organized by Chun-Hsiung Hsia, Chiun-Chuan Chen, Tai-Peng Tsai and Kung-Chien Wu et al. June 2024.
3. 2024 NCTS Young Dynamics Day. Organized by Jung-Chao Ban, Chih-Hung Chang.
4. 2024 NCTS Workshop on Dynamical Systems. Organized by Jung-Chao Ban, Chih-Hung Chang.
5. Taiwan Probability Workshop 2024. Organized by Yuan-Chung Sheu, Ching Wei Ho, Lung-Chi Chen, Wai Kit Lam, Jhih-Huang Li et al.
6. Organizing a conference on the Stein method by Gi-Ren Liu.

Seminars

1. NCTS Webinar on Nonlinear Evolutionary Dynamics. Organized by Jia-Yuan Dai, Chih-Chiang Huang and Chang-Hong Wu.
2. 2024 NCTS Seminar on Dynamical Systems by Jung-Chao Ban, Chih-Hung Chang.

Courses and lectures:

1. 2023 NCTS URP by Chun-Hsiung Hsia and Jia-Yuan Dai, supervise Ruey An Shiu (Math, NTU) and Chien-Yu Chen (Appl. Math, NCHU).
2. 2023 NCTS URP by Jy-Yi Hong
3. Summer short course in 2024 or 2025 (10 hours) by Hsin-Yuan Huang. The topics shall be about the singularly perturbed methods for nonlinear elliptic problems.
4. 2024 NCTS summer (winter) course on Dynamical Systems by Jung-Chao Ban, Chih-Hung Chang.

2.5 Scientific Computing

2.5.1 Core Members

1. Program Committee: Wei-Fan Hu (NCU), Tsung-Ming Huang (NTNU, chair), Matthew M. Lin (NCKU), Ming-Cheng Shiue (NYCU), Suh-Yuh Yang (NCU)
2. Affiliated members: Meng-Ho Chen (CCU), Pengwen Chen (NCHU), Ray-Bing Chen (NCKU), Chien-Hong Cho (CCU), Chia-Chieh Jay Chu (NTHU), Shih-Feng Hsieh (NTNU), Po-Wen Hsieh (NCHU), Chieh-Sen Huang (NSYSU), Feng-Nan Hwang (NCU), Yueh-Cheng Kuo (NUK), Ming-Chih Lai (NYCU), Tsung-Lin Lee (NSYSU), Jephian Chin-Hung Lin (NSYSU), Te-Sheng Lin (NYCU), Wen-Wei Lin (NYCU), Ching-Sung Liu (NUK), Ruey-Ling Sheu (NCKU), Yu-Chen Shu (NCKU), Yu-Hau Tseng (NUK), Weichung Wang (NTU), Chin-Tien Wu (NYCU), Mei-Heng Yueh (NTNU)

2.5.2 Program Overview

The NCTS Topical Program Scientific computing is an interdisciplinary field that involves mathematical theories, computational algorithms, and domain knowledge. While pursuing the beauty of mathematics, this field also develops innovative tools to enhance engineering and science. Our research directions are based not only on members' strengths but also on new trends in scientific computations. These directions include matrix computations in the study of the nonlinear matrix equations and the nonlinear Schrödinger equations, numerical PDEs and computational fluid dynamics, mathematical problems in image processing, entanglement qualification, phase retrieval, artificial intelligence in geometric information and medical image, convergence analysis of stretch energy minimization for spherical equiareal parameterization and volumetric stretch energy minimization.

2.5.3 Research highlight

In recent years, the scientific computing groups in NCTS have obtained significant advances in the topics of numerical PDEs for fluid dynamics, matrix computations for nonlinear matrix equations and nonlinear Schrödinger equations, low rank approximation, volume-measure-preserving optimal mass transportation problems and its application for 3D brain tumor detection and segmentation, high performance computing and image processing. The most significant contributions include the following:

(a) Machine learning

1. Volume-measure-preserving optimal mass transportation problems and its application for 3D brain tumor detection and segmentation, by Wen-Wei Lin et al

Optimal mass transportation (OMT), designed to move any irregular object without significant distortion, has been widely used in various fields, such as data compression, generative adversarial networks, and image processing. In 2021, we used the projected gradient and homotopy techniques to find a minimum volume-measure-preserving solution for the 3-manifold optimal mass transport problem. The proposed projected gradient method is shown to converge sublinearly at a rate of $\mathcal{O}(1/k)$.

Furthermore, we used OMT theory to preprocess the irregular 3D brain images in the Brain Tumor Segmentation (BraTS) 2021 dataset. Based on the input format required by the Unet algorithm, using OMT technology to convert irregular 3D brain images into cubes is a new idea for medical imaging research. We developed a cubic volume measurement-preserving OMT (VOMT) model with a density function to achieve this transformation. And the corresponding density function is created by contrast-enhanced histograms of fluid-attenuated inversion recovery (FLAIR) in brain images equalize grayscales. Using these preprocessing OMT tensors, we propose an efficient two-stage residual Unet algorithm for training and validation.

For the post-processing, we propose an adaptive ensemble procedure by solving the eigenvectors of the Dice similarity matrix and choosing the result with the highest aggregation probability as the predicted label. The Dice scores of the whole tumor (WT), tumor core (TC), and enhanced tumor (ET) regions for online validation computed by SegResUNet were 0.9214, 0.8823, and 0.8411, respectively.

2. Neural-network and finite-difference hybrid method for PDEs, by Wei-Fan Hu:

A new and efficient neural-network and finite-difference hybrid method is developed for solving Poisson equation in a regular domain with jump discontinuities on embedded irregular interfaces. Since the solution has low regularity across the interface, when applying finite difference discretization to this problem, an additional treatment accounting for the jump discontinuities must be employed. We aim to elevate such an extra effort to ease our implementation by machine learning methodology. The key idea is to decompose the solution into singular and regular parts. The neural network learning machinery incorporating the given jump conditions finds the singular solution, while the standard five-point Laplacian discretization is used to obtain the regular solution with associated boundary conditions. Regardless of the interface geometry, these two tasks only require supervised learning for function approximation and a fast direct solver for Poisson equation, making the hybrid method easy to implement and efficient. The two- and three-dimensional numerical results show that the present hybrid method preserves second-order accuracy for the solution and its derivatives, and

it is comparable with the traditional immersed interface method in the literature.

3. A shallow Ritz method for elliptic problems with singular sources, by Ming-Chih Lai:

Solving partial differential equations (PDEs) with deep neural networks (DNNs) has drawn much attention in the scientific computing community recently. Part of the theoretical reason can be attributed to the various kinds of expressive power for function approximations using DNN. In terms of implementation, there are mainly two different approaches; namely, the physics-informed neural networks, and the deep Ritz method. The major difference between the two approaches is how the loss is defined. One trains the physics-informed neural networks by minimizing the mean squared error loss of the equation residual, along with the initial and boundary condition errors. The deep Ritz method, however, begins with formulating the variational problem equivalent to the original PDE, so the natural loss function in this framework is simply the energy. Both approaches share the same major mesh-free advantage and therefore can practically solve problems in complex geometry and in high-dimensional space.

We propose a new shallow Ritz method for solving elliptic problems with singular sources. The novelties of the proposed network are three-fold. First, we remove the delta function singularity appearing in the original PDE by formulating the variational problem. Second, we include the level set function, which is commonly used as an interface indicator, as an additional feature input of the network that effectively improves the model's efficiency and accuracy. Third, we approximate the solution using a shallow neural network with only one hidden layer that significantly reduces the training cost in contrast to DNN.

(b) Image processing

1. Local-global intensity fitting energy models with fractional Laplacian for noisy and intensity inhomogeneous image segmentation, by Suh-Yuh Yang

Accurate image segmentation is crucial in many image processing and computer vision applications, but it may be significantly affected by noise and intensity inhomogeneity. In this work, we have explored three fractional derivative-based local-global intensity fitting models for segmenting noisy and intensity inhomogeneous images. The common idea behind these models is based on a valuable observation: the difference image between the simple Gaussian-filtered image and its fractional Laplacian image can preserve object shapes in the source image while reducing noise and enhancing intensity contrast. Therefore, converting the original segmentation task into one based on this obtained difference image could yield more accurate results. All these models use the same global Chan-Vese fitting energy term on the difference image, which forces the segmentation

contour to move towards some object boundary when the contour is far from the object edges. However, they use different local fitting energy terms on the difference image, which generate a local force to attract the segmentation contour to stop at the expected object boundary when it is close enough. Furthermore, we have utilized a recently developed efficient iterative solution method to realize the proposed models with energy decaying at each iteration resulting in higher performance. Finally, numerical experiments for synthetic and real images have demonstrated the efficiency of the proposed approach in addressing noise and intensity inhomogeneity for accurate image segmentation.

2. Image dehazing, image enhancement and blind image deblurring, by Po-Wen Hsieh:

Most image enhancement methods in the literature will show over-enhancement, color cast, and other phenomena when enhancing the image. To avoid the color run problem, we design a variational model that contains two complementary terms: one is used to increase image brightness, and the other is used to enhance edge structure. The effect can enhance the image while preserving the original tone by introducing an adaptive function to combine the enhancements of these two different functions. In addition, we prove the existence and uniqueness of the solution of this model. Numerical experiments demonstrate the excellent performance of this method.

Image deblurring is a very challenging inverse problem. To solve this problem, it is usually necessary to introduce appropriate regularization terms and image priors to alleviate the inherent ill-posedness. To this end, we utilize the local minimum information obtained in the blurred image to capture essential details and enhance its structure effectively.

3. Local saddles of relaxed averaged alternating reflection algorithms on phase retrieval, by Peng-Wen Chen:

We propose an ADMM formulation for one well-known algorithm called relaxed averaged alternating reflection algorithms (RAAR). The penalty is controlled by the RAAR parameter. Since the objective function is nonconvex, we show the local convergence property via studying the Hessian structure of the objective of ADMM. Some idea in this work is motivated by the discussion with Albert Fannjiang, when he visited Taiwan with the support of NCTS.

- (c) Entanglement qualification (quantum computing), by Matthew M. Lin.

Entanglement is a significant concept in physics that illustrates the interdependence of system components. It is utilized to ensure secure quantum communication. Separability, its counterpart, simplifies complex systems. Detecting entanglement's presence

is an NP-hard problem. Our work focuses on approximating mixed states with separable ones using Kronecker products. Challenges include non-linearity, undefined rank, and optimization in complex spaces. Our major contribution is a dynamic approach for low-rank entanglement approximation:

- Expressing gradient dynamics concisely.
- Ensuring global convergence from any start.
- Maintaining a probability distribution in coefficients.
- Adapting rank dynamically.

(d) Matrix computation

1. Nonlinear matrix equations and continuation methods, by Yueh-Cheng Kuo:

(i). We consider the nonlinear matrix equations (NME) $X + BX^{-1}A = Q$, where A , B , and Q are square matrices. When $B = A^\top$, Q is complex symmetric, and the imaginary part of Q is positive definite, the NME has a unique complex symmetric stabilizing solution with a positive definite imaginary part. The assumption is satisfied for some applications including Nano Research and high-speed trains. The stabilizing solution is the solution of practical interest. The research results of this topic include

- We provide an elementary proof of the existence of the NME and develop an efficient algorithm to compute the stabilizing solution.
- We constructed a nonlinear differential equation of matrix pairs that are invariant in the class of symplectic matrix pairs. The solution of this nonlinear differential equation passes the iterates generated by the fixed-point iteration, the SDA, and Newton's method with some additional conditions.
- We solve the NME that arises from the vibration analysis of high-speed trains.
- We develop a numerical method for computing the symplectic matrix pair (M, L) which represents Hamiltonian matrix exponential.

(ii). We mainly employ the continuous method to study the solutions of a system of nonlinear equations with parameters. Under the continuous change of the parameter, we investigate the change of the solution by the continuation method. The continuation method has two advantages: 1. It can observe the continuous change of solution by changing the parameter. 2. The unstable solutions can be tracked by the continuation method. Recently, we have had some results including

- We compute the Z-/H-eigenpairs of nonnegative tensors by continuation methods.
 - Computing the CP decomposition of an unbalanced tensor.
 - Find the best rank-1 approximation of nonnegative tensors.
2. Maxwell's equations for three-dimensional photonic crystals, led by Wen-Wei Lin:

This topic focuses on studying the eigenstructure of generalized eigenvalue problems (GEPs) arising in the three-dimensional (3D) source-free Maxwell's equations for photonic crystals and bi-anisotropic complex media with 3-by-3 permittivity tensor $\varepsilon > 0$, permeability tensor $\mu > 0$, and scalar magnetoelectric coupling constants $\xi = \bar{\zeta} = \nu\gamma$.

For the photonic crystals, we propose the Fast Algorithms for Maxwell's Equations (FAME) package for solving Maxwell's equations for modeling three-dimensional photonic crystals. FAME combines the null-space free method with fast Fourier transform (FFT)-based matrix-vector multiplications to solve the generalized eigenvalue problems (GEPs) arising from Yee's discretization. The GEPs are transformed into a null-space free standard eigenvalue problem with a Hermitian positive-definite coefficient matrix. We successfully use FAME on a single P100 GPU to solve a set of GEPs with matrices of dimension more than 19 million, in 127 to 191 seconds per problem. These results demonstrate the potential of our proposed package to enable large-scale numerical simulations for novel physical discoveries and engineering applications of photonic crystals.

The bi-Lebedev scheme is applied to discretize Maxwell's equations for the bi-anisotropic complex media. The resulting GEP has eigenvalues appearing in quadruples $\{\pm\omega, \pm\bar{\omega}\}$. We consider two main scenarios, where $\gamma < \gamma_*$ and $\gamma > \gamma_*$ with γ_* being a critical value. In the former case, all the eigenvalues are real. In the latter case, the GEP has complex eigenvalues, and we particularly focus on the bifurcation of the eigenstructure of the GEPs. Numerical results demonstrate that the newborn ground state has occurred after $\gamma = \tilde{\gamma} > \gamma_*$, and the associated eigenvector has an exotic phenomenon of localization. Moreover, the Poynting vectors of the newborn eigenvector are not only concentrated in the material but also display exciting patterns.

3. Computing the ground states of nonlinear Schrödinger equations, by Ching-Sung Liu:

We mainly study how to quickly and stably calculate and solve the ground state of the saturable nonlinear Schrodinger equation. We propose an iterative method to compute the ground state of the nonlinear Schrodinger equation and obtain the

nonlinear algebraic eigenvalue problem (NAEP) by discretizing the nonlinear Schrodinger equation. For any initial positive vector, we prove that the method globally converges to a positive solution of NAEP with a local quadratic convergence rate and its approximate eigenvalue sequence is strictly monotonically increasing, so convergence is guaranteed. Finally, this computing method can also be used to illustrate the existence of the ground state of the discretized saturable nonlinear Schrodinger equation.

(e) Numerical PDEs

1. An energy stable finite difference method for anisotropic surface diffusion on closed curves, by Ming-Chih Lai:

We introduce an energy stable finite difference method for motion of closed curves by anisotropic surface diffusion. Diffusion process on surface or interface is an important and ubiquitous phenomenon involved with the motion of atoms and molecules over solid surface. This problem is an important transport mechanism and arises in various applications of surface phase formation, solid-state physics, materials science, and computational geometry. For example, a growing crystalline film is an important ingredient for several applications on a nanoscale, and the equilibrium shape of crystals is a classic problem in materials science.

To solve surface diffusion problems, since the evolution law is written in the context of differential geometry, most of the numerical methods listed above satisfying energy stability are naturally based on surface finite element approach in Lagrangian description. As to grid-based Eulerian methods, for level-set approach which requires small time step to enforce the energy stability, and for phase field approach devised by using invariant energy quadratization method under isotropic surface energy. In this work, we propose a finite difference method for (weakly) anisotropic surface diffusion which not only satisfies the property of unconditional energy stability, but also generates a linear system as simple as possible with unknowns in Lagrangian coordinates.

2. Analysis and computation of the geophysical fluid dynamics, by Ming-Cheng Shiue

Our research contribution and interest focus on analysis and computation of the geophysical fluid dynamics. Several research directions are discussed below:

- On long time stability of temporal numerical schemes of the viscous 3D Primitive equations

We consider a semi-discretized Euler scheme to solve the three dimensional viscous primitive equations. Based on suitable assumptions on the initial

data and forcing terms, the long-time stability of the proposed scheme is proven by showing that the H_1 norm (in space variables) of the solutions is bounded at each time step when the time step satisfies certain smallness condition. This result matches the continuous case.

- Navier-Stokes and Darcy coupling flows based on finite difference methods
We performed numerical analysis of MAC scheme for Stokes and Darcy coupling flows and also gave a simple projection method for Navier-Stokes and Darcy coupling flow with curvy interface.
- Data assimilation algorithms and Synchronization
Analysis and computation of Data assimilation algorithms for Lorenz 63 equations have been studied and performed. The idea is based on synchronization. We also studied heterogeneous forced first-Order Kuramoto oscillator networks.
- Numerical methods and applications for ice sheet dynamics
We study the classical numerical methods applied to the benchmark examples of ice sheet dynamics and found that these methods do not converge for higher resolution. Meanwhile, we applied streamline diffusion stabilization method to the basal crevasses of the tidewater glacier to determine the grounding line of the ice sheet dynamics.

(f) Surface parameterizations and its applications, led by Wen-Wei Lin and S.-T. Yau.

- Conformal energy minimization for conformal parameterizations
Surface parameterizations have been widely applied to digital geometry processing. We propose an efficient conformal energy minimization (CEM) algorithm for computing conformal parameterizations of simply-connected open surfaces with a very small angular distortion and a highly improved computational efficiency. In addition, we generalize the proposed CEM algorithm to computing conformal parameterizations of multiply-connected surfaces. Furthermore, we prove the existence of a nontrivial accumulation point of the proposed CEM algorithm under some mild conditions. Several numerical results show the efficiency and robustness of the CEM algorithm comparing to the existing state of the art algorithms. An application of the CEM on the surface morphing between simply-connected open surfaces is demonstrated thereafter. Thanks to the CEM algorithm, the whole computations for the surface morphing can be performed efficiently and robustly.
- Stretch energy minimization for equiareal parameterizations
We propose a novel stretch energy minimization (SEM) algorithm for the computation of equiareal parameterizations of simply connected open surfaces with

very small area distortions and highly improved computational efficiencies. In addition, the existence of nontrivial limit points of the SEM algorithm is guaranteed under some mild assumptions of the mesh quality. Numerical experiments indicate that the accuracy, effectiveness, and robustness of the proposed SEM algorithm outperform the other state-of-the-art algorithms. Applications of the SEM on surface remeshing, registration, and morphing for simply connected open surfaces are demonstrated thereafter. Thanks to the SEM algorithm, the computation for these applications can be carried out efficiently and reliably.

- Volumetric stretch energy minimization for volume-preserving parameterizations

Manifold parameterizations have been applied to various fields of commercial industries. We develop a novel volumetric stretch energy minimization algorithm for volume-preserving parameterizations of simply connected 3-manifolds with a single boundary under the restriction that the boundary is a spherical area-preserving mapping. In addition, our algorithm can also be applied to compute spherical angle- and area-preserving parameterizations of genus-zero closed surfaces, respectively. Several numerical experiments indicate that the developed algorithms are more efficient and reliable compared to other existing algorithms. Numerical results on applications of the manifold partition and the mesh processing for three-dimensional printing are demonstrated thereafter to show the robustness of the proposed algorithm.

However, it is still challenging when the topology of manifolds is nontrivial, e.g., the 3-manifold of a topological solid torus. We propose a novel volumetric stretch energy minimization algorithm for volume-preserving parameterizations of toroidal polyhedra with a single boundary being mapped to a standard torus. In addition, the algorithm can also be used to compute the equiareal mapping between a genus-one closed surface and the standard torus. Numerical experiments indicate that the developed algorithm is effective and performs well on the bijectivity of the mapping. Applications on manifold registrations and partitions are demonstrated to show the robustness of our algorithms.

2.5.4 Activities at NCTS from August 2022 to September 2023

1. NCTS Seminar on Scientific Computing. Organized by Wei-Fan Hu, Tsung-Ming Huang, Matthew M. Lin, Ming-Cheng Shiue and Suh-Yuh Yang.
2. NCTS Seminar on Ice Sheet Dynamics and Its Related Topics. Organized by Min-Hung Chen, Chia-Chieh Jay Chu, Hsueh-Chen Lee, and Ming-Cheng Shiue

3. Short courses

- Advanced Course on Multi-Threaded Parallel Programming using OpenMP for Multicore/Manycore Systems, 9:00-17:00, February 14 - 16, 2023. Organized by Pochung Chen, Tsung-Ming Huang, Feng-Nan Hwang, Ying-Jer Kao and Weichung Wang.
Speaker: Kengo Nakajima (University of Tokyo)
- NCTS Short Course on Scientific Deep Learning
10:00-12:00, 13:00-14:00 July 3, 4, 6, 14:00-17:00 July 10, 11, 9:00-12:00 July 14, July 3 - 14, 2023. Organized by Weichung Wang and Chun-Hao Yang.
Speaker: Tan Bui-Thanh (University of Texas at Austin)
- Parallel Finite Element Method Using Supercomputer, 09:10-17:00, July 10 - 14, 2023. Organized by Pochung Chen, Tsung-Ming Huang, Feng-Nan Hwang, Ying-Jer Kao, Yu-Heng Tseng and Weichung Wang.
Speaker: Kengo Nakajima (University of Tokyo)

4. Workshops and Conferences

- Opportunities and Challenges in Numerical Algebra (13)-(16), 2022, 10/29, 11/26, 12/24, 2023 1/9 (online workshop). Organized by Weiguo Gao, Tsung-Ming Huang, Tiexiang Li, Xiang Wang and Zhanshan Yang.
- One-Day Workshop on Navier-Stokes Equations and Related Topics, February 14, 2023. Organized by Chiun-Chuan Chen, Jann-Long Chern and Ming-Chih Lai.
- 2023 Central -Taiwan Conference on Mathematical Modeling and Scientific Computation, February 18 - 19, 2023. Organized by Tzyy-Leng Horng, Hsin-Yun Hu, Chih-En Kuo, Kang-Man Liu, Cheng-Shu You and Juan-Ming Yuan.
- 2023 Conference on Advanced Topics and Auto Tuning in High-Performance Scientific Computing, March 24 - 25, 2023. Organized by How-Wei Chen, Ray-Bing Chen, Feng-Nan Hwang, Takahiro Katagiri, Reiji Suda, Weichung Wang and Yung-Yu Zhuang.

- 2023 NCTS Student Workshop on Scientific Computing, April 22, 2023. Organized by Wei-Fan Hu, Tsung-Ming Huang, Matthew M. Lin, Ming-Cheng Shiue and Suh-Yuh Yang.
- NCTS Symposium on Applied Mathematics and Computational Science, June 16 - 17, 2023. Organized by Chia-Chieh Jay Chu, Tsung-Ming Huang, Ming-Chih Lai, Matthew M. Lin, Chin-Tien Wu, Tsung-Fang Wu and Suh-Yuh Yang.
- 2023 NCTS South-Taiwan Workshop on Scientific Computations, Differential Equations and Application, July 21 - 22, 2023. Organized by Meng-Huo Chen and Chi-Jen Wang.
- 2023 NCTS Workshop on Computational Mathematics and Scientific Computing for Young Researchers, August 31 - September 1, 2023. Organized by Hong Ming Chen, Hsin-Yun Hu, Wei-Fan Hu, Huang-Nan Huang, Tsung-Ming Huang, Matthew M. Lin, Ming-Cheng Shiue, Weichung Wang, Suh-Yuh Yang and Tzu-Lun Yuan.

2.5.5 Future Plans

1. NCTS/NCU Seminar on Computational Optimization with Applications
Organizer: Suh-Yuh Yang (NCU)
We will explore essential topics in computational optimization, emphasizing their applications in image processing and data science. The seminar will cover various subjects, such as robust PCA, low-rank representation, sparse representation, and dictionary learning. Additionally, we will delve into fast and efficient global registration techniques and convex relaxation methods, among others.
2. NCTS Seminar on Scientific Computing
3. Seminar on Ice sheet dynamics, Organizer: Ming-Cheng Shiue
4. 2024 NCTS South-Taiwan Workshop on Scientific Computations, Differential Equations and Application
5. 2024 Conference on Advanced Topics and Auto Tuning in High-Performance Scientific Computing
6. 2024 NCTS Student Workshop on Scientific Computing

7. 2024 NCTS Workshop on Computational Mathematics and Scientific Computing for Young Researchers

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2.6 Program F: Interdisciplinary Studies

2.6.1 Core Members

1. Program Committee Members:

Tai-Chia Lin (NTU, chair), Je-Chiang Tsai (NTHU), Feng-Bin Wang (Chang Gung U), Te-Sheng Lin (NYCU)

2. Affiliated Faculty Members:

Tzyy-Leng Horng (Feng Chia U), Chiun-Chang Lee (NTHU), Dean Chou (NCKU), Yu-Hau Tseng (NUK), Yuan-Nan Young (New Jersey Institute of Technology), Chang-Yuan Cheng (NUK), Chang-Hong Wu (NNYCU)

2.6.2 Program Overview

In the past year, we focused on the following areas:

1. Mathematical Physiology
2. Mathematical Biology
3. PDE and machine learning

2.6.3 Research Highlights

Below are some of the highlights and recent breakthroughs.

Mathematical Pysiology

1. Model K⁺ Permeation Through the KcsA Channel by *Tzyy-Leng Horng*

Ion channels are a delicate biological device that is important in regulating ion concentrations inside cells, which deeply affects the functions of cells. There are three major problems with ion channels that are currently under intense research: permeation, selectivity, and gating. The permeation, especially the calculation of IV curve, of ion channels with a big porin like Gramicidin A (GA), OmpF, and OmpG, can be well studied by classical Poisson-Boltzmann (PB) and classical Poisson-Nernst-Planck (PNP) models. The results generally agree well with experimental data. For channels with a selectivity filter (SF), which is extremely narrow, such as K channels, classical PB/PNP fails to predict their IV curve due to two factors: (1) Strong negative charges from carbonyl oxygens on the backbone of SF will greatly recruit K ions into SF and K concentration would saturate due to the finite-size effect of ions. Traditional PB/PNP does not consider the size of ions, and would unrealistically over-saturate inside SF. (2) As K

ions enter SF, they would dehydrate their water shells due to the narrowness of SF. This would involve additional solvation energy that classical PB/PNP usually does not consider. To fix this problem, a modified PB/PNP model, called Bikerman-PB/PNP, is applied to consider the steric effect of ions. Together with the inclusion of solvation energy modeled by Born model, we can predict K concentration distribution of KcsA channel at equilibrium, which agrees well with molecular dynamics (MD) results from our Italian collaborator Luigi Catacuzzeno as shown in [6]. Next, we will continue to apply Bikerman-PB/PNP model to study the selectivity of KcsA channel, such as (1) how KcsA selects K over Na, (2) how Ba can block K channels due to its competitiveness with K on the occupation of SF. Again, the continuum result will be compared with MD results conducted by Luigi Catacuzzeno. With this long-term effort in studying ion channels, we have accumulated many experiences in modeling and simulating ion channels.

2. PB-steric equations: A general model of Poisson-Boltzmann equations *by Tai-Chia Lin*

When ions are crowded, the effect of steric repulsion between ions (which can produce oscillations in charge density profiles) becomes significant and the conventional Poisson-Boltzmann (PB) equation should be modified. Several modified PB equations were developed but the associated total ionic charge density has no oscillation. In [10], we derive a general model of PB equations called the PB-steric equations with a parameter Λ , which not only include the conventional and modified PB equations but also have oscillatory total ionic charge density under different assumptions of steric effects and chemical potentials. When $\Lambda = 0$, the PB-steric equation becomes the conventional PB equation, but when $\Lambda > 0$, the concentrations of ions and solvent molecules are determined by the Lambert type functions. To approach the modified PB equations, we study the asymptotic limit of PB-steric equations with the Robin boundary condition as Λ goes to infinity. Our theoretical results show that the PB-steric equations (for $0 \leq \Lambda \leq \infty$) may include the conventional and modified PB equations. On the other hand, we use the PB-steric equations to find oscillatory total ionic charge density which cannot be obtained in conventional and modified PB equations.

3. ceRNA network in ovarian cancers, *by Je-Chang Tsai*.

In living cells, chemical reactions form complex networks and thus give a very large ODE system. Also, the crucial processes are easily obscured by numerical approaches due to the complexity of the underlying networks. Our previous study proposed an analytical approach, not a numerical one, to analyze the bifurcation behaviors of network systems using their structures alone. In [14], the framework of this approach was applied to explain the relationship between

E2F6 protein and the significant change of c-KIT and PBX1 mRNA level associated with cancer stemness and immunoevasion, respectively. In particular, the epigenetic silencing of the tumor suppressor gene miR-193a by E2F6 protein is predicted.

4. Effect of multiple buffer binding sites on calcium waves, *by Je-Chang Tsai.*

The existence and properties of intracellular waves of increased free cytoplasmic calcium concentration (calcium waves) are strongly affected by the binding and unbinding of calcium ions to a multitude of different buffers in the cell. These buffers can be mobile or immobile and, in general, have multiple binding sites that are not independent. Previous theoretical studies have focused on the case when each buffer molecule binds a single calcium ion. In this study, we analyze how calcium waves are affected by calcium buffers with two non-independent binding sites, and show that the interactions between the calcium binding sites can result in the emergence of new behaviors [15].

Mathematical Biology

1. Stage-structured population and epidemiological modeling, *by Chang-Yuan Cheng.*

In [4], we study a model with two life stages, immature and mature, and incorporate both intra- and inter-specific competitions between two species in a patchy environment. The structure of monotone dynamics in such a model leads us to explore its local and global dynamics. We study the two-species model and formulate the threshold competition strength which monotonously but oppositely depends on the maturation times of two species, and indicates how the competitor invades an environment. Moreover, we demonstrate two mechanisms which give rise to dominance dynamics, under competition-dependent and -independent criteria, respectively. In [8], we considered both control strategies - vaccination and quarantine- to solve an epidemiological problem. The age since infection is also relevant to describe the population dynamics by detailed features, among which, the age-specific quarantine rate poses some mathematical challenges since the possibility of an infected individual being quarantined exists at any age of infection. We demonstrated how backward bifurcation occurs in the proposed model under a complicated but traceable and illuminative criterion, and explored it to observe the effects of certain parameters on the dynamics. In [9], we consider different genetic strains which may have different characteristics in the notion of complex networks. First result is deriving two threshold quantities, \mathcal{R}_1 and \mathcal{R}_2 , for each strain. Except the global convergence to the disease-free equilibrium, we established the conditions that ensure the global stability of each strain dominance equilibrium. Under these stability conditions,

we also determined survival of a single strain and the condition for coexistence of both strains.

2. Population dynamics and HIV modeling, *by Feng-Bin Wang.*

Motivated by population growth in a heterogeneous environment, we build a reaction-diffusion model with spatially dependent parameters in [11]. In particular, a term for spatially uneven maturation durations is included in the model, which puts the current investigation among the very few studies on reaction-diffusion systems with spatially dependent delays. The synthesized approach proposed here is applicable to broader contexts of studies on the impact of spatial heterogeneity on population dynamics, in particular, when delayed feedbacks are involved and the response time is spatially varying. The ecological models with variable quotas in a spatially variable habitat are important and significant. One more tractable approach is the reaction-diffusion-advection system, and the main difficulties are caused by the singularity in the ratio at the extinction steady state. Existence of positive steady state solutions for such system can be established in terms of the principal eigenvalues of associated nonlinear eigenvalue problems. Ref. [16] is devoted to further study of basic reproduction ratios R_0 for time-periodic homogeneous evolution systems. We introduce the definition of R_0 and show that the sign of R_0 determines the stability of the zero solution for such a system. In [1], we develop a mathematical model to simulate the impact of the blood-brain barrier (BBB) on the treatment of HIV. Our results suggest that the effect of the BBB on viral suppression in the brain must be considered for developing proper treatment protocols against HIV infection.

3. Wave propagation arising in mathematical biology, *by Chang-Hong Wu.*

Our recent research primarily focuses on analyzing the competition dynamics in two-species models represented by reaction-diffusion systems. Additionally, we investigate the global dynamics of reaction-interface problems originating from excitable media. In our works [12, 17], we concentrate on the two-species Lotka-Volterra diffusion-competition model. Here, we obtain precise estimates for the asymptotic convergence of solutions, addressing open questions within the existing literature. Our analysis encompasses scenarios of both strong-weak competition and strong competition, thereby expanding the scope of understanding. Furthermore, in our work [5], we explore a diffusion-competition system involving two free boundaries within a radially symmetric framework. In this context, the reaction terms illustrate a weak-strong competition dynamic. Our investigation reveals novel spreading phenomena when compared to conventional diffusion-competition models. From a modeling perspective, we employ the concept of

singular limit to elucidate the emergence of free boundaries, as discussed in [7]. Moreover, in our research detailed in [2, 3], we study FitzHugh-Nagumo-type reaction-diffusion models. Our primary focus is understanding the generation of wave propagation phenomena within excitable media. These findings enable us to employ relatively straightforward mathematical models, which nonetheless capture the intricate and dynamic patterns present in the original system. This approach allows us to understand the complex patterns manifesting within excitable media. In [13], we consider a class of neural field models represented by a second-order nonlinear system of integro-differential equations with space-dependent delays. We establish sufficient conditions for absolute stability and synchronization among different populations of the system. Some numerical examples are presented to demonstrate the theoretical results.

PDE and Machine Learning

1. Mathematical modeling through asymptotic analysis, scientific computation and machine learning, *by Te-Sheng Lin.*

We study the transition to dripping in the gravity-driven flow of a liquid film under an inclined plate at zero Reynolds number [18]. A hierarchy of models are derived through asymptotic analysis, and we provide evidence to show that the thin film model gives an accurate prediction for dripping onset. We also study the classification of coffee beans using single coffee bean mass spectrometry [19], in collaboration with Prof. Yu-Chie Chen from the Department of Applied Chemistry, National Yang Ming Chiao Tung University. Since the model a priori does not have physical laws, we introduce neural network-based machine learning for bean classification and find excellent accuracy. Finally, in order to explore the basic expressibility of artificial neural networks, we use the elliptic interface problem as an example to study physics-informed neural networks (PINNs). We propose a cusp-capturing PINNs [20] and an efficient neural-network and finite-difference hybrid method [21]. With these novel designs of the networks, the present network function preserves the regularity of the solution, and the proposed methods are highly accurate.

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2.6.4 Highlights of Events

Seminars

1. 2023 NCTS seminar on Mathematical Physiology (organized by Tzyy-Leng Horng, Chiun-Chang Lee and Tai-Chia Lin)
2. 2023 NCTS seminar on Mathematical Biology (organized by Chang-Yuan Cheng, Feng-Bin Wang and Chang-Hong Wu)
3. 2023 NCTS seminar on fluid mechanics and scientific machine learning (organized by Te-Sheng Lin)

Lectures and Courses

1. 2023 NCTS Short course on computational mechanics and applied mathematics (organized by, Chang-Yuan Cheng, Sze-Bi Hsu, Tai-Chia Lin, Feng-Bin Wang and Chang-Hong Wu)
2. 2023 NCTS Summer Course on Mathematical Biology (organized by Chang-Yuan Cheng, Tai-Chia Lin, Chang-Hong Wu and Feng-Bin Wang)
3. 2023 NCTS Summer Course on Scientific Machine Learning (organized by Te-Sheng Lin and Tai-Chia Lin)

Conferences and Workshops

1. 2023 NCTS Journal Club of Interdisciplinary Research Part I-III (organized by Tai-Chia Lin and Feng-Bin Wang)
2. 2023 NCTS Workshop on recent advances of interdisciplinary studies (organized by Tai-Chia Lin and Feng-Bin Wang)
3. 2023 NCTS Interdisciplinary Workshop on Biomathematics, November 13-14, 2023 (organized by Chang-Yuan Cheng, Tai-Chia Lin, Feng-Bin Wang and Chang-Hong Wu)

2.6.5 Future Plans

Conferences and workshops:

1. 2024 NCTS Workshop: Mathematics of living systems, January 2024 (organized by Tzyy-Leng Horng, Tai-Chia Lin and Feng-Bin Wang)
2. 2024 NCTS Workshop on Mathematical Biology, June 2024 (organized by Chang-Yuan Cheng, Sze-Bi Hsu, Tai-Chia Lin, Feng-Bin Wang and Chang-Hong Wu)
3. 2024 NCTS International conference on scientific machine learning, May, 2024 (organized by Ming-Chih Lai, Ming-Cheng Shiue and Te-Sheng Lin)

Seminars

1. 2024 NCTS seminar on Mathematical Physiology (organized by Tzyy-Leng Horng, Chiun-Chang Lee and Tai-Chia Lin)
2. 2024 NCTS seminar on Stochastic effect in system biology (organized by Jinsu Kim (POSTECH), Chao-Ping Hsu (AS) and Je-Chiang Tsai)

3. 2024 NCTS seminar on Mathematical Biology (organized by Chang-Yuan Cheng, Feng-Bin Wang and Chang-Hong Wu)
4. 2024 NCTS seminar on fluid mechanics and scientific machine learning (organized by Te-Sheng Lin and Yu-Hau Tseng)

Potential visitors:

1. Jinsu Kim (from POSTECH, Korea).
Expected visit period: two-three weeks in Dec of 2023.
2. Michael J. Shelley (Department of Mathematics and Courant Institute of Mathematical Sciences, New York University)
Expected visit period: January 20-28, 2024.
3. Quentin Griette (University Le Havre Normandie, France)
Expected visit period: two-three weeks in June of 2024.

Courses and lectures:

1. 2024 NCTS Summer Course on Mathematical Biology
2. NCTS Short course on Mathematical Modeling and Analysis of Infectious Disease
3. NCTS Short course on singular measure traveling waves in an epidemiological model with continuous phenotypes (Lecturer: Quentin Griette at the University Le Havre Normandie, France)

3 Host University Commitment

The commitment of the host institution, the National Taiwan University, consists of the following: budget, space, and logistic support. Overall, the host institution has been very supportive. Its commitment on budget has been completely fulfilled. Below we will focus on the part of its commitment regarding space and other logistic supports.

3.1 Space of NCTS

The Center moved to the newly-built Cosmology Building in October of 2020. The space in the new building is very nice and pleasant. According to the commitment of the host university, where the official document is attached in the following pages, NTU provides 200 ping in Cosmology Building free of charge for the Center to use. The Center also rents extra space in the building at a special and guaranteed rate. Space in parts of the second and third floor of the New Mathematics Building is also provided free of charge for the Center to use. Because it is an old building and the condition there is not perfect, we have only used the offices in the second floor for participants of USRP and the students liked the space very much. These offices are also suitable for hosting visitors and conference participants. This building and the old Mathematics building next to it would be torn down in the end of 2024 or early 2025 for the construction of a new building donated by a mathematics alumnus of NTU. The NCTS Mathematics division can partially use the space of this building when it is complete. Things related to the building are in the process and the construction of the building is expected to be complete by the year of 2028. We will roughly use a total of 1200 ping free of charge after moving to the new space. It would be a unified and bigger space for us, and the rent saved can support more academic activities.

We also have been using the Lecture room 440 on the fourth floor of the Astronomy-Mathematics Building provided by the Department of Mathematics. We have converted Room 505 in Cosmology Building, which was used for MeDA Lab before, into a classroom with 43 seats and an additional multipurpose room with about 20-30 seats. These spaces provide relief to our current need on classrooms.

3.2 Logistic support of NTU

The logistic support of the NTU in recent years has been outstanding. Whenever needed, it is easy to make appointments to discuss directly with administrative officers including the President, Vice Presidents, Provost, Dean of Research and Development, Dean of General Affairs, etc. In addition to the items mentioned in the official document of commitment, Taiwan Mathematics School (TMS) also has been greatly supported by NTU. The Center can offer courses with credits, and allow students from the cooperative universities or cooperative departments of the NCTS to take the courses.

申請機構配合事項同意書

計畫名稱：國家理論科學研究中心第五階段運作計畫(2021.1.1-2025.12.31)

計畫主持人姓名/職稱：李百祺/教授

申請機構配合措施：本計畫業經單位內部審查，同意提供下列配合事項。

一、配合款：本機構同意提供科技部核定經費之40%為配合款，於執行期間優先使用於計畫所需各項經費（含中心人員薪資、學術活動費用、使用空間的場租、軟硬體設備、裝修維護費、水電雜支等等）。本計畫執行期滿後，收支報告表內需詳細註明配合款支用情形。

二、員額：

(1) 提供數學組、物理組至少各10名博士後研究員名額，以招募優秀年輕研究人員。（於配合款中編列相關薪資）

(2) 中心主任與執行主任因推動中心業務，得依本校「專任教師授課時數減免要點」相關規定申請減免授課時數。

三、管理費：依本校「建教合作計畫管理費分配處理細則」辦理，以科技部計畫15%管理費計，如不分配至計畫主持人所屬學院（須先與學院議定），則分配至校級中心之管理費約32%。

四、結餘款：依本校「建教合作計畫結餘款分配、運用及管理要點」辦理，依當年度結餘款總額扣除個別使用款項後之餘額結算。

五、空間：

(1) 數學組使用現況及規劃：

專屬空間共約 549 坪

次震宇宙館(數學組)	4樓(200坪)及5樓無償使用空間	辦公室、小型會議室與研究室。
	租用空間 (數學組另行租借246.51坪)	中心行政區，小型研討室(30人)及大型研討室(120人)各1間，4間訪問學者辦公室與交誼區；走道公共空間設有沙發及茶水區，為公告區及休息討論區。辦公室、小型會議室與研究室。
數學研究中心	2樓(約66坪)	5間辦公室(供博士後研究員使用)及休息區
	3樓(約36坪)	6間訪問學者辦公室。

(2)物理組使用現況及規劃：
專屬空間共約 501 坪

次震宇宙館 (物理組)	4 樓(200 坪)	11 間辦公室、小型研討室(25 人)及大型研討室(100 人)各一間，設有開放式討論空間、休息討論區、茶水區。
	租用空間 (物理組另行租借 246.51 坪)	中型討論室 3 間(50 人)、小型討論室 2 間(25 人)，12 間訪客辦公室，另設有茶水區、休息討論區與公告區。
物理系	8 樓(約 54 坪)	2 間辦公室(供博士後研究員與研究生使用)、小型研討室。

(3)於次震宇宙館無償使用空間之水電費，比照校內教學單位之收費標準收費；借用研究計畫辦公室之水電費，依研究計畫辦公室收費標準計收。

(4)本期執行期間得優先租用次震宇宙館之空間，其租金不高於現行之標準。

六、其它相關配合措施：請詳細說明所提供之各項設備、學人宿舍、裝修維護費、水電雜支、停車、行政支援...等：

(1)依本校相關規定提供客座學人宿舍給國內、外長期訪問學者。

(2)國內、外學生至中心訪問期間，得依本校相關規定申請本校學生宿舍。

(3)提供一個月(含)以上中心訪客使用本校體育健身設施收費優惠。

(4)提供參加中心活動的成員停車費優惠。

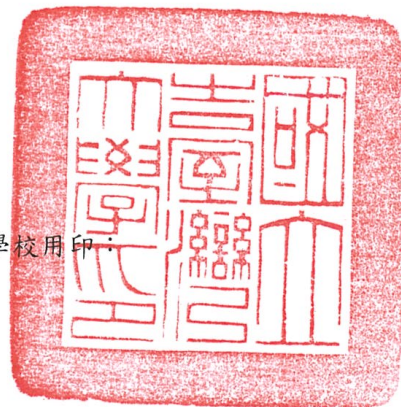
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科技部

申請機構首長(簽章)：



學校用印：



中華民國 109 年 6 月 9 日

4 Appendix

Throughout this Appendix, the following abbreviations are used for the Topical Programs:

- A = Number Theory and Representation Theory
- B = Algebraic Geometry
- C = Differential Geometry and Geometric Analysis
- D = Differential Equation and Stochastic Analysis
- E = Scientific Computing
- F = Interdisciplinary Studies

4.1 Committee Members

姓名	英文名	學校/單位	備註
陳俊全	Chiun-Chuan Chen	國立臺灣大學數學系	Executive Committee
程舜仁	Shun-Jen Cheng	中央研究院數學研究所	Executive Committee
謝銘倫	Ming-Lun Hsieh	國立臺灣大學數學系	Executive Committee
李瑩英	Yng-Ing Lee	國立臺灣大學數學系	Executive Committee
林文偉	Wen-Wei Lin	國立陽明交通大學應用數學系	Executive Committee till July 31
蔡東和	Dong-Ho Tsai	國立清華大學數學系	Executive Committee
崔茂培	Mao-Pei Tsui	國立臺灣大學數學系	Executive Committee
楊一帆	Yi-Fan Yang	國立臺灣大學數學系	Topical Program Committee (A), Chair
張介玉	Chieh-Yu Chang	國立清華大學數學系	Topical Program Committee (A)
賴俊儒	Chun-Ju Lai	中央研究院數學研究所	Topical Program Committee (A)
魏福村	Fu-Tsun Wei	國立清華大學數學系	Topical Program Committee (A)
陳榮凱	Jungkai Chen	國立臺灣大學數學系	Topical Program Committee (B), Chair
賴青瑞	Ching-Jui Lai	國立成功大學數學系	Topical Program Committee (B)
林學庸	Hsueh-Yung Lin	國立臺灣大學數學系	Topical Program Committee (B)
余正道	Jeng-Daw Yu	國立臺灣大學數學系	Topical Program Committee (B)
何南國	Nan-Kuo Ho	國立清華大學數學系	Topical Program Committee (C), Chair
江孟蓉	River Chiang	國立成功大學數學系	Topical Program Committee (C)
林俊吉	Chun-Chi Lin	國立臺灣師範大學數學系	Topical Program Committee (C)
蔡忠潤	Chung-Jun Tsai	國立臺灣大學數學系	Topical Program Committee (C)
吳恭儉	Kung-Chien Wu	國立成功大學數學系	Topical Program Committee (D), Chair
班榮超	Jung-Chao Ban	國立政治大學應用數學系	Topical Program Committee (D)
夏俊雄	Chun-Hsiung Hsia	國立臺灣大學數學系	Topical Program Committee (D)
黃信元	Hsin-Yuan Huang	國立陽明交通大學應用數學系	Topical Program Committee (D)
許元春	Yuan-Chung Sheu	國立陽明交通大學應用數學系	Topical Program Committee (D)
沈俊嚴	Chun-Yen Shen	國立臺灣大學數學系	Topical Program Committee (D)
黃聰明	Tsung-Ming Huang	國立臺灣師範大學數學系	Topical program Committee (E), Chair
胡偉帆	Wei-Fan Hu	國立中央大學數學系	Topical program Committee (E)
林敏雄	Matthew M. Lin	國立成功大學數學系	Topical program Committee (E)
薛名成	Ming-Cheng Shiue	國立陽明交通大學應用數學系	Topical program Committee (E)
楊肅烜	Suh-Yuh Yang	國立中央大學數學系	Topical program Committee (E)
林太家	Tai-Chia Lin	國立臺灣大學數學系	Topical Program Committee (F), Chair
林得勝	Te-Sheng Lin	國立陽明交通大學應用數學系	Topical Program Committee (F)
蔡志強	Je-Chiang Tsai	國立清華大學數學系	Topical Program Committee (F)
王峰彬	Feng-Bin Wang	長庚大學通識教育中心	Topical Program Committee (F)
韓善瑜	Adeel Ahmad Khan	中央研究院數學研究所	Young Theoretical Scientist
郭庭榕	Ting-Jung Kuo	國立臺灣師範大學數學系	Young Theoretical Scientist
賴俊儒	Chun-Ju Lai	中央研究院數學研究所	Young Theoretical Scientist
戴佳原	Jia-Yuan Dai	國立中興大學應用數學系	Young Theoretical Scientist
樂美亨	Mei-Heng Yueh	國立臺灣師範大學數學系	Young Theoretical Scientist

姓名	英文名	學校/單位	備註
沈俊嚴	Chun-Yen Shen	國立臺灣大學數學系	Center Scientist till July 31
黃皓瑋	Yung-Ning Peng	國立成功大學數學系	Center Scientist till July 31
彭勇寧	Hao-Wei Huang	國立清華大學數學系	Center Scientist till July 31
王業凱	Ye-Kai Wang	國立陽明交通大學應用數學系	Center Scientist till July 31
黃信元	Hsin-Yuan Huang	國立陽明交通大學應用數學系	Center Scientist
胡偉帆	Wei-Fan Hu	國立中央大學數學系	Center Scientist
林學庸	Hsueh-Yung Lin	國立臺灣大學數學系	Center Scientist
王堉彬	Feng-Bin Wang	長庚大學通識教育中心	Center Scientist
陳志瑋	Chih-Whi Chen	國立中央大學數學系	Center Scientist starting August 1
江金城	Jin-Cheng Jiang	國立清華大學數學系	Center Scientist starting August 1
劉聚仁	Gi-Ren Liu	國立成功大學數學系	Center Scientist starting August 1
吳昌鴻	Chang-Hong Wu	國立陽明交通大學應用數學系	Center Scientist starting August 1

4.2 List of Workshops, Conferences and Special Events

Event Title	Date	Venue	Organizers	Program
NCTS Number Theory Day	2023/06/01	NCTS	Ming-Lun Hsieh (NTU)	A
NCTS One-day combinatorics workshop	2023/07/27	NCTS	Wei-Hsuan Yu (NCU)	A
Japan-Taiwan Joint conference on Number theory 2023	2023/08/21- 2023/08/25	NPU	Masataka Chida (TDU), Ming-Lun Hsieh (NTU), Fu-Tsun Wei (NTHU), Yi-Fan Yang (NTU)	A
Conference in Algebraic Representation Theory (CART) 2023	2023/12/01- 2023/12/03	NCTS	Susumu Arikawa (Osaka Uni.), Shun-Jen Cheng (AS), Jae-Hoon Kwon (Seoul National Uni.), Chun-Ju Lai (Academia Sinica), Ching-Hung Lam (AS), Ngau Lam (NCKU), Satoshi Naito (Tokyo Institute of Tech.), Yung-Ning Peng (NCKU), Toshiaki Shoji (Tongji Uni.), Cheng-Chiang Tsai (AS)	A
Taipei Conference in Representation Theory VII	2023/12/18- 2023/12/22	NCTS	Shun-Jen Cheng (AS), Weiqiang Wang (Virginia U.)	A
2023 NCTS Higher Dimensional Algebraic Geometry Minicourses and Workshop	2023/03/13- 2023/03/24	NCTS	Caucher Birkar (Uni. of Cambridge & Tsinghua Uni.), Jungkai Chen (NTU & NCTS), Yujiro Kawamata (UoT & NCTS), Keiji Oguiso (UoT)	B
Modern Perspectives on Birational Geometry	2023/07/29- 2023/08/04	NCTS	Jungkai Chen (NTU & NCTS), Hsueh-Yung Lin (NTU), Evgeny Shinder (Uni. of Sheffield)	B
Perspectives in Geometric Analysis	2023/02/18 - 2/20	NCTS	Chung-Jun Tsai (NTU), Mao-Pei Tsui (NTU)	C
NCTS Workshop in Symplectic Geometry	2023/03/22- 2023/03/23	NCTS	River Chiang (NCKU), Kaoru Ono (RIMS, Kyoto U)	C
The 24th Taiwan Geometry Symposium	2023/05/13	NTHU	Chih-Wei Chen (NSYSU), Nan-Kuo Ho (NTHU), Chung-Jun Tsai (NTU), Mao-Pei Tsui (NTU)	C
Recent progress in special Lagrangian equations and deformed Hermitian-Yang-Mills equation	2023/07/17- 2023/07/21	NCTS	Chung-Jun Tsai (NTU), Mao-Pei Tsui (NTU), Mu-Tao Wang (Columbia Uni.)	C
Fourth Taiwan-Japan Joint Conference on Differential Geometry	2023/11/06- 2023/11/09	NCTS	Shu-Cheng Chang (NTU), River Chiang (NCKU), Nan-Kuo Ho (NTHU), Ying-Ing Lee (NTU), Mao-Pei Tsui (NTU)	C

NCTS 2023 Conference on Differential Geometry and Geometric Analysis	2023/12/16-2023/12/18		Hung-Lin Chiu (NTHU), Chin-Yu Hsiao (AS)	C
ReaDiNet 2023: International Conference on Parabolic and Stochastic Models in Mathematical Biology	2023/01/03-2023/01/06	Uni. of Paris at Orsay, France	Chiun-Chuan Chen (NTU), Jong-Sheng Guo (TKU)	D
2023 NCTS Young Dynamics Day	2023/02/08	NCKU	Jung-Chao Ban (NCCU), Chih-Hung Chang (NUK), Kuo-Chang Chen (NTHU), Cheng-Hsiung Hsu (NCU), Kung-Chien Wu (NCKU)	D
One-Day Workshop on Navier-Stokes Equations and Related Topics	2023/02/14	NCTS	Chiun-Chuan Chen (NTU), Jann-Long Chern (NTU), Ming-Chih Lai (NYCU)	D
The 13th Taiwan-Japan Joint Workshop for Young Scholars in Applied Mathematics	2023/03/01-2023/03/03	NCTS	Chueh-Hsin Chang (NCCU), Chiun-Chuan Chen (NTU), Yan-Yu Chen (NTU), Jann-Long Chern (NTU), Yung-Fu Fang (NCKU), Elliott Ginder (Meiji U), Chih-Chiang Huang (NCCU), Kota Ikeda (Meiji U), Mayuko Iwamoto (Shimane U), Tatsuki Kawakami (Ryukoku U), Shuichi Kinoshita (Musashino U), Hideki Murakawa (Ryukoku U), Hirokazu Ninomiya (Meiji U), Toshiyuki Ogawa (Meiji U), Yasuhisa Saito (Shimane U), Yoshitaro Tanaka (FUN), Yuichi Togashi (Hiroshima U), Chang-Hong Wu (NYCU)	D
Distinguished Lecture Series in Dynamical Systems (Speaker: Vadim Kaloshin (IST Austria))	2023/03/03	NCTS	Kuo-Chang Chen (NTHU)	D
2023 Spring Probability Workshop	2023/05/05-2023/05/06	NCTS	Ting-Li Chen (AS), Lung-Chi Chen (NCCU), May-Ru Chen (NSYSU), Shang-Yuan Shiu (NCU), Li-Hsien Leo Sun (NCU), Ju-Yi Yen (U of Cincinnati)	D

2023 NCTS PDE Conference on recent development of fluid dynamics and kinetic theory	2023/06/05-2023/06/09	NCTS	Chueh-Hsin Chang (CCU), Chun-Hsiung Hsia (NTU), Kung-Chien Wu (NCKU & NCTS)	D
2023 Symposium for Young Analysts	2023/06/08	NCTS	Hao-Wei Huang (NTHU), Chun-Yen Shen (NTU), Daniel Eli Spector (NTNU)	D
2023 NCTS Workshop on Dynamical Systems	2023/06/08-2023/06/10	NCTS	Jung-Chao Ban (NCCU), Chih-Hung Chang (NUK), Kuo-Chang Chen (NTHU), Cheng-Hsiung Hsu (NCU), Lien-Yung Kao (George Washington U)	D
NCTS Distinguished Lecture: On the Spectral Gap of Mean-field Spin Glass Models	2023/06/14	NCTS	Mao-Pei Tsui (NTU)	D
The Korea-Taiwan-Vietnam Joint Meeting on Discrete Geometry and Geometric Measure Theory	2023/07/17-2023/07/19	Vietnam	Chun-Yen Shen (NTU)	D
2023 NCTS PDE Young Scholar Workshop	2023/08/28-2023/08/30	NCTS	Chiun-Chuan Chen (NTU), Chih-Chiang Huang (CCU), Chun-Hsiung Hsia (NTU), Kung-Chien Wu (NCKU)	D
International Conference on Recent Developments of Theory and Methods in Mathematical Biology	2023/10/23-2023/10/27	NCTS	Chiun-Chuan Chen (NTU), Jong-Sheng Guo (TKU), Chun-Hsiung Hsia (NTU), Chang-Hong Wu (NYCU)	D
2023 NCTS Interdisciplinary Two-Day Workshop: Population Dynamics and Related Topics	2023/11/13-2023/11/14	NCTS	Chang-Yuan Cheng (NCKU), Tai-Chia Lin (NTU), Feng-Bin Wang (CGU), Chang-Hong Wu (NYCU)	D
Opportunities and Challenges in Numerical Algebra (16)	2023/01/09	Online Conference	Weiguo Gao (Fudan Uni.), Tsung-Ming Huang (NTNU), Tiexiang Li (Southeast Uni.), Xiang Wang (Nanchang Uni.), Zhanshan Yang (Qinghai Uni. for Nationalities)	E
2023 Conference on Advanced Topics and Auto Tuning in High-Performance Scientific Computing	2023/03/24-2023/03/25	NCCU	How-Wei Chen (NCU), Ray-Bing Chen (NCKU), Feng-Nan Hwang (NCU), Takahiro Katagiri (Nagoya U), Reiji Suda (UoT), Weichung Wang (NTU), Yung-Yu Zhuang (NCU)	E

2023 NCTS Student Workshop on Scientific Computing	2023/04/22	NCU	Wei-Fan Hu (NCU), Tsung-Ming Huang (NTNU), Matthew M. Lin (NCKU), Ming-Cheng Shiue (NYCU), Suh-Yuh Yang (NCU)	E
NCTS Symposium on Applied Mathematics and Computational Science	2023/06/16-2023/06/17	NYCU	Chia-Chieh Jay Chu (NTHU), Tsung-Ming Huang (NTNU), Ming-Chih Lai (NYCU), Matthew M. Lin (NCKU), Chin-Tien Wu (NYCU), Tsung-Fang Wu (NUK), Suh-Yuh Yang (NCU)	E
2023 NCTS South Taiwan Workshop on Scientific Computing, Differential Equations and Applications 2023 NCTS 南區科學計算、微分方程與應用研討會	2023/07/21-2023/07/22	NCCU	Meng-Huo Chen (CCU), Chi-Jen Wang (CCU)	E
2023 NCTS Workshop on Computational Mathematics and Scientific Computing for Young Researchers	2023/08/31-2023/09/01	THU	Hong Ming Chen (THU), Hsin-Yun Hu (THU), Wei-Fan Hu (NCU), Huang-Nan Huang (THU), Tsung-Ming Huang (NTNU), Matthew M. Lin (NCKU), Ming-Cheng Shiue (NYCU), Weichung Wang (NTU), Suh-Yuh Yang (NCU), Tzu-Lun Yuan (THU)	E
NCTS Student Mini-Symposium in Applied Mathematics	2023/01/11	NTHU	Wei-Fan Hu (NCU), Yueh-Cheng Kuo (NUK), Te-Sheng Lin (NYCU), Shih-Feng Shieh (NTNU), Je-Chiang Tsai (NTHU), Yu-Hau Tseng (NUK)	F
2023 Central -Taiwan Conference on Mathematical Modeling and Scientific Computation	2023/02/18-2023/02/19	FCU	Tzzy-Leng Horng (FCU), Hsin-Yun Hu (THU), Chih-En Kuo (NCHU), Kang-Man Liu (NCUE), Cheng-Shu You (FCU), Juan-Ming Yuan (PU)	F
2023 NCTS Journal Club of Interdisciplinary Research Part I	2023/04/07	NCTS	Steven Jeffrey Altschuler (UCSF), Tai-Chia Lin (NTU), Feng-Bin Wang (CGU), Lani Fang Wu (UCSF)	F
2023 NCTS Journal Club of Interdisciplinary Research Part II	2023/04/14	NCTS	Steven Jeffrey Altschuler (UCSF), Tai-Chia Lin (NTU), Feng-Bin Wang (CGU), Lani Fang Wu (UCSF)	F

2023 NCTS Workshop on recent advances of interdisciplinary studies	2023/04/20-2023/04/21	NCTS	Tai-Chia Lin (NTU), Feng-Bin Wang (CGU)	F
2023 NCTS Journal Club of Interdisciplinary Research Part III	2023/04/28	NCTS	Steven Jeffrey Altschuler (UCSF), Tai-Chia Lin (NTU), Feng-Bin Wang (CGU), Lani Fang Wu (UCSF)	F
2023 NCTS Optimization Workshop	2023/05/17	NTNU	Jein-Shan Chen (NTNU)	F
NCTS East Asia Core Doctoral Forum in Mathematics	2023/01/09-2023/01/12	NCTS	Yoshihiro Abe (Tohoku Uni.), Zhijie Chen (Tsinghua Uni.), Hao-Wei Huang (NTNU), Norisuke Ioku (Tohoku Uni.), Tsuyoshi Kato (Kyoto Uni.), Yasuyuki Kawahigashi (Uni. of Tokyo), Byeong-Kweon Oh (Seoul National Uni.), Chun-Yen Shen (NTU), Shun-Chieh Wang (NTU), Ye-Kai Wang (NYCU)	Special Event
NCTS-Kyoto Mathematics Symposium	2023/12/09	NCTS	Kuo-Chang Chen (NTHU), Hiroshi Kokubu (Kyoto U), Yng-Ing Lee (NTU & NCTS)	Special Event
URP & RA 冬季研究成果報告發表會	2023/02/09	NCTS	Yuan-Chung Sheu (NYCU)	Special Event
NCTS 2023 Spring Day	2023/03/13	NCTS	Yng-Ing Lee (NTU & NCTS)	Special Event
URP & RA Summer Presentation	2023/06/29	NCTS	Yuan-Chung Sheu (NYCU)	Special Event
2023 NCTS USRP 大學部學生暑期研究計畫期中交流分享會	2023/07/19	NCTS	Yng-Ing Lee (NTU & NCTS)	Special Event
2023 NCTS USRP 大學部學生暑期研究計畫期末成果報告發表會	2023/08/10	NCTS	Yng-Ing Lee (NTU & NCTS), Shun-Jen Cheng (AS), Mao-Pei Tsui (NTU)	Special Event
Meet with Professor Tai-Peng Tsai	2023/06/09	NCTS	Mao-Pei Tsui (NTU)	Special Event
Meet with Prof. Yen-Hsi Richard Tsai	2023/06/29	NCTS	Mao-Pei Tsui (NTU)	Special Event
Meet with Professor Horng-Tzer Yau	2023/07/12	NCTS	Mao-Pei Tsui (NTU)	Special Event

Meet with Professor Mu-Tao Wang	2023/07/26	NCTS	Mao-Pei Tsui (NTU)	Special Event
Gateway to the World-Student Presentations after Academic Visits Abroad (2023 海外暑期學校參與學員心得與課程內容分享 (I))	2023/09/11	NCTS	Yng-Ing Lee (NTU & NCTS), Chun-Yen Shen (NTU)	Special Event
Gateway to the World-Student Presentations after Academic Visits Abroad (2023 海外暑期學校參與學員心得與課程內容分享 (II))	2023/09/18	NCTS	Wai Kit Lam (NTU), Yng-Ing Lee (NTU & NCTS), Jhih-Huang Li (NTU)	Special Event
Gateway to the World-Student Presentations after Academic Visits Abroad (2023 海外暑期學校參與學員心得與課程內容分享 (III))	2023/09/25	NCTS	Yng-Ing Lee (NTU & NCTS)	Special Event

4.3 Seminar Talks

Seminar Title	Seminar Dates	Program
NCTS Number Theory Seminar	3/01, 3/03, 3/09, 3/23, 3/23, 3/30, 3/31, 3/31, 4/27, 5/04, 5/25, 6/02, 7/07, 7/11, 7/14	A
NCTS Seminar on Representation Theory	2/17, 3/31, 5/12, 8/15	A
Special Topic Seminar	6/30	A
Taipei Postdoc Seminar	3/08, 3/29, 4/26, 5/10	A
NCTS Seminar in Algebraic Geometry	2/06, 2/06, 2/10, 3/31, 3/31, 5/26, 7/14, 8/11, 9/22, 10/6, 10/13, 10/20	B
Online Seminar on Algebraic and Complex Dynamics	3/14, 3/21, 3/28, 4/11, 4/18, 4/25, 5/23	B
AS-NCTS Seminar on Geometry	1/03, 3/16	C
NCTS Differential Geometry Seminar	2/02, 2/23, 3/02, 3/08, 3/30, 4/06, 4/20, 4/27, 5/04, 5/25, 6/01, 6/21, 7/07, 7/07, 7/13, 7/13, 7/14, 8/02, 8/03, 8/23, 9/14, 10/5, 10/12, 10/18	C
NCTS International Geometric Measure Theory Seminar	1/18, 3/15, 5/17, 7/12, 9/20, 11/15	C
Special Topic Seminar	8/15, 8/16, 11/27	C
Taipei Postdoc Seminar	2/22	C
European-Asian Joint Webinar on Dynamical Systems	2/24, 3/10, 3/24, 5/19	D
Korea-Taiwan-Vietnam Joint Seminar in Combinatorics and Analysis	2/17, 3/03, 3/17, 3/31, 4/07, 4/21	D
NCTS Nonlinear PDE and Analysis Seminar	3/01, 3/15, 3/29, 4/19, 5/17, 6/07, 6/14, 8/17, 9/13, 9/22	D
NCTS Probability Seminar	3/06, 3/20, 4/17, 5/01, 5/26, 5/26, 5/29, 6/05, 7/25, 8/01	D
NCTS Webinar on Nonlinear Evolutionary Dynamics	1/12, 3/08, 3/15, 3/22, 4/12, 4/19, 4/26, 5/11, 5/24, 5/31, 9/13, 10/4, 10/11, 10/18	D
Seminar on Free Probability and Random Matrices	2/20, 3/07	D
Special Topic Seminar	9/14	D
Taipei Postdoc Seminar	5/24	D
NCTS Seminar on Dynamical Systems	10/13, 10/20	D
NCTS Probability and PDE Joint Seminar	10/11	D

Seminar Title	Seminar Dates	Program
NCTS Seminar on Ice Sheet Dynamics and Its Related Topics	2/24, 3/17, 4/28, 5/19	E
NCTS Seminar on Scientific Computing	1/05, 3/31, 6/06, 6/07, 6/14, 7/05, 7/05, 7/10	E
NCTS Seminar on Mathematical Biology	2/24, 3/10, 4/25, 7/07, 7/19	F
NCTS Seminar on Mathematical Physiology	1/10, 2/02, 3/09, 3/30, 6/12, 8/31, 9/1, 9/7, 9/25	F
NCTS Seminar on PDE and Machine Learning	3/24	F

Date	Speaker	Affiliation	Title of Talk
Program A			
2023/8/15	Jing-Song Huang	Chinese University of Hong Kong (Shenzhen)	Fourier Transforms for Representations of Reductive Lie Groups
2023/7/14	Ju-Feng Wu	University of Warwick	On p -adic Adjoint L-functions for Bianchi Cuspforms: The p -split Case
2023/7/11	Wentang Kuo	University of Waterloo	On Artin's Primitive Root Conjecture and Serre's Cyclicity Conjecture
2023/7/7	Sheng-Chi Liu	Washington State University	Moments of Central L-values for Maass Forms over Imaginary Quadratic Fields
2023/6/30	Alexander Barg	University of Maryland	Smoothing of Codes, Uniform Distributions, and Applications
2023/6/2	John Duncan	Academia Sinica	Congruent Numbers and Umbral Moonshine
2023/5/25	Sheng-Yang Ho	Pennsylvania State University	On the Rational Cuspidal Divisor Class Groups of Drinfeld Modular Curves $X_0(p^r)$
2023/5/12	Yung-Ning Peng	National Central University	Classification of Irreducible Modules over Type A Principal Finite W-superalgebras II
2023/5/10	Chien-Hua Chen	NCTS	On Singular Moduli for Higher Rank Drinfeld Modules
2023/5/4	Hidekazu Furusho	Nagoya University	p -adic Hypergeometric Function Related with p -adic Multiple Polylogarithms
2023/4/27	Yen-Tsung Chen	Pennsylvania State University	Linear Relations among Carlitz Polylogarithms at Algebraic Points
2023/4/26	Huy Quoc Dang	NCTS	Fundamental Groups in Characteristic $p > 0$
2023/3/31	Shunsuke Yamana	Osaka Metropolitan University	On p -adic L-functions for $U(2,1) \times U(1,1)$
2023/3/31	Haining Wang	Fudan University	Level Raising and Gross--Kudla--Schoen Diagonal Cycles
2023/3/31	Yung-Ning Peng	National Central University	Classification of Irreducible Modules over Type A Principal Finite W-superalgebras
2023/3/30	Shin Hattori	Tokyo City University	Triviality of the Hecke Action on Ordinary Drinfeld Cuspforms of Level $\Gamma_1(t^n)$
2023/3/29	Tzu-Jan Li	Academia Sinica	On the Reducedness of a Ring of Invariants
2023/3/23	Özge Ülkem	Galatasaray University	Continued Fractions over Norm-Euclidean Imaginary Quadratic Field
2023/3/23	Shin Hattori	Tokyo City University	p -adic Continuous Families of Drinfeld Eigenforms of Finite Slope
2023/3/9	Oguz Gezmis	Heidelberg University	Almost Holomorphic Drinfeld Modular Forms

Date	Speaker	Affiliation	Title of Talk
Program A			
2023/3/1	Ehud De Shalit	Hebrew University of Jerusalem	Foliations on Shimura Varieties in Characteristic p
2023/2/17	Yang Zeng	Nanjing Audit University	On the Minimal Finite W -superalgebras and Related Whittaker Categories

Program B

2023/10/20	Pedro Núñez	National Taiwan University	Indecomposability of Derived Categories of Hyperelliptic Manifolds
2023/10/13	Keita Goto	National Taiwan University	An Introduction to Berkovich Geometry and Kontsevich-Soibelman Conjecture
2023/10/6	Sho Tanimoto	Nagoya University	Sections of Fano Fibrations over Curves
2023/9/22	Kuan-Wen Lai	Academia Sinica	Bijjective Cremona Transformations of the Plane
2023/8/11	Xiaowei Wang	Rutgers University	K -stability, K^{ahler} -Einstein Metric and Moduli Space
2023/7/14	Wenhao Ou	Academy of Mathematics and Systems Science, CAS	Log Abundance for K^{ahler} Threefolds
2023/5/26	Shih-Hsin Wang	University of Utah	Families of Jets on Higher Du Val Singularities
2023/5/23	Yusheng Luo	Stony Brook University	Boundedness Problems in Conformal Dynamics
2023/4/25	Shunsuke Kano	Tohoku University	Categorical Dynamical Systems Arising from Sign-stable Mutation Loops
2023/4/18	Julie Tzu-Yueh Wang	Academia Sinica	Some Developments on Filtration Methods in Diophantine Geometry and Nevanlinna Theory
2023/4/11	Fabian Haiden	University of Southern Denmark	Motivic DT Invariants of Quadratic Differentials
2023/3/31	Marta Benozzo	University College London	On the Canonical Bundle Formula in Positive Characteristic
2023/3/31	Yujiro Kawamata	University of Tokyo & NCTS	NC Deformations, Semi-orthogonal Decompositions and Q -Gorenstein Smoothing
2023/3/28	Duc Viet Vu	University of Cologne	Intersection of Holomorphic Curves with Generic Hypersurfaces
2023/3/21	Lucas Kaufmann	University of Orléans	Dynamics on Projective Spaces: Maps, Correspondences and Group Actions
2023/3/14	Genki Ouchi	Nagoya University	Stability Conditions on $K3$ Surfaces and Mass of Spherical Objects
2023/2/10	Keita Goto	Kyoto University	On Affine Structures which Come from Berkovich Geometry

Date	Speaker	Affiliation	Title of Talk
2023/2/6	Federico Fallucca	University of Trento	On the Degree of the Canonical Map of Surfaces of General Type
2023/2/6	Pedro Núñez	University of Freiburg	Adapted Differentials on Campana Orbifolds

Program C

2023/11/27	Brett Parker	Australian National University	Degenerations of Holomorphic Curves, Tropical Geometry, Gluing Theorems, and Exploded Manifolds
2023/11/15	Robert Haslhofer	University of Toronto	Mean Curvature Flow with Surgery
2023/10/18	Kai-Hsiang Wang	Northwestern University	Collapsing Ricci Limit Spaces with No Manifold Structure
2023/10/12	Tongrui Wang	Westlake University	Free Boundary Minimal Hypersurfaces in Locally Wedge-shaped Manifolds
2023/10/5	Wei-Ting Kao	National Taiwan University	The Existence of the Solution of the Singular Yamabe Equation on CR Manifolds and its Asymptotic Behavior near Boundary
2023/9/20	Georg Weiss	Universität Duisburg-Essen	Rectifiability, Finite Hausdorff Measure, and Compactness for Non-minimizing Bernoulli Free Boundaries
2023/9/14	Kuan-Hui Lee	University of California, Irvine	Linear Stability and Moduli Space of Generalized Ricci Solitons
2023/8/23	Chien Lin	Chongqing University of Technology	Existence of Nonconstant CR-holomorphic Functions of Polynomial Growth in Sasaki Manifolds
2023/8/16	Cheuk Yu Mak	University of Southampton	Loop Group Action on Symplectic Cohomology
2023/8/15	Cheuk Yu Mak	University of Southampton	Lagrangian Link Quasimorphisms and the Non-simplicity of Homeomorphism Group of Surfaces
2023/8/3	Jeremie Szeftel	Sorbonne Université	Nonlinear Stability of Kerr for Small Angular Momentum
2023/8/2	Jeremie Szeftel	Sorbonne Université	Nonlinear Stability of Kerr for Small Angular Momentum
2023/7/14	Samuel Z. Lin	University of Oklahoma	Spectral Multiplicity and Nodal Domains of Torus-invariant Metrics
2023/7/13	Shih-Fang Yeh	Michigan State University	Instability of Big Bang
2023/7/13	Kai-Wei Zhao	University of Notre Dame	Ancient Curve Shortening Flow of Low Entropy

2023/7/12	Brian Krummel	University of Melbourne	Analysis of Singularities of Area Minimizing Currents
2023/7/7	Damin Wu	University of Connecticut	Bergman Metric on Some Negatively Curved Complete Kähler Manifolds
2023/7/7	Lan-Hsuan Huang	University of Connecticut	Positive Mass Theorem for Asymptotically Locally Hyperbolic Manifolds
2023/6/21	Brian Harvie	NCTS	A Rigidity Theorem for Asymptotically Flat Static Manifolds and its Applications
2023/6/1	Keita Kunikawa	Tokushima University	Liouville Type Theorem for Harmonic Maps of Controlled Growth
2023/5/25	Christopher Ling-Po Kuo	University of Southern California	Sheaf Theoretic Methods in Symplectic Geometry
2023/5/17	Christos Mantoulidis	Rice University	Generic Regularity of Minimizing Hypersurfaces in Dimensions 9 and 10
2023/5/4	Jiawei Liu	Nanjing University of Science & Technology	Conical Kähler-Ricci Flow and Its Related Topics
2023/4/27	Pak-Yeung Chan	University of California, San Diego	Curvature and Gap Theorems of Gradient Ricci Solitons
2023/4/20	Hsin-Chuang Chou	National Taiwan Normal University	Integral Decompositions of Varifolds
2023/4/6	Long-Sin Li	University of California, Irvine	Willmore Flow on Complete Surfaces
2023/3/30	Yuan Shyong Ooi	Pusan National University	Rigidity Result of Graphical Mean Curvature Flow Translating Solution
2023/3/16	Peter Bouwknegt	Australian National University	A Case for Surjective Submersions
2023/3/15	Jie Zhou	Capital Normal University	Bi-Lipschitz Regularity of 2-varifolds with the Critical Allard Condition
2023/3/8	Yangyang Li	The University of Chicago	Area Ratio Bounds and the Existence of Anisotropic Minimal Surfaces
2023/3/2	Yat Hin Marco Suen	Institute for Basic Science	Lagrangian Multi-sections and Their Toric Equivariant Mirror
2023/2/23	Christian Scharrer	University of Bonn	Around Three and a Half Worlds in Zero Days - On the Curvature Cost of Short World Trips
2023/2/22	Simon-Raphaël Fischer	NCTS	Curved Yang-Mills Gauge Theories
2023/2/2	Tang-Kai Lee	Massachusetts Institute of Technology	Uniqueness of Conical Singularities for Mean Curvature Flows
2023/1/18	Filip Rindler	University of Warwick	Singularities, Rectifiability, and PDE-constraints

Date	Speaker	Affiliation	Title of Talk
2023/1/3	Chin-Yu Hsiao	Academia Sinica	Semi-classical Spectral Asymptotics of Toeplitz Operators on CR Manifolds

Program D

2023/10/20	Yu-Ting Su	National University of Kaohsiung	Cucker–Smale Flocking under Hierarchical Leadership (2)
2023/10/18	Montie Avery	Boston University	Universality in Spreading into Unstable States
2023/10/13	Yu-Ting Su	National University of Kaohsiung	Cucker–Smale Flocking under Hierarchical Leadership (1)
2023/10/11	Bi-Jyun Li	National Chengchi University	Introduction Some Properties of Continuity of Sample Paths for Brownian Motion
2023/10/11	Robin Chemnitz	Free University of Berlin	Sensitivity in CRN in Relation to the Network Structure: an Abstract Approach
2023/10/4	Tobias Böhle	Technische Universität München	Bifurcation Analysis of Twisted States in Phase Oscillator Networks
2023/9/22	Luboš Pick	Charles University	Sharp Transfer of Regularity for the Ornstein-Uhlenbeck Equation
2023/9/14	Fushing Hsieh	University of California, Davis	Is Statistics Prescientific?
2023/9/13	Tibor Krisztin	University of Szeged	On the Dynamics of Some Mackey-Glass Type Equations
2023/9/13	Cheng Ouyang	University of Illinois at Chicago	Colored Noise and Parabolic Anderson Model on Torus
2023/8/17	Mimi Dai	University of Illinois at Chicago	Developments in Fluid Equations Since Leray's Time
2023/8/1	Hau-Tieng Wu	Duke University	Toward Statistical Inference with Synchrosqueezing Transform
2023/7/25	Yu-Ting Chen	University of Victoria	Singularly Perturbed Differential Operators and Some Stochastic Analytic Counterparts
2023/6/14	Zhi An Wang	The Hong Kong Polytechnic University	On Some Reaction-diffusion Models with Density-dependent Dispersal
2023/6/7	Qing Han	University of Notre Dame	A Concise Boundary Regularity for the Uniformly Degenerate Elliptic Equations
2023/6/5	Jiun-Chau Wang	University of Saskatchewan	Irregularity for Perturbations of Random Matrices
2023/5/31	Wenjie Ni	University of New England	Spreading Phenomena in Nonlocal Diffusion Equations with Free Boundaries in High Dimensions

Date	Speaker	Affiliation	Title of Talk
2023/5/29	Cheuk-Yin Lee	National Tsing Hua University	An Introduction to Hitting Probabilities of Random Fields (II)
2023/5/26	Yimin Xiao	Michigan State University	Macroscopic Fractals, Multifractals, and Stochastic Processes
2023/5/26	Cheuk-Yin Lee	National Tsing Hua University	An Introduction to Hitting Probabilities of Random Fields (I)
2023/5/24	Prasun Roychowdhury	NCTS	Poincare Meets Hardy Inequality via Criticality Theory
2023/5/24	Zhucheng Jin	University of Science and Technology of China	Spreading Speeds for Non-autonomous Prey-predator Systems
2023/5/19	Yubin He	South China University of Technology	Quantitative Recurrence Properties for Piecewise Expanding Maps on $[0,1]^d$
2023/5/17	Soonsik Kwon	Korea Advanced Institute of Science and Technology	Blow Up Solutions of Radial Self-dual Chern-Simons-Schrödinger Equations
2023/5/11	Inkyung Ahn	Korea University	Population Models with Fokker-Planck-type Diffusions in Spatially Heterogeneous Environment
2023/5/1	Xiaowen Zhou	Concordia University	Skew Brownian Motion with Two-valued Drift
2023/4/26	Alejandro López Nieto	Free University of Berlin	Enharmonic Oscillators: Towards the Global Dynamics of Delay Differential Equations
2023/4/21	Minki Kim	Gwangju Institute of Science and Technology	Strong Erdős-Hajnal Properties in Chordal Graphs
2023/4/19	Isabelle Schneider	Free University of Berlin	Symmetry Groupoids in Dynamical Systems
2023/4/19	Jin Woo Jang	Pohang University of Science and Technology	Magnetic Confinement for the 2D Axisymmetric Relativistic Vlasov-Maxwell System in an Annulus
2023/4/17	Yuki Chino	National Yang Ming Chiao Tung University	Random Walk in Cooling Random Environment IV
2023/4/12	Hiroshi Ishii	Kyoto University	Dynamics of Localized Patterns in Nonlocal Reaction-diffusion Equations Depending on the Integral Kernel Shape
2023/4/7	Chieu-Minh Tran	National University of Singapore	Measure Doubling of Small Sets in $(\mathrm{SO}(3, \mathbb{R}), \mu)$
2023/3/31	Van Khu Vu	National University of Singapore	Locally-constrained de Bruijn Codes and Their Applications
2023/3/29	Nejla Nouaili	Université Paris-Dauphine	Singularities in the Complex Ginzburg Landau Equation

Date	Speaker	Affiliation	Title of Talk
2023/3/24	Yu-Hao Liang	National University of Kaohsiung	Flocking in a New Discrete Cucker-Smale Model
2023/3/22	Milen Ivanov	Bulgarian Academy of Sciences	On the Existence and Stability of Truncated Contact Defects in Reaction-diffusion Systems
2023/3/20	Yuki Chino	National Yang Ming Chiao Tung University	An Application of Random Walk in Random Environment
2023/3/17	Jaehoon Kim	Korea Advanced Institute of Science and Technology	A Bandwidth Theorem for Graph Transversals
2023/3/15	Bernold Fiedler	Free University of Berlin	Global Bifurcations via Genericity 1: Stationary and Periodic Solutions
2023/3/15	Donghyun Lee	Pohang University of Science and Technology	H^s Holder Regularity of the Boltzmann Equation Past an Obstacle
2023/3/10	Cheng-Yu Tsai	National Chengchi University	The Strip Entropy Approximation of Markov Shifts on Trees
2023/3/8	Yuan Lou	Shanghai Jiao Tong University	Coexistence of Strains in Some Reaction-diffusion Systems
2023/3/7	Pei-Lun Tseng	NYU Abu Dhabi	The Infinitesimal Distribution of Anticommutators and Commutators II
2023/3/6	Yuki Chino	National Yang Ming Chiao Tung University	Random Walk in Random Environment (II)
2023/3/3	Dabeen Lee	Korea Advanced Institute of Science and Technology	Non-smooth, Holder-smooth, and Robust Submodular Maximization
2023/3/1	Tej-Eddine Ghoul	New York University	Stable Self-similar Magnetic Reconnection
2023/2/24	Yu-Liang Wu	University of Oulu	On the Topological Pressure of Axial Product on Trees
2023/2/20	Pei-Lun Tseng	NYU Abu Dhabi	The Infinitesimal Distribution of Anticommutators and Commutators
2023/2/17	Chun-Hung Liu	Texas A&M University	Homomorphism Counts in Robustly Sparse Graphs
2023/1/12	Takashi Teramoto	Asahikawa Medical University	Action Functional Approach to Localized Solutions in a Three Component FitzHugh-Nagumo Model

Program E

2023/7/10	Ren-Cang Li	The University of Texas at Arlington	A Theory of the NEPv Approach for Optimization On the Stiefel Manifold Part II: NEPv
2023/7/5	Ren-Cang Li	The University of Texas at Arlington	A Theory of the NEPv Approach for Optimization On the Stiefel Manifold Part I: NPDo

Date	Speaker	Affiliation	Title of Talk
2023/7/5	Tan Bui-Thanh	University of Texas at Austin	Enabling Approaches for Real-time Deployment, Calibration, and UQ for Digital Twins
2023/6/14	Yen-Hsi Richard Tsai	University of Texas at Austin	Nearest Neighbor Sampling of Point Clouds Using Rays
2023/6/7	Yen-Hsi Richard Tsai	University of Texas at Austin	Stability of Learning from Embedded Low Dimensional Data
2023/6/6	So-Hsiang Chou	Bowling Green State University	A Family of High Order Enriched Finite Element Methods for Interface Problems
2023/5/19	Tabea Tscherpel	Technische Universität Darmstadt	Finite Element Approximation for Non-Newtonian Fluid Flow
2023/4/28	Qin Sheng	Baylor University	A Renaissance of the Operator Splitting Methods with Applications
2023/3/31	Moody T. Chu	North Carolina State University	Optimal Hamiltonian Synthesis for Quantum Computing
2023/3/17	Ralf Greve	Institute of Low Temperature Science , Hokkaido University	Ice-sheet Modelling: Basics and Selected Applications
2023/2/24	Lin Mu	University of Georgia	Pressure Robust Scheme for Incompressible Flow
2023/1/5	Guangliang Chen	San Jose State University	On the Speed and Memory Scalability of Spectral Clustering

Program F

2023/9/25	Angelyn R. Lao	De La Salle University	Graph Theoretical Analysis of Biological and Ecological Systems
2023/9/7	Bogdan Kazmierczak	Polish Academy of Sciences	Traveling and Standing Fronts on Curved Surfaces
2023/9/1	Tsung-Yu Chen	University of California, Davis	Coupling Gating to Ion Permeation in the Pore of the CLC Chloride Channel
2023/8/31	Bogdan Kazmierczak	Polish Academy of Sciences	Polarization of Concave Domains by Traveling Wave Pinning
2023/7/19	Jie Liang	University of Illinois at Chicago	Topological Structure of Non-Diffusive Reactions Dynamics of Molecules and Stochastic Landscapes of Molecular Networks
2023/7/7	Tetsuya Hiraiwa	Academia Sinica	Modeling and Numerical Simulations on Dynamic Self-Organization of Migrating Cells
2023/6/12	Ching-Long Lin	The University of Iowa	Imaging-based Cluster-Informed Lung Assessment and Modeling

Date	Speaker	Affiliation	Title of Talk
2023/4/25	Pierre Magal	University of Bordeaux	Epidemic Model with Age of Infection and the Return Home Model
2023/3/30	Hao Wu	Fudan University	The Cahn-Hilliard Equation with Dynamic Boundary Conditions
2023/3/24	Bryan Quaife	Florida State University	Boundary Integral Equation Methods for Small Scale Hydrodynamics
2023/3/10	Frédéric Hamelin	Institut Agro , Université Rennes	Spatial Spread of Infectious Diseases with Conditional Vector Preferences
2023/3/9	Shixin Xu	Duke Kunshan University	A Tridomain Model for Potassium Clearance in Optic Nerve of Necturus
2023/2/24	Henry Shum	University of Waterloo	Elastohydrodynamic Modelling of Flagellated Bacterial Motility
2023/2/2	Marc R. Roussel	University of Lethbridge	Graph-theoretical Stability Analysis, Part 2: Further Developments
2023/1/10	Marc R. Roussel	University of Lethbridge	Graph-theoretical Stability Analysis, Part 1: The Bridge Between Network Structure and Dynamics

4.4 Courses

Courses	Dates	Organizers	Lecturers
Program A			
Lecture Series: Congruences of Modular Forms and Galois Representations	2023-09-05 / 2023-09-07	Ming-Lun Hsieh (NTU)	Jacques Tilouine (Université Paris 13)
Uniformity Results in Diophantine Geometry	2023-08-07 / 2023-08-10	Julie Tzu-Yueh Wang (AS)	Amos Turchet (Università degli studi Roma Tre)
The Filtration Method in Diophantine Approximation and K- Stability	2023-08-07 / 2023-08-10	Julie Tzu-Yueh Wang (AS)	Min Ru (University of Houston)
NCTS Short Course on Representation Theory: Lecture series on Quantum Wreath Products	2023-08-01 / 2023-08-04	Yng-Ing Lee (NTU)	Chun-Ju Lai (Academia Sinica)
2023 Spring Course: Introduction to t-Motives and Related Topics	2023-02-13 / 2023-06-14	Yi-Fan Yang (NTU)	Chia-Fu Yu (Academia Sinica)
Winter Short Course on Algebraic Geometry	2023-01-03 / 2023-01-13	Yi-Fan Yang (NTU)	Chia-Fu Yu (Academia Sinica)
Program B			
Birational Automorphism Groups of Holomorphic Symplectic Manifolds	2023-07-29 / 2023-07-30	Jungkai Chen (NTU & NCTS), Hsueh-Yung Lin (NTU), Evgeny Shinder (Uof Sheffield)	Shigeru Mukai (Kyoto University)
Rationality Problem for Conic Bundles	2023-07-29 / 2023-07-30	Jungkai Chen (NTU & NCTS), Hsueh-Yung Lin (NTU), Evgeny Shinder (Uof Sheffield)	Yury Prokhorov (Steklov Mathematical Institute)
Resolution of Singularities for Everyone	2023-07-29 / 2023-07-30	Jungkai Chen (NTU & NCTS), Hsueh-Yung Lin (NTU), Evgeny Shinder (Uof Sheffield)	Dan Abramovich (Brown University)
Mini-Courses on Computational Algebraic Geometry	2023-05-24 / 2023-06-14	Jungkai Chen (NTU & NCTS)	Christopher Peterson (Colorado State University)
Higher Dimensional Fano Varieties	2023-03-14 / 2023-03-17	Caucher Birkar (U of Cambridge & Tsinghua U), Jungkai Chen (NTU & NCTS), Yujiro Kawamata (U of Tokyo & NCTS), Keiji Oguiso (U of Tokyo)	Joaquin Moraga (University of California, Los Angeles)

Derived Categories and Rationality of Fano Threefolds	2023-03-14 / 2023-03-17	Caucher Birkar (U of Cambridge & Tsinghua U), Jungkai Chen (NTU & NCTS), Yujiro Kawamata (U of Tokyo & NCTS), Keiji Oguiso (U of Tokyo)	Alexander Kuznetsov (Steklov Mathematical Institute)
Categorical Donaldson-Thomas Theory, Wall-crossing and Applications	2023-03-13 / 2023-03-16	Caucher Birkar (U of Cambridge & Tsinghua U), Jungkai Chen (NTU & NCTS), Yujiro Kawamata (U of Tokyo & NCTS), Keiji Oguiso (U of Tokyo)	Yukinobu Toda (IPMU)
On the Minimal Model Program for Foliations	2023-03-13 / 2023-03-17	Caucher Birkar (U of Cambridge & Tsinghua U), Jungkai Chen (NTU & NCTS), Yujiro Kawamata (U of Tokyo & NCTS), Keiji Oguiso (U of Tokyo)	Paolo Cascini (Imperial College London & NCTS)
Program C			
Mathematical General Relativity: Evolutionary and Causal Aspects	2023-10-11 / 2023-12-13	Nan-Kuo Ho (NTHU), Yng-Ing Lee (NTU), Mao-Pei Tsui (NTU)	Willie Wai-Yeung Wong (Michigan State University)
Mini-course on Mathematics in Manifold Learning	2023-07-21 / 2023-07-21	Chih-Wei Chen (NSYSU), River Chiang (NCKU)	Yi-Sheng Wang (National Sun Yat-sen University), Chin-Hung Lin (National Sun Yat-sen University), Seçkin Günsen (National Sun Yat-sen University), Liren Lin
Lectures on KdV Theory and Related Subjects	2023-04-17 / 2023-10-31	Yng-Ing Lee (NTU)	Chang Shou Lin (National Taiwan University)
Introduction to Extrinsic Geometric Flows	2023-02-21 / 2023-03-28	Mao-Pei Tsui (NTU)	Brian Harvie (NCTS)

Program D			
NCTS Mini-course on Dynamical Systems: Dynamics Meets Geometry	2023-08-02 / 2023-08-16	Chih-Hung Chang (NUK)	Lien-Yung Kao (George Washington University)
Kleinian Groups and Rational Iteration	2023-07-25 / 2023-07-28	Chih-Hung Chang (NUK)	Russell Lodge (Indiana State University)
Number Theory Mini-Course: An Introduction to the Circle Method Part I, II, III	2023-07-10 / 2023-07-11	Chun-Yen Shen (NTU)	Yu-Ru Liu (University of Waterloo)
A Brief Discussion on Brownian Motion and Related Processes with Applications	2023-06-15 / 2023-06-21	Lung-Chi Chen (NCCU)	Ju-Yi Yen (University of Cincinnati)
Markoff-Lagrange Spectrum and Symbolic Dynamics	2023-06-08 / 2023-06-10	Jung-Chao Ban (NCCU), Chih-Hung Chang (NUK), Kuo-Chang Chen (National Tsing Hua University), Cheng-Hsiung Hsu (National Central University), Lien-Yung Kao (George Washington University)	Shigeki Akiyama (University of Tsukuba)
Rigidity and Regularity of Diffeomorphism Groups	2023-06-08 / 2023-06-10	Jung-Chao Ban (National Chengchi University), Chih-Hung Chang (National University of Kaohsiung), Kuo-Chang Chen (National Tsing Hua University), Cheng-Hsiung Hsu (National Central University), Lien-Yung Kao (George Washington University)	Sang-hyun Kim (Korea Institute for Advanced Study)
Program E			
Parallel Finite Element Method Using Supercomputer	2023-07-10 / 2023-07-14	Weichung Wang (NTU), Tsung-Ming Huang (NTNU), Feng-Nan Hwang (NCU), Pochung Chen (NTHU), Ying-Jer Kao (NTU), Yu-Heng Tseng (NTU)	Kengo Nakajima (University of Tokyo)
NCTS Short Course on Scientific Deep Learning	2023-07-03 / 2023-07-14	Weichung Wang (NTU), Chun-Hao Yang (NTU)	Tan Bui-Thanh (University of Texas at Austin)

Advanced Course on Multi-Threaded Parallel Programming using OpenMP for Multicore/Manycore Systems	2023-02-14 / 2023-02-16	Weichung Wang (NTU), Tsung-Ming Huang (NTNU), Feng-Nan Hwang (NCU), Pochung Chen (NTHU), Ying-Jer Kao (NTU), Yu-Heng Tseng (NTU)	Kengo Nakajima (University of Tokyo)
Program F			
NCTS Summer Course on Scientific Machine Learning	2023-07-17 / 2023-08-08	Tai-Chia Lin (NTU), Te-Sheng Lin (NYCU)	Jingfang Huang (University of North Carolina at Chapel Hill), Petr Plechac (University of Delaware)
2023 NCTS Summer Course on Mathematical Biology	2023-06-29 / 2023-08-10	Tai-Chia Lin (NTU), Chang-Yuan Cheng (NPU), Chang-Hong Wu (NYCU), Feng-Bin Wang (CGU)	Christopher Heggerud (University of Alberta), Julian Lopez-Gomez (Universidad Complutense de Madrid), Miao-Jung Yvonne Ou (University of Delaware), Naveen K. Vaidya (San Diego State University), Feng-Bin Wang (Chang Gung University), Hao Wang (University of Alberta), Xueying Wang (Washington State University), Yawen Yan (University of Alberta)
Computer and Math I, II, III	2023-06-26 / 2023-07-07	Mao-Pei Tsui (NTU)	Hsin-Po Wang (University of California, Berkeley)
NCTS Short Course on Computational Mechanics and Applied Mathematics	2023-02-10 / 2023-04-28	Tai-Chia Lin (NTU), Sze-Bi Hsu (NTHU), Chang-Yuan Cheng (NPU), Chang-Hong Wu (NYCU), Feng-Bin Wang (CGU)	Goong Chen (Texas A&M University)
Spectral Clustering Theory, Algorithms, Scalability, and Applications	2023-01-04 / 2023-01-06	Chih-Wei Chen (NSYSU)	Guangliang Chen (San Jose State University)

4.5 List of Visitors

Arrival date	Departure date	Days of visit (2023)	Name	Program	Affiliation	Country
2022/12/26	2023/1/2	2	Yu-Shen Lin	C	Boston University	USA
2022/12/25	2023/1/4	4	Noriaki Ikeda	C	Ritsumeikan University	Japan
2022/12/26	2023/1/5	5	Fabien Trihan	A	Sophia University	Japan
2022/12/23	2023/1/8	8	Ju-Yi Yen	D	University of Cincinnati	USA
2023/1/9	2023/1/12	4	Byeong-Kweon Oh	D	Seoul National University	South Korea
2023/1/8	2023/1/12	5	Dohyeong Kim	D	Seoul National University	South Korea
2023/1/8	2023/1/12	5	Hangjun Cho	D	Seoul National University	South Korea
2023/1/8	2023/1/12	5	Jungkwun Kim	D	Sungkyunkwan University	South Korea
2023/1/8	2023/1/12	5	Miho Mukohara	D	University of Tokyo	Japan
2023/1/8	2023/1/12	5	Masahiro Kurisaki	D	University of Tokyo	Japan
2023/1/8	2023/1/12	5	Sohyun Jeon	D	Ewha Womans University	South Korea
2023/1/8	2023/1/12	5	Jaehyun Kim	D	Ewha Womans University	South Korea
2023/1/8	2023/1/12	5	Soobin Cho	D	Seoul National University	South Korea
2023/1/8	2023/1/12	5	Seheon Ham	D	Seoul National University	South Korea
2023/1/8	2023/1/12	5	Seonwoo Kim	D	Seoul National University	South Korea
2023/1/8	2023/1/12	5	Akito Uruno	D	Seoul National University	South Korea
2023/1/8	2023/1/12	5	Jongheun Yoon	D	Seoul National University	South Korea
2023/1/8	2023/1/12	5	Jihun Kim	D	Sungkyunkwan University	South Korea
2023/1/8	2023/1/12	5	Yota Maeda	D	Kyoto University	Japan
2023/1/8	2023/1/12	5	Masafumi Hattori	D	Kyoto University	Japan
2023/1/8	2023/1/12	5	Hayato Imori	D	Kyoto University	Japan
2023/1/8	2023/1/12	5	Akihiro Miyagawa	D	Kyoto University	Japan
2023/1/8	2023/1/12	5	Tsuyoshi Kato	D	Kyoto University	Japan

Arrival date	Departure date	Days of visit (2023)	Name	Program	Affiliation	Country
2023/1/8	2023/1/12	5	Yasuyuki Kawahigashi	D	University of Tokyo	Japan
2022/9/12	2023/1/12	12	Camille Laurent-Gengoux	C	Université de Lorraine	France
2023/1/8	2023/1/12	5	Keita Goto	B	Kyoto University	Japan
2023/1/9	2023/1/13	5	Yuan-Nan Young	F	New Jersey Institute of Technology	USA
2022/12/12	2023/1/13	13	Lien-Yung Kao	D	George Washington University	USA
2022/12/26	2023/1/14	14	Guangliang Chen	F	San Jose State University	USA
2023/1/4	2023/1/24	21	Mu-Tao Wang	C	Columbia University	USA
2023/1/1	2023/1/31	31	Tang-Kai Lee	C	Massachusetts Institute of Technology	USA
2023/2/13	2023/2/17	5	Kengo Nakajima	E	University of Tokyo	Japan
2023/2/12	2023/2/19	8	Thomas Yizhao Hou	E	California Institute of Technology	USA
2023/2/19	2023/3/3	13	Yat Hin Marco Suen	C	Institute for Basic Science	South Korea
2023/2/17	2023/3/5	17	Qing-Ming Cheng	C	Fukuoka University	Japan
2023/2/19	2023/3/10	20	Ehud De Shalit	A	The Hebrew University of Jerusalem	Israel
2023/3/12	2023/3/17	6	Yukinobu Toda	B	IPMU	Japan
2023/3/12	2023/3/18	7	Rahul Ajit	B	The University of Utah	USA
2023/3/13	2023/3/19	7	Florin Ambro	B	Institute of Mathematics of the Romanian Academy	România
2023/3/13	2023/3/19	7	Felix Goebler	B	Goethe-University Frankfurt	Germany
2023/3/19	2023/3/22	4	Caucher Birkar	B	University of Cambridge	UK
2023/3/12	2023/3/22	11	Paolo Cascini	B	Imperial College London	UK
2023/3/10	2023/3/24	15	Joaquin Moraga	B	University of California, Los Angeles	USA
2023/3/21	2023/3/25	5	Viktor Ginzburg	C	University of California, Santa Cruz	USA

Arrival date	Departure date	Days of visit (2023)	Name	Program	Affiliation	Country
2023/3/20	2023/3/25	6	Kota Yoshioka	B	Kobe University	Japan
2023/3/19	2023/3/25	7	Kaoru Ono	C	RIMS , Kyoto University	Japan
2023/3/19	2023/3/25	7	James Mckernan	B	University of California, San Diego	USA
2023/3/19	2023/3/25	7	Tien Cuong Dinh	B	National University of Singapore	Singapore
2023/3/19	2023/3/25	7	Jun-Muk Hwang	B	Institute for Basic Science	South Korea
2023/3/19	2023/3/25	7	Kuan-Wen Lai	B	University of Massachusetts, Amherst	USA
2023/3/19	2023/3/25	7	Burt Totaro	B	University of California, Los Angeles	USA
2023/3/19	2023/3/25	7	De Qi Zhang	B	National University of Singapore	Singapore
2023/3/19	2023/3/25	7	Yan Lung Leon Li	C	The Chinese University of Hong Kong	Hong Kong
2023/3/19	2023/3/25	7	Conan Nai Chung Leung	C	The Chinese University of Hong Kong	Hong Kong
2023/3/19	2023/3/25	7	Xiao Zheng	C	The Chinese University of Hong Kong	Hong Kong
2023/3/18	2023/3/25	8	Kieran O'Grady	B	Sapienza Università di Roma	Italy
2023/3/17	2023/3/25	9	Mihnea Popa	B	Harvard University	USA
2023/3/12	2023/3/25	14	Alexander Kuznetsov	B	Steklov Mathematical Institute	Russia
2023/3/12	2023/3/25	14	Yongnam Lee	B	Korea Advanced Institute of Science and Technology	South Korea
2023/3/12	2023/3/25	14	Shinnosuke Okawa	B	Osaka University	Japan
2023/3/12	2023/3/25	14	Hsin-Ku Chen	B	National Taiwan University	Taiwan
2023/3/12	2023/3/25	14	Theodoros Papazachariou	B	University of Glasgow	UK
2023/3/15	2023/3/27	13	Nero Budur	B	Universite Catholique de Louvain, Belgium	Belgium

Arrival date	Departure date	Days of visit (2023)	Name	Program	Affiliation	Country
2023/3/12	2023/3/27	16	Keiji Oguiso	B	University of Tokyo	Japan
2023/3/14	2023/3/28	15	Özge Ülkem	A	Galatasaray University	Turkey
2023/3/13	2023/3/29	17	JongHae Keum	B	Korea Institute for Advanced Study	South Korea
2023/3/18	2023/3/31	14	Alessio Corti	B	Imperial College London	UK
2023/3/15	2023/3/31	17	Martin Guest	C	Waseda University	Japan
2023/3/27	2023/4/2	7	Shunsuke Yamana	A	Osaka Metropolitan University	Japan
2023/3/11	2023/4/5	26	Marta Benozzo	B	University College London	UK
2023/3/12	2023/4/12	32	Yujiro Kawamata	B	University of Tokyo	Japan
2023/4/16	2023/4/30	15	Pierre Magal	F	University of Bordeaux	France
2023/1/31	2023/4/30	90	Goong Chen	F	Texas A&M University	USA
2023/3/26	2023/5/2	38	Lani Fang Wu	F	University of California, San Francisco	USA
2023/3/26	2023/5/2	38	Steven Jeffrey Altschuler	F	University of California, San Francisco	USA
2023/5/4	2023/5/7	4	Nicolas Privault	D	Nanyang Technological University	Singapore
2023/5/3	2023/5/7	5	Takashi Kumagai	D	Waseda University	Japan
2023/5/2	2023/5/7	6	Jiro Akahori	D	Ritsumeikan University	Japan
2023/5/1	2023/5/8	8	Hau-Tieng Wu	F	Duke University	USA
2023/4/28	2023/5/9	12	Hidekazu Furusho	A	Nagoya University	Japan
2023/5/28	2023/6/4	8	Kazuo Aoki	C	Kyoto University	Japan
2023/5/17	2023/6/5	20	Kai-Wen Lan	A	University of Minnesota	USA
2023/6/4	2023/6/9	6	Yoshiyuki Kagei	D	Tokyo Institute of Technology	Japan
2023/5/22	2023/6/9	19	Yi-Lin Lee	A	Indiana University	USA
2023/6/7	2023/6/10	4	Sang-hyun Kim	D	Korea Institute for Advanced Study	South Korea
2023/6/6	2023/6/10	5	Daisuke Kawagoe	D	Kyoto University	Japan
2023/6/7	2023/6/11	5	Hiroki Takahasi	D	Keio University	Japan
2023/6/7	2023/6/11	5	Shigeki Akiyama	D	University of Tsukuba	Japan

Arrival date	Departure date	Days of visit (2023)	Name	Program	Affiliation	Country
2023/5/19	2023/6/12	25	Tai-Peng Tsai	D	University of British Columbia	Canada
2023/6/5	2023/6/14	10	Ji Li	D	Macquarie University	Australia
2023/5/18	2023/6/18	32	Christopher Peterson	B	Colorado State University	USA
2023/5/30	2023/7/2	34	Yen-Hsi Richard Tsai	E	University of Texas at Austin	USA
2023/5/5	2023/7/5	62	Chi-Heng Lo	A	Purdue University	USA
2023/7/3	2023/7/7	5	Lan-Hsuan Huang	C	University of Connecticut	USA
2023/7/3	2023/7/7	5	Damin Wu	B	University of Connecticut	USA
2023/6/29	2023/7/7	9	Hsin-Po Wang	F	University of California, Berkeley	USA
2023/6/12	2023/7/7	26	Zane Kun Li	D	University of Wisconsin–Madison	USA
2023/6/25	2023/7/10	16	Hao Wang	F	University of Alberta	Canada
2023/6/29	2023/7/12	14	Ren-Cang Li	E	The University of Texas at Arlington	USA
2023/7/6	2023/7/13	8	Kai-Wei Zhao	C	University of Notre Dame	USA
2023/7/9	2023/7/15	7	Kengo Nakajima	E	University of Tokyo	Japan
2023/7/1	2023/7/16	16	Tan Bui-Thanh	E	University of Texas at Austin	USA
2023/7/10	2023/7/19	10	Bharathwaj Palvannan	A	Indian Institute of Science	India
2023/6/2	2023/7/21	50	Horng-Tzer Yau	D	Harvard University	USA
2023/5/2	2023/7/21	81	Ju-Yi Yen	D	University of Cincinnati	USA
2023/7/16	2023/7/25	10	Adam Jacob	C	University of California, Davis	USA
2023/7/24	2023/7/26	3	Yu-Ting Chen	D	University of Victoria	Canada
2023/7/5	2023/7/28	24	Naveen K. Vaidya	F	San Diego State University	USA
2023/7/3	2023/7/31	29	Xueying Wang	F	Washington State University	USA
2023/7/4	2023/8/1	29	Ju-Feng Wu	A	University of Warwick	UK

Arrival date	Departure date	Days of visit (2023)	Name	Program	Affiliation	Country
2023/6/26	2023/8/3	39	Chun-Hung Liu	A	Texas A&M University	USA
2023/7/30	2023/8/4	6	Nicholas Shepherd-Barron	B	King's College London	UK
2023/7/3	2023/8/4	33	Brice Franke	D	Université de Bretagne Occidentale	France
2023/7/31	2023/8/5	6	Dmitry Kaledin	B	Higher School of Economics	Russia
2023/7/31	2023/8/5	6	Konstantin Shramov	B	Higher School of Economics	Russia
2023/7/30	2023/8/5	7	Jihun Park	B	CGP , Institute for Basic Science	South Korea
2023/7/29	2023/8/5	8	Dan Abramovich	B	Brown University	USA
2023/7/29	2023/8/5	8	Evgeny Shinder	B	University of Sheffield	UK
2023/7/28	2023/8/5	9	Hamid Abban	B	University of Nottingham	UK
2023/7/28	2023/8/5	9	Konstantin Loginov	B	Higher School of Economics	Russia
2023/7/28	2023/8/5	9	Keiji Oguiso	B	University of Tokyo	Japan
2023/7/28	2023/8/5	9	Niklas Lemcke	B	National Taiwan University	Taiwan
2023/7/28	2023/8/5	9	Yury Prokhorov	B	Steklov Mathematical Institute	Russia
2023/7/28	2023/8/5	9	Evgueni Tevelev	B	University of Massachusetts, Amherst	USA
2023/6/3	2023/8/9	68	Russell Lodge	D	Indiana State University	USA
2023/7/6	2023/8/11	37	Yu-Ru Liu	A	University of Waterloo	Canada
2023/7/6	2023/8/11	37	Wentang Kuo	A	University of Waterloo	Canada
2023/5/20	2023/8/11	84	Po-Ying Chen	F	Duke University	USA
2023/7/28	2023/7/31	4	Natsume Kitagawa	B	Nagoya University	Japan
2023/7/30	2023/8/12	14	Julian Lopez-Gomez	F	Universidad Complutense de Madrid	Spain
2023/6/7	2023/8/15	70	Mu-Tao Wang	C	Columbia University	USA
2023/5/15	2023/8/15	93	Lien-Yung Kao	D	George Washington University	USA
2023/7/7	2023/8/16	41	Hau-Tieng Wu	F	Duke University	USA

Arrival date	Departure date	Days of visit (2023)	Name	Program	Affiliation	Country
2023/8/14	2023/8/18	5	Mimi Dai	D	University of Illinois at Chicago	USA
2023/7/31	2023/8/18	19	Ju-Yi Yen	D	University of Cincinnati	USA
2023/8/11	2023/8/19	9	Jing-Song Huang	A	Chinese University of Hong Kong (Shenzhen)	China
2023/7/30	2023/8/19	21	Min Ru	A	University of Houston	USA
2023/7/30	2023/8/19	21	Xiaowei Wang	C	Rutgers University	USA
2023/8/13	2023/8/22	10	Cheuk Yu Mak	C	University of Southampton	UK
2023/8/3	2023/8/22	20	Amos Turchet	A	Università degli studi Roma Tre	Italy
2023/8/20	2023/8/25	6	Yasuhiro Oki	A	Hokkaido University	Japan
2023/8/20	2023/8/25	6	Masataka Chida	A	Tokyo Denki University	Japan
2023/8/20	2023/8/26	7	Hohto Bekki	A	Max Planck Institute for Mathematics	Japan
2023/8/20	2023/8/26	7	Minoru Hirose	A	Nagoya University	Japan
2023/8/20	2023/8/26	7	Shinichi Kobayashi	A	Kyushu University	Japan
2023/8/20	2023/8/26	7	Yoichi Mieda	A	University of Tokyo	Japan
2023/8/20	2023/8/26	7	Kenichi Namikawa	A	Tokyo Denki University	Japan
2023/8/20	2023/8/26	7	Takao Yamazaki	A	Chuo University	Japan
2023/8/20	2023/8/26	7	Kazuaki Miyatani	A	Osaka Metropolitan University	Japan
2023/8/20	2023/8/26	7	Shunsuke Yamana	A	Osaka Metropolitan University	Japan
2023/8/15	2023/8/27	13	Chien Lin	C	Chongqing University of Technology	China
2023/8/1	2023/8/31	31	Yunping Jiang	D	The City University of New York	USA
2023/7/20	2023/9/20	63	Fushing Hsieh	F	University of California, Davis	USA
2023/9/3	2023/9/29	27	Jacques Tilouine	A	Université Paris 13	France
2023/9/23	2023/10/1	9	Isao Ishikawa	A	Ehime University	Japan
2023/10/22	2023/10/27	6	Nicolas Champagnat	D	The National Institute for Research in Digital Science and Technology	France
2023/10/22	2023/10/27	6	Philippe Souplet	D	Université Paris 13	France

Arrival date	Departure date	Days of visit (2023)	Name	Program	Affiliation	Country
2023/10/22	2023/10/27	6	Ariane Trescases	D	Institut de Mathématiques de Toulouse	France
2023/10/22	2023/10/27	6	Toshiyuki Ogawa	D	Meiji University	Japan
2023/10/22	2023/10/27	6	Inkyung Ahn	D	Korea University	South Korea
2023/10/22	2023/10/27	6	Yong-Jung Kim	D	Korea Advanced Institute of Science and Technology	South Korea
2023/10/22	2023/10/27	6	Changwook Yoon	D	Chungnam National University	South Korea
2023/10/25	2023/10/28	4	Masaharu Nagayama	D	Hokkaido University	Japan
2023/10/23	2023/10/28	6	Shin-Ichiro Ei	D	Hokkaido University	Japan
2023/10/22	2023/10/28	7	Hiroshi Matano	D	Meiji University	Japan
2023/10/22	2023/10/28	7	Sohei Tasaki	D	Hokkaido University	Japan
2023/10/22	2023/10/28	7	Hoyoun Kim	D	King Abdullah University of Science & Technology	Saudi Arabia
2023/10/22	2023/10/28	7	Minggi Lee	D	Kyungpook National University	South Korea
2023/11/5	2023/11/8	4	Miyuki Koiso	C	Kyushu University	Japan
2023/11/5	2023/11/8	4	Takahiro Oba	C	Osaka University	Japan
2023/11/6	2023/11/9	4	Yoshiki Jikumaru	C	University of Tokyo	Japan
2023/11/3	2023/11/9	7	Martin Guest	C	Waseda University	Japan
2023/11/5	2023/11/10	6	Kota Hattori	C	Keio University	Japan
2023/11/5	2023/11/10	6	Shota Hamanaka	C	Osaka Central Advanced Mathematical Institute	Japan
2023/11/5	2023/11/10	6	Yoshinobu Kamishima	C	Josai University	Japan
2023/11/5	2023/11/10	6	Omar Kidwai	C	Okinawa Institute of Science and Technology Graduate University	Japan
2023/11/5	2023/11/10	6	Chien Lin	C	Chongqing University of Technology	China

Arrival date	Departure date	Days of visit (2023)	Name	Program	Affiliation	Country
2023/11/5	2023/11/10	6	Yoshihiro Ohnita	C	Waseda University & OCAMI	Japan
2023/11/5	2023/11/10	6	Thomas Raujouan	C	Kobe University	Japan
2023/11/5	2023/11/10	6	Yuichiro Sato	C	Kogakuin University	Japan
2023/11/5	2023/11/10	6	Masashi Yasumoto	C	Tokushima University	Japan
2023/11/12	2023/11/15	4	Yoichi Enatsu	D	Tokyo University of Science	Japan
2023/11/12	2023/11/16	5	Ryo Oizumi	D	National Institute of Population and Social Security Research	Japan
2023/11/3	2023/11/19	17	Yihong Du	D	University of New England	Australia
2023/11/19	2023/11/25	7	Noe Kawamoto	D	Hokkaido University	Japan
2023/11/12	2023/11/28	17	King-Yeung Lam	D	Ohio State University	USA
2023/11/26	2023/12/9	14	Kaoru Ono	C	RIMS , Kyoto University	Japan
2023/11/26	2023/12/9	14	Brett Parker	C	Australian National University	Australia
2023/12/18	2023/12/29	12	Bharathwaj Palvannan	A	Indian Institute of Science	India
2023/12/18	2023/12/29	12	Chi-Yun Hsu	A	Santa Clara University	USA
2023/10/2	2024/1/12	91	Camille Laurent-Gengoux	C	Université de Lorraine	France
2023/8/15	2024/8/31	139	Willie Wai-Yeung Wong	C	Michigan State University	USA

2873

4.6 Publications

4.6.1 Publications of Key Members

Journal Name	2022 Ack (55)	2022 AFF (57)	2023 Ack (47)	2023 AFF (38)	To Appear (38)
Advances in Applied Mathematics and Mechanic			1		
Advances in Mathematics	1	2			
Algebra Number Theory				1	1
Algebraic Geometry					1
Ann. Math. Québec				1	
Annals of Mathematical Sciences and Applications	1				
Annals of Mathematics					1
Applicable Analysis	1	1			
Applied Mathematics Letter	1				
Archiv der Mathematik	1	1			
ARS Mathematica Contemporanea		1			
Asian Journal of Math					1
Bulletin of the London Mathematical Society			1	1	1
Bulletin of Mathematical Biology				2	1
Bulletin of the Australian Mathematical Society		1			
Calculus of Variations and Partial Differential Equations			3	2	
Cambridge Journal of Mathematics	1				
Chaos		1	1	1	1
Classical Quantum Gravity				1	
Comm. in Contemporary Mathematics		1	1		
Communications in Algebra			1	1	1
Communications in Analysis and Geometry	1				
Communications in Computational Physics			2	2	
Communications in Mathematical Physics		1	1	1	
Communications in Mathematical Sciences					1
Comptes Rendus Mathématique, Acad. Sci. Paris			1		
Computer Physics Communications	1				
Deep-Sea Research I.		1			
Discrete and Continuous Dynamical System Series-B	2		1		
Displays	1				
Documenta Mathematica	1				
Electronic Journal of Probability	2	1			
Ergodic Theory and Dynamical Systems			1	1	1

Journal Name	2022 Ack	2022 AFF	2023 Ack	2023 AFF	To Appear
FEMS Microbiology Ecology		1			
Food Chemistry				1	
Forum of Mathematics, Sigma		1			
Frontiers in Applied Mathematics and Statistics			1		
Geometric and Functional Analysis	1				
Hokkaido M. J.		1			
IEEE Transactions on Circuits and Systems I		2			
Indagationes Mathematicae	1	1			
Indiana Univ Math Journal					1
Int. J. of Mathematics	1	1			
International Journal of Molecular Science		1			
International Journal of Number Theory				1	
International Mathematics Research Notices		1	1	1	
Involve					1
Israel Journal of Mathematics					1
J. Differential Equations	1	1			
Japan Journal of Industrial and Applied Mathematics			1		
Journal of algebra and application		1			
Journal of Computational and Applied Mathematics			1	1	
Journal of Computational Physics	3	4	2	2	1
Journal of Differential Equations	1	1	2	1	
Journal of Dynamics and Differential Equation				2	1
Journal of European Mathematical Society			1		1
Journal of Fluid Mechanics	3		1		
Journal of Mathematical Analysis and Applications	1	1	1		
Journal of Mathematical Biology			1	1	
Journal of Nonlinear and Convex Analysis					1
Journal of Number Theory	1	2	1	1	
Journal of Pure and Applied Algebra	1	1			
Journal of Scientific Computing	2				
Journal of Statistical Physics	1		1	2	
Journal of Topology and Analysis			1		1
Journal of the Australian Mathematical Society			1		
Mathematical Physics, Analysis and Geometry			2	2	

Journal Name	2022 Ack	2022 AFF	2023 Ack	2023 AFF	To Appear
Mathematical Proceedings of the Cambridge Philosophical Society			1		
Mathematical Research Letters	1				
Mathematika					1
Mathematische Annalen	4	3			
Mathematische Nachrichten	1	1		2	
Mathematische Zeitschrift	1				
Nagoya Math. J.		1			
Nature Communications	2	4			
Nonlinear Analysis		2			
Nonlinear Differential Equations and Applications			1		
Osaka Journal of Mathematics			1		
PLOS Computational Biology					1
Potential Analysis	1				
Potentials and Partial Differential Equations					1
Probab. Surveys	1				
Proceedings of the American Mathematical Society	1		1	1	
Proceedings of the ISCTE International Symposium on Stochastic Systems Theory and its Applications		1			
Quantum Information Processing	1				
Random Matrices: Theory and Applications			1		
Random Structures & Algorithms					1
Real Analysis Exchange	2	1			
Representation Theory		1			
Research in Number Theory		1			
Revista de la Real Academia de Ciencias Exactas, Físicas y Naturales. Serie A. Matemáticas		1			
RIMS Kokyuroku Bessatsu		1			
Science Advances			1	1	
Scientific Reports	1				
Semigroup Forum			2	1	2
SIAM Journal on Applied Mathematics				1	
SIAM Journal on Imaging Sciences			2		1
SIAM Journal on Mathematical Analysis			2	1	1
Studia Mathematica	1	1	1		1

Journal Name	2022 Ack	2022 AFF	2023 Ack	2023 AFF	To Appear
Symmetry, Integrability and Geometry: Methods and Applications		1			
Taiwanese Journal of Mathematics		1			
The Journal of Geometric Analysis	1	1	1	1	
The Ramanujan Journal		1			
Theoretical Computer Science	2	1			
Transactions of the American Mathematical Society	1	1	1	1	1
Transformation Groups	3	2			

4.6.2 Publications of Postdoctoral Fellows

Author	Title	Journal	To Appear	ACK	AFF	Year
Andrea Galasso	Toeplitz operators on CR manifolds and group actions	The Journal of Geometric Analysis 33, 21 (2023). https://doi.org/10.1007/s12220-022-01078-9		Y	Y	2023
Andrea Galasso	Equivariant fixed point formulae and Toeplitz operators under Hamiltonian torus actions and remarks on equivariant asymptotic expansions	Int. J. of Mathematics, Vol. 33, No. 2 (2022) https://doi.org/10.1142/S0129167X22500112		Y	Y	2022
Andrea Galasso	On the singularities of the Szegő kernels on CR orbifolds	arXiv:2208.03690		Y	Y	2022
Iacopo Brivio	Invariance of plurigenera fails in positive and mixed characteristic	International Mathematics Research Notices, 2022;, rnac304, https://doi.org/10.1093/imrn/rnac304			Y	2022
Iacopo Brivio	Lifting globally F-split surfaces to characteristic zero	arXiv:2205.01779		Y	Y	2022
Iacopo Brivio	Invariance of plurigenera for some varieties with good minimal models	arXiv:2207.08107		Y	Y	2022
Chun-Wei Chang	Anticipating the occurrence and type of critical transitions.	Science Advances 9: 1 eabq4558		Y	Y	2023
Chun-Wei Chang	Detecting regime shifts in nonlinear dynamics	PLOS Computational Biology	Y			2023
Chun-Wei Chang	Comments on identifying causal relationships in nonlinear dynamical systems via empirical mode decomposition	Nature Communications 13, 2860			Y	2022

Author	Title	Journal	To Appear	ACK	AFF	Year
Chun-Wei Chang	Causal networks of phytoplankton diversity and biomass are modulated by environmental context	Nature Communications 13, 1140.			Y	2022
Chien-Hua Chen	Exceptional cases of adelic surjectivity for Drinfeld modules of rank 2	Acta Arithmetica 202 (2022), 361-377				2022
Chien-Hua Chen	On singular moduli for higher rank Drinfeld modules	arXiv:2303.03643			Y	2023
Chien-Hua Chen	Masser-Wüstholz bound for reducibility of Galois representations for Drinfeld modules of arbitrary rank	arXiv:2303.12399			Y	2023
Chien-Hua Chen	Class number relation for higher rank Drinfeld modules	work in progress			Y	2023
Yen-An Chen	Log canonical foliation singularities on surfaces	Mathematische Nachrichten 296 (2023), No. 8, 3222–3256			Y	2023
Yen-An Chen	On toric foliations	arXiv:2308.05053		Y		2023
Yen-An Chen	ACC for foliated log canonical thresholds	arXiv:2202.11346			Y	2022
Huy Dang	Local Oort groups and the isolated differential data criterion.	Journal de théorie des nombres de Bordeaux, 34(1), 251–269 (2022)				2022
Huy Dang	The moduli space of cyclic covers in positive characteristic.	arXiv:2306.14711.			Y	2023
Simon-Raphaël Fischer	Integrating curved Yang-Mills gauge theories,	arXiv:2210.02924			Y	2022
Oğuz Gezmiş	On Drinfeld modular forms of higher rank and quasi-periodic functions	Transactions of the American Mathematical Society 375 (2022), 2387-2416			Y	2022

Author	Title	Journal	To Appear	ACK	AFF	Year
Brian Harvie	Inverse Mean Curvature Flow over Non-Star-Shaped Surfaces.	Mathematical Research Letters, Vol. 29, No. 4 (2023), 1065-1086				2023
Brian Harvie	Inverse Mean Curvature Flow of Rotationally Symmetric Hypersurfaces	Calculus of Variations and Partial Differential Equations 62, 125 (2023). https://doi.org/10.1007/s00526-023-02469-8		Y	Y	2023
Brian Harvie	The Mass of the Static Extension of Small Spheres	International Mathematics Research Notices 2023;, rnad045, https://doi.org/10.1093/imrn/rnad045			Y	2023
Brian Harvie	The Limit of the Inverse Mean Curvature Flow on a Torus.	Proceedings of the American Mathematical Society 150 (2022), 3049-3061.				2022
Brian Harvie	A Rigidity Theorem for Asymptotically Flat Static Manifolds and its Applications.	arXiv:2305.08570				2023
Brian Harvie	The Mass of the Static Extension of Small Spheres.	arXiv:2209.00141				2022
Yoshinori Kamijima	Mixing time and simulated annealing for the stochastic cellular automata.	Journal of Statistical Physics 190, 79 (2023) https://doi.org/10.1007/s10955-023-03090-x .			Y	2023
Yoshinori Kamijima	Mean-field behavior of nearest-neighbor oriented percolation on the BCC lattice above $8 + 1$ dimensions	Mathematical Physics, Analysis and Geometry 26, 4 (2023). https://doi.org/10.1007/s11040-022-09441-6		Y	Y	2023
Yoshinori Kamijima	Stochastic optimization via parallel dynamics: rigorous results and simulations.	Proceedings of the ISCTE International Symposium on Stochastic Systems Theory and its Applications 2022 (2022): 65–71.			Y	2022

Author	Title	Journal	To Appear	ACK	AFF	Year
Jesse Madnick	Associative Submanifolds of Squashed 3-Sasakian Manifolds	arXiv:2208.10622		Y	Y	2022
Jesse Madnick	Cohomogeneity-One Lagrangian Mean Curvature Flow	arXiv:2208.01574		Y	Y	2022
Jesse Madnick	A Variational Characterization of Calibrated Submanifolds	arXiv:2204.08591		Y	Y	2022
Sanghyuck Moon	Nonlinear Schrödinger systems with trapping potentials for mixed attractive and repulsive interactions.	Calculus of Variations and Partial Differential Equations volume 62, Article number: 189 (2023)		Y		2023
Sanghyuck Moon	Asymptotic analysis on positive solutions of the Lane-Emden system with nearly critical exponents.	Transactions of the American Mathematical Society 376 (2023), No. 7, 4835-4899		Y		2023
Sanghyuck Moon	Non-abelian Chern-Simons-Higgs system with indefinite functional	Nonlinear Differential Equations and Applications 30, 36 (2023). https://doi.org/10.1007/s00030-022-00837-5		Y		2023
Sanghyuck Moon	On the uniqueness of linear convection-diffusion equations with integral boundary conditions.	Comptes Rendus Mathématique, Acad. Sci. Paris 361, 191-206 (2023)		Y		2023
Sanghyuck Moon	On the topological solutions with vortices and antivortices for the Maxwell-Chern-Simons $O(3)$ sigma model on a torus	Journal of Differential Equations Vol. 309, 2022, pp.1-29			Y	2022

Author	Title	Journal	To Appear	ACK	AFF	Year
Sanghyuck Moon	Bubbling solutions of mixed type for a general non-abelian Chern-Simons-Higgs system of rank 2 over a torus	Nonlinear Analysis Vol. 214(2022), 112552			Y	2022
Bin Nguyen	Some algebraic surfaces with canonical map of degree 10, 12, 14.	Communications in Algebra https://doi.org/10.1080/00927872.2023.2232869	Y	Y	Y	2023
Bin Nguyen	A new infinite family of irregular algebraic surfaces with canonical map of degree 8.	Archiv der Mathematik, Vol. 119, Issue 2, pp 147–153 (2022)		Y	Y	2022
Bin Nguyen	New examples of canonical covers of degree 3	Mathematische Nachrichten 295 (2022), no. 3, 450–467		Y	Y	2022
Bharathwaj Palvannan	Codimension two cycles in Iwasawa theory and tensor product of Hida families.	Mathematische Annalen Vol. 383 (2022), 39–75			Y	2022
Jun-Wen Peng	New normal forms for degree three polynomials and rational functions	Involve	Y			2023
Jun-Wen Peng	Integrality and Thurston rigidity for bicritical PCF polynomials	Periodica Mathematica Hungarica Vol. 87 (2023), 245–264				2023
Jun-Wen Peng	Arithmetic and geometric deformations of 3-folds	Bulletin of London Mathematical Society	Y	Y	Y	2023
Jun-Wen Peng	Abundance theorem for threefolds in mixed characteristic	Mathematische Annalen (2022). https://doi.org/10.1007/s00208-022-02514-5			Y	2022
Prasun Roychowdhury	Improved Poincaré-Hardy inequalities on certain subspaces of the Sobolev space	Proceedings of the American Mathematical Society 151 (2023), 3513–3527		Y	Y	2023

Author	Title	Journal	To Appear	ACK	AFF	Year
Marco Sutti	Implicit low-rank Riemannian schemes for the time integration of stiff partial differential equations	arXiv:2305.11532			Y	2023
Marco Sutti	SPHM: a MATLAB package for Smoothed Particle Hydrodynamics simulations	arXiv:2209.05189			Y	2023
Marco Sutti	The leapfrog algorithm as nonlinear Gauss–Seidel	arXiv:2010.14137			Y	2023
Yasuhiro Terakado	The discriminant of a hypersurface in weighted projective space	International Journal of Number Theory Vol. 19, No. 02, pp. 419-438 (2023)			Y	2023
Yasuhiro Terakado	Hecke eigensystems of automorphic forms (mod p) of Hodge type and algebraic modular forms	Mathematische Annalen, Vol. 382 (2022), 69-102				2022
Yasuhiro Terakado	Mass formulas and the basic locus of unitary Shimura varieties	arXiv:2210.04054			Y	2022
Chien Hsun Wang	Stability conditions and braid group actions on affine A type quivers	Journal of Algebra and Application Vol. 21, No. 09, 2250174 (2022)			Y	2022
Kuan-Hsiang Wang	On non-local nonlinear elliptic equations involving an eigenvalue problem	Revista de la Real Academia de Ciencias Exactas, Físicas y Naturales. Serie A. Matemáticas 116, 45 (2022). https://doi.org/10.1007/s13398-021-01190-5				2022
Yi-Sheng Wang	Geometric realization and its variants	Hokkaido M. J. 51(2) (2022)			Y	2022
Yi-Sheng Wang	Unknotting annuli and handlebody-knot symmetry	Topology Appl. 305 (2022)			Y	2022

Author	Title	Journal	To Appear	ACK	AFF	Year
Peng-Jie Wong	Primes in the Chebotarev density theorem for all number fields	Journal of Number Theory 241 (2022), 700-737			Y	2022
Peng-Jie Wong	On Stark's class number conjecture and the generalised Brauer-Siegel conjecture	Bulletin of the Australian Mathematical Society 106 (2022), 288-300.			Y	2022
Peng-Jie Wong	Counting zeros of the Riemann zeta function	Journal of Number Theory 235 (2022), 219-241			Y	2022
Peng-Jie Wong	Shifted moments of the Riemann zeta function	arXiv:2206.03350			Y	2023
Peng-Jie Wong	Fourier coefficients of automorphic L-functions over primes in ray classes	arXiv:2103.15713			Y	2022

4.7 Undergraduate Research and Summer Research Program

4.7.1 URP

NCTS URP 2022

主題名稱	指導老師	學員 1	學員 2	學員 3
Heat and Bergman Kernels Asymptotics in Complex Geometry	蕭欽玉 (中研院數學所)	台大數學四 蔡以心		
L_∞ algebra and its applications	廖軒毅 (清華數學)	清華理學院學士班四 劉思承	清華數學三 呂建德	清華數學三 翁麟翔
Denoising and Sticking of Images and Surfaces	樂美亨 (師大數學)	中央數學四 林固德	師大數學四 黃靖恩	
同步化問題中的隨機微分方程以及時滯微分方程	夏俊雄 (台大數學)	台大資工四 蔡仲恩		
Association of indoor temperature, humidity, and air pollutants with cognition and frailty in older adults	程蘊菁 (台大流行病學及預防醫學)	台大公衛三 陳姍萱	台大公衛三 黃映潔	
Algebraic geometry and analytic geometry (GAGA)	卓士堯 (清華數學)	清大數學四 吳沂騰	清大數學四 林俊廷	
異質性材料熱傳問題及電導係數求解問題的數學模型	曾昱豪 (高雄大應數)	高雄大應數四 李玉萱	高雄大應數三 曾柏翰	高雄大應數二 劉書伶
The connective constant of the self-avoiding random walk on planar lattices	方向 (中央數學)	中央數學四 吳念潔		

NCTS URP 2023

研究主題名稱	指導教授	學員一	學員二	學員三
Collective Phenomena in Dynamical Systems Governed by Differential Equations	夏俊雄(台大數學) 戴佳原(中興應數)	台大數學大三 徐睿安	中興應數大三 陳建佑	—
Randomly Indexed Branching Process and Its Applications	洪芷漪(政大應數)	政大統計輔會計 大三 丁柔萱	政大統計輔應數大 三 饒湘茂	—
Deep Hedging	東聖甯(清大數學) 杜昌燁(東吳數學)	台大外文雙修數學 大四 徐樂融	清大數學大四 黃得晉	清大資工輔計量 金融大三 楊晨鍾
Representation Theory of Semisimple Lie Algebras	陳志瑋(中央數學)	中央數學大二 鐘禮謙	—	—
Potential Vorticity for Boundary Layer in Hadley Circulation and Pangu AI Model Study	郭鴻基(台大大氣)	台大大氣大三 陳芊涵	—	—
Undergraduate Research Program—Flocking Dynamics by Markov Processes	梁育豪(高雄大學應 數)	高雄大應數大四 蘇榆庭	高雄大應數大三 陳冠博	高雄大應數大三 林欣妤
Maslov Index, Floer Homology and Fukaya Category	廖軒毅(清大數學)	清大數學系大三 劉筱玟	—	—

4.7.2 USRP

NCTS USRP 2023

主題名稱	指導老師	助教	學員 1	學員 2	學員 3	旁聽
(1) Central Limit Theorems and Stein's Method for Gaussian Approximations	劉聚仁 (成大數學) 許元春 (陽交大應數)	郝嘉誠 蘇彥維	陽明交大應數 大二 曾庭逸	清大數學 大二 姚羿安	台大數學雙 經濟大二 徐睿安	中央數學 大三 林思
(2) Physics-informed Neural Networks	林得勝 (陽交大應數) 曾昱豪 (高大應數)	李玉萱	高大應數大四 郭昱婕	陽明交大應 數大三 謝杰穎	東吳會計雙 主修數學 大三 江郁文	-
(3) Conjugate gradient method for solving large sparse linear systems with applications on computations of volume-preserving maps	樂美亨 (台師大數學) 黃聰明 (台師大數學)	劉書詠	台師大數學 大三 鄭亦展	台師大數學 大三 鄭凱謙	台師大數學 大三 陳宥銓	-
(4) On the study of matrix iteration and its related differential equations	謝世峰 (台師大數學) 郭岳承 (高大應數)	鄭煥璋	台師大數學 大四 許伊婷	政大應數 大三 吳俊暉	台師大數學 大四 陳博昇	台師大數學 大四 李侑駿
(5) Potential Vorticity Invertibility for boundary layer in Hadley Circulation	郭鴻基 (台大大氣)	陳柏孚	台大大氣大二 陳芊涵	台大地質 大一 李恩齊	台大大氣 大二 姚博宸	台師大數學 大四 吳宗螢
(6) Curvature equation with conical singularities and integrable Lamé	郭庭榕 (台師大數學)	-	台師大數學 大三 張竣維	台師大數學 大二 吳秉庠	UCL 大三 盧又詩	台師大數學 大二 詹子軒
(7) Representation theory of degenerate affine periplectic Brauer algebras	陳志瑋 (中央數學) 彭勇寧 (成大數學)	林明駿	台師大數學 大三 鄭文彥	台師大數學 大三 李浩廷	中央數學 大一 鐘禮謙	-
(8) 環面上動力傳輸方程式的 Strichartz 估計	江金城 (清大數學)	梁孟豪	台大機械大二 周芷瑜	清華數學雙 主修物理大 二 洪振傑	台大數學 大二 曾軍愷	-
(9) Online Portfolio Selection and Learning Quantum States	李彥寰 (台大資工)	王嘉澤	台大醫學大二 蕭梓宏	台大電機 大三 陳愷均	台大數學 大二 曾暉富	-