SCHEDULE

May 12, 2025

9:00-9:20	Opening
Morning Session	Chair: Jie Wu
9:20-10:10	**Yongjin Song** (Inha University) *Iterated loop space structures of geometric groups*
10:10-10:30	Tea Break
10:30-11:20	**Nguyen The Cuong** (Vietnam National University) *On the Quillen map for certain Borel constructions*
11:20-11:30	Tea Break
11:0-11:55	**Katsuhiko Kuribayashi** (Shinshu University) *Toward Riemannian diffeology*
	Lunch
Afternoon Session	Chair: Xuezhi Zhao
2:00-2:50	**Ping Li** (Fudan University) *The compactification of topology trivial complex manifolds and Fujita's conjectures*
2:50-3:00	Tea Break
3:00-3:50	**Samik Basu** (Indian Statistical Institute) *Equivariant cohomology of projective spaces*
3:50-4:10	Tea Break
	Chair: Suyoung Choi
4:10-5:00	**Pham Van Tuan** (Vietnam National University) *Some results on the cohomology of the orthogonal and symplectic groups*
5:00-5:10	Tea Break
5:10-5:35	**Mengmeng Zhang** (BIMSA) *Calculating higher digraph homotopy groups*
5:35-6:00	**Seonghyun Yu** (Ajou University) *On the full subcomplexes of Bier spheres and their topological applications*

May 13, 2025

Morning Session	Chair: Yongjin Song
9:15-10:05	**Rongling Wu** (BIMSA) *Graph representation theory of statistics*
10:05-10:25	Tea Break
10:25-11:15	**So Yamagata** (Fukuoka University) *Khovanov-like categorifications of polynomials in matroid theory*
11:15-11:25	Tea Break
11:25-11:50	**Meiyan Kang** (Ajou University) *Topological Data Analysis for robust object detection in GPR data*
	Lunch
Afternoon Session	Chair: Nguyen H.V. Hung
2:00-2:50	**Sergei Ivanov** (BIMSA) *Completions and localizations of groups and spaces*
2:50-3:00	Tea Break
3:00-3:50	**Masaki Kameko** (Shibaura Institute of Technology.) *Coniveau filtrations with* $\mathbb{Z}/2$ *coefficients*
3:50-4:10	Tea Break
	Chair: Daisuke Kishimoto
4:10-5:00	**Yuki Minowa** (Kyoto University) *Parametrized topological complexity of spherical fibrations over spheres*
5:00-5:10	Tea Break
5:10-5:35	**Ngo Anh Tuan** (Vietnam National University) *The Margolis homology of the cohomology restriction from an extra-special group to its maximal elementary abelian subgroups*
5:35-6:00	**Yichen Tong** (West Lake University) *On the fundamental groups and the magnitude-path spectral sequence of a directed graph*
	Banquet

May 14, 2025

Morning Session	Chair: Toshiyuki Miyauchi
9:15-10:05	**Guozhen Wang** (Fudan University) *The Kervaire invariant one problem*
10:05-10:25	Tea Break
10:25-11:15	**Nguyen H.V. Hung** (Vietnam National University) *The Margolis homology of the restriction image from the alternating group to its generic maximal elementary abelian subgroup*
11:15-11:25	Tea Break
11:25-11:50	**Younghan Yoon** (Ajou University) *Cohomology of real Coxeter toric varieties*
	Lunch
	Free afternoon

May 15, 2025

Morning Session	Chair: Zhi Lü
9:15-10:05	**Kyungbae Park** (Kangwon National University) *On lens spaces bounding simple smooth 4-manifolds*
10:05-10:25	Tea Break
10:25-11:15	**Hyungryul Baik** (KAIST) *Reconstruction of 3-manifolds from infinity*
11:15-11:25	Tea Break
11:25-11:50	**Toshiyuki Miyauchi** (Fukuoka University) *Matrix Toda brackets in the EHP sequence*
	Lunch
Afternoon Session	Chair: Nguyen The Cuong
2:00-2:50	**Sho Hasui** (Osaka Metropolitan University) *Homotopy commutativity in quasitoric manifolds*
2:50-3:00	Tea Break
3:00-3:50	**Jongbaek Song** (Pusan National University) *Homotopy rigidity for toric varieties*
3:50-4:10	Tea Break
	Chair: Haibao Duan
4:10-5:00	**Seongjeon Park** (Jeonju University) *Smoothness of the intersection of Schubert varieties and a Hessenberg variety*
5:00-5:10	Tea Break
5:10-5:35	**Shicheng Wang** (Peking University) *Maps between circle bundles over hyperbolic manifolds*
5:35-6:00	**Zhongzi Wang** (Peking University) *Shortest filling geodesics on hyperbolic surfaces*

May 16, 2025

Morning Session	Chair: Hongyu Wang
9:15-10:05	**Daisuke Kishimoto** (Kyushu University) *Vector fields on noncompact manifolds*
10:05-10:25	Tea Break
10:25-11:15	**Soumen Sarkar** (Indian Institute of Technology) *Resolution of singularities of quasitoric orbifolds, equivariant cobordism, and equivariant cohomology of quasi-contact toric manifolds.*
11:15-11:25	Tea Break
11:25-11:50	**Takefumi Nosaka** (Institute of Science Tokyo) *Continuous cocycles of some diffeomorphism groups from Bott-Chern-Simons form*
	Lunch
Afternoon Session	Chair: Samik Basu
2:00-2:50	**Kensuke Arakawa** (Kyoto University) *Monoidal relative categories model monoidal (∞ ,1)-categories*
2:50-3:00	Tea Break
3:00-3:50	**Fengling Li** (Dalian University of Technology) *A three-variable invariant of planar knotoids via Gauss diagrams*
3:50-4:10	Tea Break
	Chair: Jianzhong Pan
4:10-5:00	**Pengcheng Li** (Great Bay University) *Cohomotopy sets of manifolds of small dimension*
5:00-5:10	Tea Break
5:10-5:35	**Shuang Wu** (BIMSA) *Applications of GLMY theory in metabolomic networks of complex diseases*

MONOIDAL RELATIVE CATEGORIES MODEL MONOIDAL $(\infty, 1)$-CATEGORIES

KENSUKE ARAKAWA

Homotopical study of mathematical objects often starts by identifying a subcategory of "weak equivalences" that behave like isomorphisms. In this spirit, *relative categories* offer a minimalistic framework for homotopy theory: They are categories equipped with a designated subcategory of weak equivalences. A remarkable theorem of Barwick and Kan shows that this simple structure in fact models $(\infty, 1)$-categories. More precisely, any relative category $(\mathcal{C}, \mathcal{W})$ gives rise to an $(\infty, 1)$-category $\mathcal{C}[\mathcal{W}^{-1}]$ by localizing at the weak equivalences. This process defines a functor

$$\mathsf{RelCat}[\mathrm{DK}^{-1}] \to \mathcal{C}\mathsf{at}_{(\infty,1)},$$

where DK denotes the subcategory of relative functors that induce equivalences of localizations. Barwick and Kan showed that this functor is an equivalence.

In practice, many relative categories come equipped with a monoidal structure whose tensor product preserves weak equivalences in each variable. In such cases, the localization inherits a monoidal structure. This raises a natural question: Do monoidal relative categories model monoidal $(\infty, 1)$-categories? The author recently proved that the answer is yes, borrowing techniques inspired by Segal's infinite loop space machine. In this talk, we explain the ideas behind the proof, explore some applications, and suggest possible generalizations.

Kyoto University
Email address: `Arakawa.kensuke.22c@st.kyoto-u.ac.jp`

RECONSTRUCTION OF 3-MANIFOLDS FROM INFINITY

HYUNGRYUL BAIK

By work of Thurston, Calegari, Calegari-Dunfield, Fenley, and Frankel-Schleimer-Segerman, it is known that many 3-manifolds naturally have a circle at infinity which is usually referred as universal circle. We show that in many cases, we can reconstruct 3-manifolds from a universal circle. This talk is based on joint work with various subsets of KyeongRo Kim, Hongtaek Jung, Chenxi Wu, Bojun Zhao.

KAIST
Email address: hrbaik85@gmail.com

EQUIVARIANT COHOMOLOGY OF PROJECTIVE SPACES

SAMIK BASU

The homology and cohomology of projective spaces is one of the most important calculations in Algebraic Topology. Usually these feature in the first course in the subject. However, when we allow a group to act, the answer is not quite simple, even when the group is finite. In this talk, I will focus on computations of the equivariant homology and cohomology of projective spaces with integer coefficients. More precisely, in the case of cyclic groups, we show that the cellular filtration of the projective space $P(k\rho)$, of lines inside copies of the regular representation, has free homology and cohomology. This is carried out both in the complex case, and also in the quaternionic case, and further, for the C_2 action on $\mathbb{C}P^n$ by complex conjugation. I will also describe how the cohomology ring may be computed in many cases. Most of these results are joint work with Pinka Dey and Aparajita Karmakar, and some results also feature in joint work with Surojit Ghosh.

INDIAN STATISTICAL INSTITUTE
Email address: samikbasu@isical.ac.in

HOMOTOPY COMMUTATIVITY IN QUASITORIC MANIFOLDS

SHO HASUI

In this talk, we consider the homotopy commutativity of the loop space of a quasitoric manifold, which is defined as a topological analogue of a projective toric manifold. Like the relation between toric varieties and fans, the quasitoric manifolds are in one-to-one correspondence with the (equivalence classes of) pairs (P, λ), where P is a simple polytope and λ is a characteristic matrix on P, an integer matrix satisfying certain non-singular condition with respect to the combinatorial structure of P. We give a necessary and sufficient condition for a quasitoric manifold M to have homotopy commutative loop space in terms of the pair (P, λ) corresponding to M.

Osaka Metropolitan University
Email address: s.hasui@omu.ac.jp

COMPLETIONS AND LOCALISATIONS OF GROUPS AND SPACES

SERGEI IVANOV

This talk will explore the Bousfield-Kan completion of spaces, homology localization of spaces, and the corresponding notions of completion and Bousfield localization for groups. In particular, we will discuss a series of results related to the Bousfield problem concerning the homology of group completions, as well as the phenomenon of rationally bad spaces.

BIMSA
Email address: ivanov.s.o.1986@gmail.com

CONIVEAU FILTRATIONS WITH $\mathbb{Z}/2$ COEFFICIENTS

MASAKI KAMEKO

Let X be a smooth complex variety of dimension m. We say a cohomology class $x \in H^i(X;A)$ with coefficients in an abelian group A has coniveau $\geq c$ if it vanishes outside of a closed subset of codimension $\geq c$. We also say that x has strong coniveau $\geq c$ if it is the Gysin pushforward of a class y on a smooth complex variety Y of dimension $\leq m-c$ through a proper morphism $f\colon Y \to X$. We use these notions to define two filtrations on the cohomology group $H^i(X;A)$. We denote them by $N^cH^i(X;A)$, $\tilde{N}^cH^i(X;A)$, respectively. In general, $\tilde{N}^cH^i(X;A) \subset N^cH^i(X;A)$. The equality $\tilde{N}^cH^i(X;A) = N^cH^i(X;A)$ holds if X is proper and $A=\mathbb{Q}$. Recently, Benoist and Ottem showed that if X is projective and $A=\mathbb{Z}$, the equality does not hold in general. Also, they asked whether the inclusion $\tilde{N}^1H^3(X;\mathbb{Z}/2) \subset N^1H^3(X;\mathbb{Z}/2)$ is strict for a smooth projective complex variety X. We show that the above inclusion is strict.

By Ekedahl's theorem, for a compact Lie group G and a positive integer m, there is a smooth projective complex variety X with m-equivalence $X \to B(G\times S^1)$. To obtain the result, we use the classifying space of the compact Lie group $PU(4)\times S^1$, where $PU(4)$ is the projective unitary group of degree 4, that is, the quotient group of the unitary group $U(4)$ of degree 4 by its center S^1.

Shibaura Institute of Technology
Email address: kameko@shibaura-it.ac.jp

TOPOLOGICAL DATA ANALYSIS FOR ROBUST OBJECT DETECTION IN GPR DATA

MEIYAN KANG

This study explores a novel approach to analyzing Ground Penetrating Radar (GPR) data through the application of Topological Data Analysis (TDA). Although GPR is widely utilized for subsurface investigations, traditional analysis methods often face challenges due to noise and the complex structure of the data. TDA offers a robust mathematical framework for capturing the intrinsic topological features embedded in GPR signals. We present a systematic workflow employing TDA to enhance object detection performance, demonstrating its potential to improve robustness and interpretability in GPR-based subsurface imaging.

AJOU UNIVERSITY
Email address: miyeon@ajou.ac.kr

VECTOR FIELDS ON NONCOMPACT MANIFOLDS

DAISUKE KISHIMOTO

I will talk about joint work with Tsuyoshi Kato and Mitsunobu Tsutaya, in which we establish the Poincaré-Hopf theorem for a noncompact manifold M with a cocompact and properly discontinuous action of a group. Key ingredients are a new way of counting infinitely many discrete points of M and an integral on the bounded cohomology of M, which are given in terms of some quasi-isometry invariant of M.

Kyushu University
Email address: kishimoto.daisuke.275@m.kyushu-u.ac.jp

TOWARD RIEMANNIAN DIFFEOLOGY

KATSUHIKO KURIBAYASHI

Diffeology provides a natural generalization of differential topology and geometry. The de Rham theory and (abstract) homotopy theory have also been developed in the diffeological setting. However, it is hard to say that the development of Riemannian notion for diffeological spaces is sufficient. In this talk, a framework for Riemannian diffeology is introduced. To this end, we use the tangent functor in the sense of Blohmann and one of options of a metric on a diffeological space in the sense of Iglesias-Zemmour. As a consequence, we may deal with Riemannian metrics for a diffeological adjunction space and the space of smooth maps in our framework simultaneously. This talk is based on joint work with Keiichi Sakai and Yusuke Shiobara.

SHINSHU UNIVERSITY
Email address: `kurimath@shinshu-u.ac.jp`

A THREE-VARIABLE INVARIANT OF PLANAR KNOTOIDS VIA GAUSS DIAGRAMS

FENGLING LI

As a generalization of the classical knots, knotoids are equivalence classes of immersions of the oriented unit interval in a surface. In recent years, a variety of invariants of spherical and planar knotoids have been constructed as extensions of invariants of classical and virtual knots. In this talk, we introduce a three-variable transcendental invariant of planar knotoids which is defined over an index function of a Gauss diagram. We describe properties of this invariant and show that it is a Vassiliev invariant of order one. We provide lower bounds on the Gordian distance of homotopic planar knotoids by using the transcendental invariant. This is joint work with Wandi Feng and Andrei Vesnin.

Dalian University of Technology
Email address: `fenglingli@dlut.edu.cn`

COHOMOTOPY SETS OF MANIFOLDS OF SMALL DIMENSION

PENGCHENG LI

The n-th cohomotopy set of a CW-complex X is the set $\pi^n(X)$ of homotopy classes of based maps from X to the n-sphere S^n. Unlike the homotopy groups, Cohomotopy sets are much less studied but they have important uses. In particular, they are related to framed bordism and higher gauge fields in M-theory. The cohomotopy sets of 4-manifolds were worked out simultaneously by Taylor and Kirby-Melvin-Teichner in 2012. In this talk, we will discuss basic analysis methods and recent progress on the cohomotopy sets of 5-, 6-, and 7-dimensional manifolds, assuming their integral homology groups contains no 2-torsion.

Great Bay University
Email address: lipcaty@outlook.com

THE COMPACTIFICATION OF TOPOLOGY TRIVIAL COMPLEX MANIFOLDS AND FUJITA'S CONJECTURES

PING LI

Two problems in Hirzebruch's 1954 Problem List are concerned with the compactification of complex Euclidean spaces and the uniqueness of complex projective spaces. Takao Fujita proposed in 1980 three closely related conjectures strengthening the two above problems. In this talk we will review the related history and some recent progress.

Fudan University
E-mail address: pinglimath@fudan.edu.cn

PARAMETRIZED TOPOLOGICAL COMPLEXITY OF SPHERICAL FIBRATIONS OVER SPHERES

YUKI MINOWA

Parametrized topological complexity is a numerical homotopy invariant of a fibration, which arose in the robot motion planning problem with external constraints. I will talk about the parametrized topological complexity of spherical fibrations over spheres. I will present a lower bound given by the weak category of a certain space. Then I will talk about the determination of the parametrized topological complexity of certain fibrations, especially the unit tangent bundle of even dimensional spheres.

KYOTO UNIVERSITY
Email address: minowa.yuki.48z@st.kyoto-u.ac.jp

MATRIX TODA BRACKETS IN THE EHP SEQUENCE

TOSHIYUKI MIYAUCHI

H. Toda introduced the Toda bracket, a tool for computing the homotopy groups of spheres. In particular, the Toda bracket indexed by n is important in calculating the unstable homotopy groups of spheres using the EHP sequence. The matrix Toda bracket is a generalization of the Toda bracket introduced by M. G. Barratt. J. Yang, T. Miyauchi and J. Mukai (2024) defined the matrix Toda bracket indexed by n and obtained some relations between the matrix Toda bracket indexed by n and the EHP sequence. On the other hand, T. Miyauchi and J. Mukai (2017) introduced a definition different from the matrix Toda bracket indexed by n than that defined by Yang-Miyauchi-Mukai, and determined the 2-primary components of the 32-stem homotopy groups of spheres. The matrix Toda bracket indexed by n in these two definitions is different. In this talk, I will explain some properties of the matrix Toda bracket indexed by n defined by Miyauchi-Mukai and its relationship with the EHP sequence.

Fukuoka University
Email address: `tmiyauchi@fukuoka-u.ac.jp`

THE MARGOLIS HOMOLOGY OF THE COHOMOLOGY RESTRICTION FROM AN EXTRA-SPECIAL GROUP TO ITS MAXIMAL ELEMENTARY ABELIAN SUBGROUPS

NGÔ A. TUẤN

Let p be an odd prime and let M_n be the extra-special p-group of order $p^{2n+1} (n \geq 1)$ and exponent p^2. We completely compute the mod p Margolis homology of the image $ImRes(A, M_n)$ for every maximal elementary abelian p-subgroup A of M_n.

VIETNAM NATIONAL UNIVERSITY
Email address: ngoanhtuan@vnu.edu.vn

THE MARGOLIS HOMOLOGY OF THE RESTRICTION IMAGE FROM THE ALTERNATING GROUP TO ITS GENERIC MAXIMAL ELEMENTARY ABELIAN SUBGROUP

NGUYEN H. V. HUNG

For p an odd prime, let $E^n = (\mathbb{Z}/p)^n$ act on itself by translations to define an embedding as a subgroup of the alternating group A_{p^n} on p^n letters. We compute the mod p homology of the image of the restriction $Res(A_{p^n}, E^n) : H^*(A_{p^n}; \mathbb{F}_p) \to H^*(E^n; \mathbb{F}_p)$ with differential given by the Milnor operation Q_j, for every n and j. In doing so, we disprove an analogue of Pengelley-Sinha's conjecture for symmetric groups by constructing critical elements in this Margolis homology. The Margolis homology of $\mathrm{Im}Res(A_{p^n}, E^n)$ is non-zero in both even and odd degrees, unlike the case of similar restriction maps for symmetric groups, which are concentrated in even degrees. Our calculation is a necessary step in calculating Margolis homology of alternating groups, which in turn plays a key role in our broader program to understand Morava K-theory of alternating groups.

Vietnam National University
Email address: nhvhung@gmail.com

ON THE QUILLEN MAP FOR CERTAIN BOREL CONSTRUCTIONS

NGUYEN T. CUONG

It is well-known that the cohomology of a Lie group is isomorphic to the cohomology of its unique maximal Torus. Applying this idea to study the cohomology of finite groups over the prime field $\mathbb{F}_p$, Quillen considered the category of elementary abelian p-subgroups and conjugation maps. Restriction maps on cohomology induce the Quillen map from the cohomology of a finite group to the limit of the cohomology of its elementary abelian p-subgroups. After the famous result of Quillen's, the kernel and cokernel of this map consists of nilpotent elements. Such a map is called an F-isomorphism. The cohomology of elementary abelian p-groups is nice and well-understood and therefore can help to investigate the cohomology of finite groups. When the Quillen map is injective, we say that the cohomology of the finite group is detected by the cohomology of elementary abelian p-groups. It is also important to know when the Quillen maps are isomorphisms. Lannes observed that the Quillen map is actually a map of unstable modules over the Steenrod algebra. Using techniques in the category of unstable modules, Gunawardena - Lannes - Zarati showed that the mod 2 Quillen map for symmetric groups are isomorphisms. Recently, Lannes extends the result to alternating groups and finite coxeter groups. Following Lannes's suggestion, we study the cohomology of certain Borel constructions. The main result that we will discuss in this talk is that if the Quilen map for a finite group is an isomorphism then the Quillen map for the corresponding Borel construction is also an isomorphism.

Vietnam National University
Email address: thecuong.nguyen@vnu.edu.vn

CONTINUOUS COCYCLES OF SOME DIFFEOMORPHISM GROUPS FROM BOTT-CHERN-SIMONS FORM

TAKEFUMI NOSAKA

The topology of gauge groups and of diffeomorphism groups of manifolds has been studied from many approaches with several motivations and applications. In this talk, we focus on the continuous group cohomology of such groups, and study Bott's construction of continuous cocycles of the groups in some strong conditions. The idea of the construction is to regard the higher transgressions of the Chern-Simons forms. I will present some non-trivialcocycles of some groups, and discuss some relations to Bott-Thurston cocycles and recent works of Nariman, Galatius and Randal-Williams.

Institute of Science Tokyo
Email address: nosaka@math.titech.ac.jp

ON LENS SPACES BOUNDING SIMPLE SMOOTH 4-MANIFOLDS

KYUNGBAE PARK

It is well known that every 3-manifold bounds a smooth 4-manifold. In this talk, we address the question of which 3-manifolds can bound 4-manifolds under certain topological conditions. In particular, we study which lens spaces can bound smooth 4-manifolds with second Betti number one. Specifically, we show that there exist infinite families of lens spaces that bound compact, simply connected, smooth 4-manifolds with second Betti number one, yet do not bound any 4-manifold consisting of a single 0-handle and 2-handle. Moreover, we establish the existence of infinite families of lens spaces that bound compact, smooth 4-manifolds with first Betti number zero and second Betti number one, but do not bound simply-connected 4-manifolds with second Betti number one. The construction of such 4-manifolds with lens space boundaries is motivated by the study of rational homology projective planes with cyclic quotient singularities. This is joint work with Woohyeok Jo and Jongil Park.

KANGWON NATIONAL UNIVERSITY
Email address: kyungbaepark@kangwon.ac.kr

SMOOTHNESS OF THE INTERSECTION OF SCHUBERT VARIETIES AND A HESSENBERG VARIETY

SEONJEONG PARK

Hessenberg varieties, first studied by De Mari, Procesi, and Shayman, are subvarieties of the full flag variety defined in terms of a Hessenberg function h and a linear transformation X. In this talk, we focus on the Hessenberg variety $\mathrm{Hess}(S, h)$ determined by a regular semisimple linear transformation S. A *Hessenberg Schubert variety* $\Omega_{w,h}$ is defined as the closure of an (opposite) Schubert cell Ω_w° inside the regular semisimple Hessenberg variety $\mathrm{Hess}(S, h)$ of type A. In general, the Hessenberg Schubert variety $\Omega_{w,h}$ is distinct from the intersection $\Omega_w \cap \mathrm{Hess}(S, h)$, and in fact, it appears as an irreducible component of this intersection. As a consequence, if $\Omega_w \cap \mathrm{Hess}(S, h)$ is smooth, then $\Omega_{w,h}$ is also smooth. Since $\Omega_w \cap \mathrm{Hess}(S, h)$ is a GKM space with respect to the natural torus action, we can associate to it a graph $\Gamma_{w,h}$. We first show that $\Omega_w \cap \mathrm{Hess}(S, h)$ is smooth if and only if the graph $\Gamma_{w,h}$ is regular. This, in turn, implies that the Hessenberg Schubert variety $\Omega_{w,h}$ is smooth whenever $\Gamma_{w,h}$ is regular. Finally, we discuss how these results can be generalized to other T-varieties. This talk is based on joint work with Jaehyun Hong and Eunjeong Lee.

JEONJU UNIVERSITY
Email address: seonjeongpark@jj.ac.kr

SOME RESULTS ON THE COHOMOLOGY OF THE ORTHOGONAL AND SYMPLECTIC GROUPS

VAN TUAN PHAM

Let $\mathbb{k}$ be a field of positive characteristic p. In this talk, we discuss the rational cohomology of the orthogonal group scheme $\mathrm{O}_{n,n}$ and the symplectic group scheme Sp_n with coefficients in polynomial algebra

$$S^*\left(\left(\left(\mathbb{k}^{2n\vee}\right)^{(r)}\right)^{\oplus \ell}\right).$$

Here $\left(\left(\mathbb{k}^{2n\vee}\right)^{(r)}\right)^{\oplus \ell}$ (for simplicity, we write $\mathbb{k}^{2n\vee(r)\oplus\ell}$) is the direct sum of ℓ copies of r-th Frobenius twist of dual linear of $\mathbb{k}$-vector space $\mathbb{k}^{2n}$ and

$$S^*\left(\mathbb{k}^{2n\vee(r)\oplus\ell}\right) = \bigoplus_{d=0}^{\infty} S^d\left(\mathbb{k}^{2n\vee(r)\oplus\ell}\right)$$

is polynomial algebra on $\mathbb{k}$-vector space $\mathbb{k}^{2n\vee(r)\oplus\ell}$. The main result of this presentation is a cohomological version of the first fundamental theorem of invariant theory for orthogonal and symplectic groups.

Vietnam National University
Email address: phamvantuan1987@vnu.edu.vn

RESOLUTION OF SINGULARITIES OF QUASITORIC ORBIFOLDS, EQUIVARIANT COBORDISM, AND EQUIVARIANT COHOMOLOGY OF QUASI-CONTACT TORIC MANIFOLDS

SOUMEN SARKAR

In this talk, I'll show that there is a resolution of singularities of a quasitoric orbifold. Then I'll prove that a quasi-contact toric manifold is equivariantly a boundary. This result implies that good contact toric manifolds and generalized lens spaces are equivariantly boundaries. Then I'll compute the equivariant cohomology ring of quasi-contact toric manifolds.

Indian Institute of Technology
Email address: soumen@iitm.ac.in

HOMOTOPY RIGIDITY FOR TORIC VARIETIES

JONGBAEK SONG

The standard formulation of the cohomological rigidity problem in toric topology asks whether the homeomorphism or diffeomorphism types of smooth toric varieties are determined by their integral cohomology rings. While no counterexamples are known, many affirmative results have been established. In fact, since the cohomology ring is a homotopy invariant, it is much natural to ask the classification up to homotopy equivalences, rather than homeomorphism types. In this talk, we introduce several partial answers to this question for certain toric varieties. This is based on joint works with X. Fu, T. So, and S. Theriault.

Pusan National University
Email address: jongbaek.song@gmail.com

ITERATED LOOP SPACE STRUCTURES OF GEOMETRIC GROUPS

YONGJIN SONG

The disjoint union of some geometric groups gives rise to an iterated loop space. Braid groups give rise to a double loop space. Mapping class groups give rise to infinite loop space. The iterated loop space structures of these groups play a key role in the proof of (generalized) Harer conjecture. There are two routes in the iterated loop space theory. One is through category theory and another one is through operad theory.

It has been known for many years that BB_∞^+ is homotopy equivalent to $\Omega^2 S^2$. From this we can induce the fact that any double loop space map from the plus construction of classifying space of infinite braid group to any other double loop space is homotopically trivial if it induces zero homology homomorphism in the degree 1.

Inha University
Email address: `yjsong@inha.ac.kr`

ON THE FUNDAMENTAL GROUPS AND THE MAGNITUDE-PATH SPECTRAL SEQUENCE OF A DIRECTED GRAPH

YICHEN TONG

Directed graphs are crucial combinatorial objects and are of great interest in both pure and applied mathematics. In particular, methods from algebraic topology, especially homotopy theory, have been introduced to study (directed) graphs. The fundamental group and the path homology of a directed graph are introduced by Grigor'yan, Lin, Muranov, and Yau, and is related through the Hurewicz theorem. Later, Di, Ivanov, Mukoseev, and Zhang showed that the fundamental group admits a natural sequence of quotient groups called r-fundamental groups, which captures the quasi-metric structure of a directed graph that the fundamental group cannot capture. On the other hand, the magnitude-path spectral sequence connects magnitude homology and path homology of a directed graph due to Asao, and it may be thought as a sequence of homology of a directed graph. In this talk, we study relations of the r-fundamental groups and the magnitude-path spectral sequence through the Hurewicz theorem and the Seifert-van Kampen theorem.

This is joint work with Daisuke Kishimoto.

West Lake University
Email address: tongyichen@westlake.edu.cn

THE KERVAIRE INVARIANT ONE PROBLEM

GUOZHEN WANG

The Kervaire invariant is the analogue of the signature of 4k-manifolds for (4k+2)-manifolds. It palys an important role in the classification of homotopy spheres. Browder's work shows that the Kervaire invariant, viewed as a framed cobordism invariant, is detected by the h_i^2 classes in the Adams spectral sequence. It is a longstanding problem for which dimensions there exists framed manifolds with Kervaire invariant 1. We will give a brief review of the construction of the Kervaire invariant one classes for $i < 6$ and Hill-Hopkins-Ravenel's theorem that they do not exist for $i > 6$. We will present our recent work on the existance of Kervaire classes for $i = 6$ in dimension 126. This is joint work with Weinan Lin and Zhouli Xu.

Fudan University
E-mail address: wangguozhen@fudan.edu.cn

MAPS BETWEEN CIRCLE BUNDLES OVER HYPERBOLIC MANIFOLDS

SHICHENG WANG

Let E_i be an oriented circle bundle over a closed oriented aspherical n-manifold M_i with Euler class e_i. We prove that the mapping degree set $D(E_1, E_2)$ is finite if M_2 is hyperbolic and e_2 is not torsion.

Peking University
E-mail address: `wangsc@math.pku.edu.cn`

SHORTEST FILLING GEODESICS ON HYPERBOLIC SURFACES

ZHONGZI WANG

We obtain the minimal length of a filling (multi-)geodesic on a genus g hyperbolic surface in the moduli space of hyperbolic surfaces and show that it is realized by the geodesic whose complement is a right-angled regular $(8g-4)$-gon. A single geodesic realizing this minimum is also provided. This is a joint work with Yue Gao and Jiajun Wang.

Peking University
E-mail address: wangzz22@stu.pku.edu.cn

GRAPH REPRESENTATION THEORY OF STATISTICS

RONGLING WU

We live in an era of big data, where everyone can access a steam of data as scientific treasures at their fingertips. Traditional statistics has been instrumental for manipulating experimental data that are collected under a priori assumptions at a limited dimension, but it can hardly meet the need of big data analysis. Big data often emerge as dynamic graphs or networks in which nodes are linked in a nonlinear, stochastic manner, with the directionality, sign and weight of links determining the networks as a cohesive whole. In this talk, I will be presenting a new norm of statistical thinking, which combines evolutionary game theory, ecological niche theory and graph theory through quasi-dynamic modeling, to create a graph representation theory of statistics. This theory could leverage statistics to better predict the future and transform big data into practical values.

BIMSA
E-mail address: ronglingwu@bimsa.cn

APPLICATIONS OF GLMY THEORY IN METABOLOMIC NETWORKS OF COMPLEX DISEASES

SHUANG WU

Human diseases involve metabolic alterations. Metabolomic profiles have served as a biomarker for the early identification of high-risk individuals and disease prevention. However, current approaches can only characterize individual key metabolites, without taking into account their interactions.This work have leveraged a statistical physics model to combine all metabolites into bDSW networks and implement GLMY homology theory to analyze and interpret the topological change of health state from symbiosis to dysbiosis.The application of this model to real data allows us to identify several hub metabolites and their interaction webs, which play a part in the formation of inflammatory bowel diseases.

BIMSA

E-mail address: shuangwu@bimsa.cn

KHOVANOV-LIKE CATEGORIFICATIONS OF POLYNOMIALS IN MATROID THEORY

SO YAMAGATA

Khovanov introduced a bigraded cohomology theory of links, whose graded Euler characteristic is the Jones polynomial. Analogously, several constructions of the Khovanov-type (co)homology theories have been provided beyond the knot theory, such as the chromatic cohomology of graphs and the characteristic homology of hyperplane arrangements. A matroid is a structure that reflects the notion of abstract dependency, including cycles in graphs and linear dependency of vectors. In particular, we can obtain matroids from both graphs and arrangements of hyperplanes. In this talk, we provide (co)homology groups of the characteristic polynomial of matroids as a generalization of the chromatic cohomology and characteristic homology of hyperplane arrangements. If I have time, I would also like to introduce the categorification of the Tutte polynomial and the weak Reidemeister moves in the regular matroid. This talk is based on the joint work with Takuya Saito.

Fukuoka University
E-mail address: so.yamagata@fukuoka-u.ac.jp

COHOMOLOGY OF REAL COXETER TORIC VARIETIES

YOUNGHAN YOON

One approach to understanding Weyl groups is through the study of the associated real Coxeter toric varieties. In this talk, we discuss the rational cohomology of these varieties, including known computations of their Betti numbers. Furthermore, we describe the multiplicative structures of the cohomology rings, focusing in particular on types A and B.

AJOU UNIVERSITY
Email address: younghan300@ajou.ac.kr

ON THE FULL SUBCOMPLEXES OF BIER SPHERES AND THEIR TOPOLOGICAL APPLICATIONS

SEONGHYUN YU

A Bier sphere is a simplicial sphere, introduced by Tomas Bier in 1992, obtained as the deleted join of a simplicial complex and its (combinatorial) Alexander dual. Full subcomplexes of a simplicial complex are important in the study of related topological invariants, for instance, in the context of Hochster's formula. In this talk, we determine the topological types of full subcomplexes of Bier spheres, and compute associated topological invariants, such as Betti numbers, as applications.

AJOU UNIVERSITY
Email address: yoosh0319@ajou.ac.kr

CALCULATING HIGHER DIGRAPH HOMOTOPY GROUPS

MENGMENG ZHANG

In 2014, Grigor'yan, Lin, Muranov and Yau introduced the homotopy theory of digraphs and defined the digraph homotopy groups by taking the fundamental group of the (n-1)-fold iterated based loop digraph. Then inspired by the cubical approach to defining the higher homotopy groups of a based space, a more direct approach to defining higher digraph homotopy groups, which exhibit properties similar to those of the homotopy groups of based topological spaces, was given. At this point two questions naturally arise. Is there a digraph whose higher homotopy group is nontrivial? What other properties of higher homotopy groups for topological spaces have digraph analogues? The purpose of this paper is to address these questions. This is joint work with Stephen Theriault, Jie Wu, and Shing-Tung Yau.

BIMSA
E-mail address: `mengmengzhang@bimsa.cn`