East Asian Core Doctoral Forum on Mathematics 2019*

January 9-11, 2019
Tohoku University, Sendai, Japan

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Venue
Katahira Sakura Hall, Katahira Campus, Tohoku University

Contact
Takahiro Kubota, takahiro.kubota.q6@dc.tohoku.ac.jp

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Plenary talks

Speaker: Shu-Cheng Chang (National Taiwan U.)
Title: On the CR Analogue of Yau's Uniformization Conjecture
Abstract: In this talk, we will survey the recent progress toward the CR analogue of uniformization problems in a complete strictly pseudo-convex CR manifold. Firstly, we derive the generalized of Riemann mapping theorem by Chern-Ji and affirm the partial answer of the CR Frankel conjecture in a closed spherical strictly pseudo-convex CR manifold. Secondly, we mainly focus on the first CR Yau uniformization conjecture such as the sharp dimension estimate of holomorphic functions and three-circle theorem in a complete noncompact Sasakian manifold which is an odd dimensional counterpart of Kaehler geometry. Finally, the second CR Yau uniformization conjecture on the existence of nonconstant CR-holomorphic functions of polynomial growth will be addressed.

Speaker: Engui Fan (Fudan U.)
Title: Riemann-Hilbert Approach to Asymptotic of Polynomials and Random Matrices
Abstract: In this talk, we first show the connections among the Riemann-Hilbert problem, orthogonal polynomials and random matrices. Then we show how to use Riemann-hilbert approach to analyze asympototic of orthogonal polynomials and random matrices.

Speaker: Kyungbae Park (Seoul National U.)
Title: Knot surgery problems and Heegaard Floer theory
Abstract: A classical theorem in low dimensional topology, due to Lickorish and Wallace, says that any closed orientable 3-manifold can be obtained by Dehn-surgery (cut-and-pasting) along a link in the 3-sphere. One natural question is which 3-manifolds can be constructed by Dehn-surgery along a knot, one component link. In this talk, we present some fundamental topological conditions for such 3-manifolds and review the history of the problem. In particular, we use Heegaard Floer theory to show that there are infinite families of irreducible 3-manifolds such that both the first Betti number and the weight of the fundamental group are one but they cannot be obtained by Dehn-surgery along a knot. This is a joint work with Matt Hedden, Min Hoon Kim, and Tom Mark.

Parallel talks

Speaker: Kuan-Wei Chen (National Chiao Tung U.)
Title: Synchronized Oscillations of Segmentation Clock Genes in Zebrafish
Abstract: Mathematical models expressed by delay equations or ODEs have been proposed to depict the kinetics of the segmentation clock genes in interacting cells of zebrafish embryos. For such models, it is important to find conditions under which cells can achieve synchronization in a sufficiently short time. However, theoretical analysis on the existence and stability of synchronous periodic solutions for such models is a non-trivial task. In this lecture, we present the analysis on the synchronous oscillations in the ODE model proposed in Uriu et al. (2010) to see how parameter values influence the periods. Based on the analysis and numerical computations extended from the analysis, we explore how the periods and amplitudes of the oscillations vary with the degradation rates, synthesis rates, and coupling strength. In addition, it is interesting to compare models with delay and without delay to clarify which is more suitable to generate stable synchronous oscillations. We shall also illustrate the difference between the dynamics in systems modeled with linear degradation and the one in systems with Michaelis-Menten reactions for the degradation. This is a joint work with Chih-Wen Shih and Kang-Ling Liao.

Speaker: SeungYeon Cho (Sungkyunkwan U.)
Title: High order conservative Semi-Lagrangian scheme for the BGK model of the Boltzmann equation
Abstract: In this work, we present a conservative semi-Lagrangian finite-difference scheme for the BGK model. The classical semi-Lagrangian finite difference scheme for the BGK model performs stably for all the range of Knudsen number, but are not conservative. There are two source of such loss of the conservation property. First, the accuracy of the cancellation of the relaxation operator in the zeroth, first and second velocity moments depends heavily on the number of velocity grids and non-negligible errors may arise if the number of velocity grids is not sufficient. Secondly, since the scheme is not of the conservative form, the error may accumulate in the numerical computation of the transport term. To treat the first problem and ensure the machine precision conservation of mass, momentum and energy with a relatively small number of velocity grid points, we replace the continuous Maxwellian with the discrete Maxwellian introduced by Mieussens. The second difficulty is treated by implementing a conservative correction procedure based on the flux difference form. The effectiveness of the proposed scheme is demonstrated by extensive numerical tests.

Speaker: Biy-Kuang Day (National Tsing Hua U.)
Title: Equivalence between two constructions of universal bundles and their applications.
Abstract: The concept of universal bundle is crucial in the study of group actions on spaces. A standard way to construct universal bundles is by the Dold-Steenrod construction. However, since simplicial methods has more advantages in many ways, mathematicians now prefer to construct universal bundles through bar construction. I will prove that for abelian groups, these two methods are equivalent and some useful properties of NDR-pairs of groups are given by this equivalence.

Speaker: Mathieu Fevre (Kyoto U.)
Title: Compressed sensing in bi partites and multi partites.
Abstract: Compressed sensing is a technique that allows to recover a signal (represented by a vector) from a low number of measurements on that signal, by finding solutions to an underdetermined linear system. It requires the signal to be sparse. Matrix completion, is the analog of compressed sensing in bi-partite. Under some conditions of low rank and incoherence property, it allows to recover a matrix from a sampling of its

entries. We present those results and algorithms that computationnally recover the signal in one partite, or the completed matrix in bi partite. Moreover, we present an idea of generalization in tri-partites and multi-partites.

Speaker: Mizuki Fukuda (Tohoku U.)
Title: On $SL(2,\mathbb{C})$-metabelian representations of fibered 2-knot groups
Abstract: A branched twist spin is a fibered 2-knot in the four sphere and it is constructed from singular fibers of a circle action on the four sphere. It is known by Lin and Nagasato that the number of conjugacy classes of irreducible $SL(2,\mathbb{C})$-metabelian representations of any 1-knot group Is determined by its knot determinant.
In this talk, I give higher dimensional version of Lin's and Nanasato's theorem about branched twist spins.
To prove this, I use a presentation of the knot group obtained from the fibers of the knot exterior of the branched twist spin.

Speaker: Chuangqiang Hu (Tsinghua U.)
Title: Complete weight distribution and MacWilliams identities for asymmetric quantum codes.
Abstract: In 1997, Shor and Laflamme defined the weight enumerators for quantum error-correcting codes and derived a MacWilliams identity. We extend their work by introducing our double weight enumerators and complete weight enumerators. The MacWilliams identities for these enumerators can be obtained similarly. With the help of MacWilliams identities, we obtain various bounds for asymmetric quantum codes.

Speaker: Yung-Hsiang Huang (National Taiwan U.)
Title: On the asymptotics of eigenvalues and ground state energy of saturable nonlinear Schrodinger equations
Abstract: It is known many phenomenon in nonlinear optics can be described by nonlinear Schrodinger equations with saturable nonlinearity. Here we study a sequence of related minimizing problems parametrized by L^2-constraints. We establish the asymptotics for virial ratios, eigenvalues and energies of ground states as the parameter tends to infinity. Furthermore, we show the lower bound of the ground state energy has a 2nd order term at least of logarithm growth.

Speaker: Zhangmin Huang (Fudan U.)
Title: S^1-action on unitary manifolds with isolated fixed points
Abstract: Let $S^1 \curvearrowright M$ fix isolated points and preserve the unitary structure, where M is a unitary closed manifold. If M is not a boundary, then the number of isolated points is greater than $f(dimM)$, where f is some linear function. In 1980, Kosniowski conjectured that the most likely function is $f(x) = \frac{x}{4}$. Namely $\mid M^{S^1} \mid \geq [\frac{dimM}{4}] + 1$. Kosniowski showed that the conjecture is true for $\mid M^{S^1} \mid \leq 2$.
Let $W = (w_{ij})$ be a $m \times n$ matrix, where all w_{ij} are nonzero integers. Define a complex function over variable z,

$$T^W_{x,y}(z) := \sum_{i=1}^{m} \epsilon_i \prod_{j=1}^{n} \frac{xz^{w_{ij}} + y}{z^{w_{ij}} - 1}.$$

We call the function $T^W_{x,y}(z)$ rigid, if the function does not depend upon the choice of z. I will mainly introduce the progress of this problem and use the rigidity of $T^W_{x,y}(z)$ to prove that if $\mid M^{S^1} \mid = 3$, the conclusion is also true.

Speaker: Tsukasa Ishibashi (U. Tokyo)
Title: Cluster Dehn twists in cluster modular groups
Abstract: A cluster modular group, which is introduced by Fock-Goncharov, is an automorphism group of a cluster ensemble. The latter is a pair of contractible manifolds carrying presymplectic/ Poisson structures. These objects can be thought as combinatorial (or algebro-geometric) generalizations of mapping class groups and Teichmuller spaces of orientable surfaces.

In this talk, we introduce the concept of “cluster Dehn twists” in a cluster modular group, which is a generalization of (half-) Dehn twists in the mapping class group of a surface.
We show that orbits of the action of a cluster Dehn twist on the cluster ensemble have the similar asymptotic behavior as those of (half-) Dehn twists.
Moreover, for several cluster ensemble of finite mutation type, we show that the corresponding cluster modular group is generated by cluster Dehn twists.

Speaker: Kunihiro Ito (Tohoku U.)
Title: A generalization of the Landen connection formula and relations among multi-indexed poly-Bernoulli numbers
Abstract: The Landen connection formula for multiple polylogarithms, which is shown by Okuda and Ueno, gives much information on multiple zeta functions and their special values.
In this talk, we present a kind of generalization of the Landen connection formula for multiple polylogarithms of shuffle type in several variables with certain classes of indices.
We also mention its application to relations among multi-indexed poly-Bernoulli numbers.

Speaker: Hiroki Kato (U. Tokyo)
Title: The characteristic cycle of an l-adic sheaf and wild ramification
Abstract: I will discuss a new proof of Saito-Yatagawa's result that the characteristic cycle of an l-adic sheaf on a variety of positive characteristic is determined by its wild ramification along infinity. Saito Yatagawa's proof relies on a global argument, but the new proof is purely local and gives a refined result. The key ingredient is to prove that wild ramification of the Milnor fiber cohomology is determined by wild ramification of the original l-adic sheaf.

Speaker: Doheon Kim (Seoul National U.)
Title: The global well-posedness of the kinetic thermodynamic Cucker-Smale model with chemotatic movements
Abstract: We present coupled kinetic-macroscopic equations describing the dynamic behaviors of thermodynamic Cucker-Smale (in short TCS) ensemble undergoing velocity jumps and chemotactic movements. The proposed coupled model consists of a kinetic TCS equation supplemented with a turning operator for the kinetic density of TCS particles, and a reaction-diffusion equation for the chemotactic density. We study global-in-time existence of a strong solution for the proposed model.

Speaker: Jeongho Kim (Seoul National U.)
Title: Complete cluster predictability of the 1-Dimensional Cucker-Smale flocking model
Abstract: We present a complete predictability of clustering for the Cucker-Smale(C-S) model on the line. Emergence of multi-cluster flocking is often observed in numerical simulations for the C-S model with short-range interactions. However, the explicit computation of the number of emergent multi-clusters a priori is a challenging problem for the Cucker-Smale flocking model. In this paper, we present an explicit criterion and algorithm to calculate the number of clusters and their bulk velocities in terms of initial configuration, coupling strength and communication weight function in one-dimensional setting. We present a nite increasing sequence of coupling strengths in which the number of asymptotic clusters has a jump. We also provide several numerical examples and compare them with analytical results.

Speaker: Sinhwi Kim (Sungkyunkwan U.)
Title: Harmonic manifolds and Jacobi fields
Abstract: A Riemannian manifold is called harmonic if a volume density centered at a point depends only on

the distance from the center. This talk examines totally geodesic submanifolds of harmonic manifolds and the relation between harmonicity and Jacobi fields.

Speaker: Koichi Komada (Tohoku U.)
Title: Final state problem for class of nonlinear nonlocal dispersive equation
Abstract: We study the large time asymptotics of solutions to the class of nonlinear dispersive equation

$$\partial_t u - P(-i\partial_x)\partial_x u = -\partial_x(u^3), \qquad t > 0,\ x \in \mathbb{R},$$

where $P(-i\partial_x)$ is the pseudo-differential operator defined by the symbol $P(\xi)$. We consider the case that the dispersion $P(-i\partial_x)$ is a nonlocal and non-homogeneous operator. Since the rate of point-wise decay of solutions to the linearized equation is $O(t^{-1/2})$, we expect that the cubic nonlinear interaction will not be negligible for large time. We show that there exist modified scattered states.

Speaker: Guan-Yu Lai (National Chiao Tung U.)
Title: Dynamical Zeta Function and its Applications
Abstract: In recent years, the dynamical system become the one of most important research in mathematics. And the dynamical zeta function is the one of the most important part in the dynamical system. In here, I will explain something about the relation between dynamical zeta function, meromorphic extension and number theory.

Speaker: Pin-Zhi Lai (National Tsing Hua U.)
Title: Hitchin's Equations over Surfaces with Boundary
Abstract: Let K be a compact connected Lie group, and Σ be a compact Riemann surface of genus bigger than one with non-empty boundary components. We study the moduli spaces of solutions to the Hitchin's equations with structure group K over Σ. In this talk, we look at two situations. First, we consider the case when K is simply-connected and Σ has arbitrary number of boundary components. Secondly, we consider the case when K is not simply-connected but Σ has exactly one boundary component. We will explain how to obtain a quasi-Hamiltonian structure on the moduli space in both cases.

Speaker: Gihyun Lee (Seoul National U.)
Title: Complex powers of elliptic pseudodifferential operators on noncommutative tori
Abstract: Noncommutaitve tori are one of the central objects in Alain Connes' noncommutative geometry program. Connes introduced a pseudodifferential calculus on noncommutative tori, and this pseudodifferential calculus have been widely used in the differential geometry study of noncommutative tori by various people. In this talk, I want to introduce Connes' pseudodifferential calculus and show the construction of complex powers of elliptic pseudodifferential operators on noncommutative tori. Joint work with H. Ha and R. Ponge.

Speaker: Hsin-Yi Lee (National Central U.)
Title: Global Shock Wave Solutions of Hyperbolic Balance Laws for Multi-lane Traffic Flow Model.
Abstract: In this talk, we consider a multi-lanes model of traffic flow, which is governed by a hyperbolic system of balance laws. The system of balance laws is given as a 2 by 2 nonlinear hyperbolic system with discontinuous source. The global existence of entropy solutions to the Cauchy problem of this multi-lanes model is established by a new version of generalized Glimm method. The generalized solutions of the Riemann problem, which is the building block of the generalized Glimm scheme, are constructed by Lax's method and an invention of perturbations solving linearized hyperbolic equations with modified source terms. The residuals is estimated for the consistency of the generalized Glimm scheme. The wave interaction estimates are provided

for the decay of Glimm functionals and the result for the asymptotic behavior of solutions.

Speaker: Jongrak Lee (Ewha Womans U.)
Title: Toeplitz operators on the derivative Hardy space
Abstract: In this talk, we discuss the Toeplitz operators on the derivative Hardy spaces. First we study the properties of Toeplitz operators on the derivative Hardy spaces. Next, we give a necessary and sufficient condition for Toeplitz operators T_φ with polynomial symbols φ to be hyponormal.

Speaker: Wei Liu (Tsinghua U.)
Title: Regularity of solutions to higher order equations and related open problems.
Abstract: By establishing new global integral estimates for some weighted operators and interior estimates of elliptic equations, we obtain boundedness of the solution and its gradient of the fourth equation in general domains.

Speaker: Zhimin Liu (Fudan U.)
Title: On the Structure of Irreducible Yetter-Drinfeld Modules over Quasi-Triangular Hopf Algebras
Abstract: Let (H, R) be a finite dimensional quasi-triangular Hopf algebra over an algebraically closed field k of characteristic zero. In this talk, we give the structure of irreducible objects of the Yetter-Drinfeld module category ${}^H_H\mathcal{YD}$. Let H_R denote Majid's transmuted braided group of H. Let W be any irreducible left subcomodule of H_R, and D be the Yetter-Drinfeld submodule of H, generated by W. Then D is irreducible in ${}^H_H\mathcal{YD}$, and is a subcoalgebra of H_R as well. We then define the R-adjoint-stable algebra $N_W = W^*\square_D (H \otimes W)$ of W, which is also an H-comodule algebra. For any simple left N_W-module U, we prove that $(H \otimes W)\otimes_{N_W} U$ is irreducible in ${}^H_H\mathcal{YD}$. Moreover, all irreducible objects of ${}^H_H\mathcal{YD}$ are obtained in this way. We stress that N_W is such an algebra over which the dimension of each irreducible left module divides its dimension.If $H = kG$ is the group algebra of a finite group, then the characterization in this talk generalize the results of Dijkgraaf-Pasquier-Roche and Gould. This is a joint work with Shenglin Zhu.

Speaker: Zhenyu Ming (Tsinghua U.)
Title: Isotropic invariants for tensors.
Abstract: Tensor function representation theory is an essential topic in continuum mechanics, which focuses on the tensor invariants under coordinate transformations. Since tensor invariants often reveal more intrinsic information of materials than tensor components, the complete and irreducible representation for invariant tensor functions plays a key role in modeling nonlinear constitutive equations in both theoretical and applied physics. The representation of vectors and second order tensors was well established in the latter half of the twentieth century. With modified method, we can obtain some further results for higher order tensors.

Speaker: Michiya Mori (U. Tokyo)
Title: Order isomorphisms of operator intervals in von Neumann algebras.
Abstract: It is well-known that a mapping between two intervals in the real line is an order isomorphism if and only if it is a continuous monotone increasing bijection.
In this talk, we would like to consider an operator version of it.
We give a complete description of order isomorphisms between operator intervals of von Neumann algebras.

Speaker: Yesom Park (Ewha Womans U.)
Title: An Efficient MILU Preconditioning for Solving the 2D Poisson equation with Neumann boundary condition
Abstract: MILU preconditioning is known to be the optimal one among all the ILU-type preconditionings in solving the Poisson equation with Dirichlet boundary condition. It is optimal in the sense that it reduces the

condition number from $O\left(h^{-2}\right)$, which can be obtained from other ILU-type preconditioners, to $O\left(h^{-1}\right)$. However, with Neumann boundary condition, the conventional MILU cannot be used since it is not invertible, and some MILU preconditionings achieved the order $O\left(h^{-1}\right)$ only in rectangular domains. In this article, we consider a standard finite volume method for solving the Poisson equation with Neumann boundary condition in general smooth domains, and introduce a new and efficient MILU preconditioning for the method in two dimensional general smooth domains. Our new MILU preconditioning achieved the order $O\left(h^{-1}\right)$ in all our empirical tests. In addition, in a circular domain with a fine grid, the CG method preconditioned with the proposed MILU runs about two times faster than the CG with ILU.

Speaker: Xiaoshan Qin (Fudan U.)
Title: Noncommutative quasi-resolutions
Abstract: The notion of a noncommutative quasi-resolution is introduced for a general noncommutative noetherian algebra with singularities, even for a non-Cohen-Macaulay algebra. If A is a commutative normal Gorenstein domain, then a noncommutative quasi-resolution of A naturally produces a noncommutative crepant resolution (NCCR) of A in the sense of Van den Bergh, and vice versa. We prove that

(i) in dimension two, all noncommutative quasi-resolutions of a given noncommutative algebra are Morita equivalent, and

(ii) in dimension three, all noncommutative quasi-resolutions of a given noncommutative algebra are derived equivalent.

These assertions generalize important results of Van den Bergh, Iyama-Reiten and Iyama-Wemyss in the commutative and central-finite cases.
This is a joint work with Yanhua Wang and James. J. Zhang.

Speaker: Wei-Bo Su (National Taiwan U.)
Title: Mean Curvature Flow of Asymptotically Conical Lagrangian Submanifolds
Abstract: In this talk, I will describe some results about Mean Curvature Flow (MCF) of Asymptotically Conical (AC) Lagrangian submanifolds. Short-time existence of AC Lagrangian MCF and long-time existence and convergence results in equivariant case will be given. In particular, we show that the MCF starting from equivariant almost-calibrated AC Lagrangian will exists for all time and converges to a Lagrangian catenoid or an Anciaux's expander, depending on the characterizing angle of the asymptotic cone.

Speaker: Ken Sumi (Kyoto U.)
Title: Tropical Riemann-Roch inequality on tropical abelian surfaces
Abstract: Tropical geometry appears as a limit of complex algebraic geometry.
Mikhalkin-Zharkov and Gathmann-Kerber showed Riemann-Roch theorem for compact tropical curves in 2008. It is very interesting to generalize Riemann-Roch theorem for heigher dimensional tropical varieties, while the formulation is not done yet even for tropical surfaces. As the first step to the generalization, we show that a Riemann-Roch inequality for tropical abelian surfaces.

Speaker: Miyu Suzuki (Kyoto U.)
Title: Quaternion distinguished representations and base change for unitary groups
Abstract: Base change lift is a map from the set of cuspidal automorphic representations of a unitary group to the set of automorphic representations of a general linear group. Flicker and Rallis conjectured that a cuspidal automorphic representation of GL is in the image of the base change lift if and only if it is distinguished with respect to certain subgroup. Considering quaternion distinguished representations, we propose a slight

generalization of this conjecture and prove it for $GL(2)$ by using a relative trace formula. We also consider a local analog of this conjecture.

Speaker: Masahiro Takeda (Kyoto U.)
Title: The cohomology of the classifying spaces of certain gauge group
Abstract: A gauge group is the topological group of automorphisms of a principal bundle. The cohomology of the classifying space of a gauge group is important in its own right and also for applications, but the integral cohomology has not been determined in non-trivial case. I compute the integral cohomology ring of the classifying spaces of gauge groups of principal $U(2)$-bundles over the 2-sphere by generalizing the operation for free loop spaces, called the free suspension.

Speaker: Hsin-Han Tsai (National Taiwan U.)
Title: Highly Efficient GPU Eigensolver for Three-Dimensional Photonic Crystal Band Structures with Any Bravais Lattice
Abstract: A null-space free method with the FFT-based matrix-vector multiplications was proposed to solve the Maxwell equations that model the three-dimensional photonic crystals. The most time-consuming parts of this method were the FFT-based matrix-vector multiplications. In this article, we propose new mathematical formulas to compute the FFT-based matrix-vector multiplications and derive highly efficient algorithms on top of the NVIDIA GPU architecture. The resulting algorithms are approximately two-to threefold faster than the previous algorithms. We have successfully used a single NVIDIA Tesla P100 GPU to solve a set of generalized eigenvalue problems of $5,184,000$ dimensions in 17 to 22 seconds for each problem. Furthermore, we ported the codes to a GPU cluster and achieved near linear scalability. To our knowledge, these GPU implementations of the proposed algorithms are the fastest implementations. The schemes can be applied to simulate a three-dimensional photonic crystal with all 14 Bravais lattices. These highly efficient schemes and codes raise possibilities for large-scale and near real-time numerical simulations for novel physical discoveries and engineering applications of photonic crystals.

Speaker: Kuan-Hsiang Wang (National U. Kaohsiung)
Title: On the Local Well-Posedness for the Quantum Zakharov System
Abstract: In this talk, we consider the local well-posedness for the quantum Zakharov system in spacial dimensions $d = 1, 2, 3$. For 1D, the nonlinear estimates are proved directly without Strichartz estimates. For 2D and 3D, the crucial nonlinear estimates are derived by the Strichartz estimates for fourth order Schröding equation and fourth order wave equation respectively. We obtain the regions of regularities of the quantum Zakharov system for which the local well-posedness hold and cover the regions of local well- posedness for Zakharov system for $d = 1, 2, 3$. We follow the work of Ginibre-Tsutsumi-Velo with some adaptions. Comparing with the result in their work, we improved the region of local well-posedness for Zakharov system in 1D. This is a join work with Yung-Fu Fang and Hsi-Wei Shih.

Speaker: Min Wang (Fudan U.)
Title: A further analysis of backward error in polynomial deflation
Abstract: When polynomial roots vary widely in order of magnitude, severe numerical instability problem may occur due to deflation schemes. Peters and Wilkinson [*IMA Journal of Applied Mathematics,* 8(1):16-35, (1971)] have proposed deflation schemes to prevent the numerical stability of the remaining approximate roots from being severely worse than the one of the deflated root. In this talk, from the viewpoint of backward error of approximate roots, we show that this root distribution can be utilized to help improve the backward stability

of some remaining approximate roots when using the deflation schemes proposed by Peters and Wilkinson.

Speaker: Zhiyuan Wang (Tsinghua U.)
Title: A unified approach to holomorphic anomaly equations and quantum spectral curves.
Abstract: We present a unified approach to holomorphic anomaly equations and some well-known quantum spectral curves. We develop a formalism of abstract quantum field theory based on the diagrammatics of the Deligne Mumford muduli spaces $\overline{M}_{g,n}$ and derive a quadratic recursion relation for the abstract free energies in terms of the edge-cutting operators. This abstract quantum field theory can be realized by various choices of a sequence of holomorphic functions and suitable propagators, and the realized quantum field theory can be represented by formal Gaussian integrals. Various applications are given. This is a joint work with Prof. Jian Zhou.

Speaker: Quan Xu (Tsinghua U.)
Title: A functoiral Riemann Roch theorem in positive characteristic.
Abstract: In this talk, firstly we will recall Deligne's functorial Riemann Roch theorem for a projective and smooth morphism of relative dimension one. By Pink and Roessler's construction for Bott element in Adams Riemann Roch theorem in positive characteristic, we give an analogue of Deligne's functorial Riemann Roch theorem in positive characteristic, which does not rely on the Mumford isomorphism and on the contrary. We give its analogue. We also extend the morphism to any relative dimension. Furthermore, we give an analogue of the Knudesen-Mumford extension in positive characteristic.

Speaker: Seokbeom Yoon (Seoul National U.)
Title: The volume and Chern-Simons invariant of a Dehn-filled manifold
Abstract: Due to the work of Thurston, a cusped manifold, such as a hyperbolic knot complement in the 3-sphere, can be well understood as we decompose it into ideal tetrahedra. In particular, Zickert showed that the volume and Chern-Simons invariant of a cusped manifold can be computed in terms of ideal tetrahedra. In this talk, we generalize the formula of Zickert to a Dehn-filled manifold. Also, we apply our formula to an octahedral decomposition of a link complement which results in a diagrammatic formula for computing the volume and Chern-Simons invariant.

Speaker: Youngho Yoon (Seoul National U.)
Title: A concrete calculation of Hirzebruch-Milnor class of hyperplane arrangements
Abstract: Hirzebruch class was introduced on singular spaces, as a way to unify several characteristic classes. For singular projective hypersurfaces (and more generally for projective complete intersections), one can also define the virtual Hirzebruch class. The difference of the two is measured by Hirzebruch-Milnor class, defined by L. Maxim, M. Saito, and J. Schürmann. They provided a formula for this class in terms of Hodge spectrum and resolution of singularities. For low dimensional hyperplane arrangements, however, we can calculate the difference class directly on the ambient space, using an expression of Hirzebruch class in terms of the characteristic polynomial of the arrangement. The result of our calculation agree with theirs in the examples we have considered.

Speaker: Yeonghun Youn (Seoul National U.)
Title: Nonlinear potential theory for general elliptic systems
Abstract: By the pioneering work of De Giorgi and Nash, the answer to Hilbert's 19th problem is well known nowadays, that is, solutions to regular elliptic and parabolic equations are smooth enough. Unfortunately, for elliptic systems without certain diagonal structure assumption, the regularity result fails to holds. Though solutions to elliptic systems are not smooth in general, they have regularity properties in some open subset of

given domains with measure zero complement set, and we call such results by partial regularity. In this talk, we are going to study general elliptic systems with nonhomogeneous data and partial regularity of the systems via modified 1-Riesz potential of the given data.

Speaker: Yu-Cheng Zhang (National Central U.)
Title: Toward Semantic Loop Closure in SLAM Systems
Abstract: In this talk, we will provide an introduction to visual SLAM system. Then the semantic object-assisted and the time and spatial sequence comparison approach are proposed to improve the similarity measurement in the SLAM process. By integrating recognized objects like landmarks and signs, we can classify similar scenes better and significantly improve building-scale indoor mapping results.

Speaker: Tong Zhao (Fudan U.)
Title: The Limit of Mixed-Mechanism Interacting Particle System Model
Abstract: Elaborating on the voter process model with mixed-mechanism under suitable scaling by researching the original, I find two new mechanisms, which are random switch and unbiased local Homogenization, and subtly biased advantage but with state dependent coefficient will be involved. Of all these mechanisms, the most crucial one, the high-frequency duplication whose existence identifies the limit equation as SPDE driven by space time white noise generates the diffusion term and noise term in each case, and the most valuable one, the state dependent mechanism credits me with the presentation here.

Speaker: Ruipeng Zhu (Fudan U.)
Title: Homological determinant for skew Calabi-Yau algebras
Abstract: Firstly, I will give the definition of the homological determinant of Hopf actions on (non-graded) skew Calabi-Yau algebras, which coincide with the connected graded case. Secondly, I will introduce some results about the relations between Hopf actions and Nakayama automorphisms, which also can be proved by using homological determinant. Lastly, we summarize some results about the Calabi-Yau property of Ore extensions and smash products, and we will give some applications about how homological determinant impact the Nakayama automorphisms of Ore extensions and smash products.

Day 1 (January 9, Wednesday)

08:30～	Registration	
08:50～09:00	Opening	
	Chair: Motoko Kotani (Tohoku U.)	
09:00～10:00	Kyungbae Park (Seoul National U.)	
10:00～10:30	Tea break	
	Chair: Kunihiro Ito	Chair: Xiaoshan Qin
10:30～10:55	Tsukasa Ishibashi (U. Tokyo)	Zhiyuan Wang (Tsinghua U.)
11:00～11:25	Gihyun Lee (Seoul National U.)	Hsin-Yi Lee (National Central U.)
11:30～11:55	Ruipeng Zhu (Fudan U.)	Mathieu Fevre (Kyoto U.)
12:00～13:30	Lunch break	
	Chair: Seokbeom Yoon	Chair: Ken Sumi
13:30～13:55	Kuan-Hsiang Wang (National U. Kaohsiung)	Youngho Yoon (Seoul National U.)
14:00～14:25	Michiya Mori (U. Tokyo)	Pin-Zhi Lai (National Tsing Hua U.)
14:30～14:55	Zhimin Liu (Fudan U.)	Doheon Kim (Seoul National U.)
15:00～15:30	Tea break	
	Chair: Koichi Komada	Chair: Zhenyu Ming
15:30～15:55	Kuan-Wei Chen (National Chiao Tung U.)	Mizuki Fukuda (Tohoku U.)
16:00～16:25	Sinhwi Kim (Sungkyunkwan U.)	Tong Zhao (Fudan U.)
16:30～16:55	Miyu Suzuki (Kyoto U.)	Jeongho Kim (Seoul National U.)

Day 2 (January 10, Thursday)

	Chair: Tsuyoshi Kato (Kyoto U.)	
09:00～10:00	Shu-Cheng Chang (National Taiwan U.)	
10:00～10:30	Tea break	
	Chair: Tsukasa Ishibashi	Chair: Hsin-Yi Lee
10:30～10:55	Min Wang (Fudan U.)	Wei-Bo Su (National Taiwan U.)
11:00～11:25	Jongrak Lee (Ewha Womans U.)	Masahiro Takeda (Kyoto U.)
11:30～11:55	Yu-Cheng Zhang (National Central U.)	Chuangqiang Hu (Tsinghua U.)
12:00～13:30	Lunch break	
13:30～17:00	Poster session	
15:00～16:00	Committee meeting	
13:30～17:00	Poster session	
Night	Banquet	

Day 3 (January 11, Friday)

	Chair: Yasuyuki Kawahigashi (U. Tokyo)	
09:00～10:00	Engui Fan (Fudan U.)	
10:00～10:30	Tea break	
	Chair: Jongrak Lee	Chair: Zhimin Liu
10:30～10:55	Zhenyu Ming (Tsinghua U.)	Ken Sumi (Kyoto U.)
11:00～11:25	Guan-Yu Lai (National Chiao Tung U.)	Seokbeom Yoon (Seoul National U.)
11:30～11:55	Koichi Komada (Tohoku U.)	Quan Xu (Tsinghua U.)
12:00～13:30	Lunch break	
	Chair: Gihyun Lee	Chair: Kuan-Hsiang Wang
13:30～13:55	Yesom Park (Ewha Womans U.)	Biy-Kuang Day (National Tsing Hua U.)
14:00～14:25	Hsin-Han Tsai (National Taiwan U.)	Hiroki Kato (U. Tokyo)
14:30～14:55	SeungYeon Cho (Sungkyunkwan U.)	Zhangmin Huang (Fudan U.)
15:00～15:30	Tea break	
	Chair: Wei-Bo Su	Chair: Mizuki Fukuda
15:30～15:55	Kunihiro Ito (Tohoku U.)	Yung-Hsiang Huang (National Taiwan U.)
16:00～16:25	Xiaoshan Qin (Fudan U.)	Yeonghun Youn (Seoul National U.)
16:30～16:55	Wei Liu (Thinghua U.)	
17:00～17:10	Closing	