TITLES AND ABSTRACTS

Takuro Abe (Kyushu University)
Title: *B-sequences of the logarithmic modules*
Abstract: Terao's polynomial B has been played an important role in the research of logarithmic derivation modules of hyperplane arrangements. In this talk we generalize this polynomial B-theory to higher order derivations and logarithmic differential forms, whose structures were not known unless the arrangement is free. As applications we prove the structure theorem for higher order logarithmic modules close to free, compute Solomon-Terao polynomials.

Yasuhiko Asao (Fukuoka University)
Title: *Introduction to magnitude homology*
Abstract: Magnitude of metric spaces defined by Leinster is an analogue of Euler characteristic of topological spaces. Actually, it contains Euler characteristic of simplicial complexes as a special case. As Euler characteristic is categorified by homology in the sense of Khovanov, magnitude is categorified by magnitude homology defined by Hepworth-Willerton. For example, the Poincare polynomial of hyperplane arrangements can be seen as a kind of magnitude, hence it has a categorification by magnitude homology. In this talk, we give a short introduction to this theory and explain a relation to path homology theory developed by Grigor'yan-Muranov-Lin-S.-T. Yau et al.

Michael Cuntz (Leibniz University Hannover)
Title: *Grassmannians over rings and subpolygons*
Abstract: We investigate special points on the Grassmannian which correspond to friezes with coefficients in the case of rank two. Using representations of arithmetic matroids we obtain a theorem on subpolygons of specializations of the coordinate ring. As a special case we recover the characterization of subpolygons in classic frieze patterns. Moreover, we observe that specializing clusters of the coordinate ring of the Grassmannian to units yields representations that may be interpreted as arrangements of hyperplanes with notable properties. In particular, we get an interpretation of certain Weyl groups and groupoids as generalized frieze patterns.

Daniele Faenzi (Université de Bourgogne)
Title: *Logarithmic vector fields and projective duality with applications to discriminants*
Abstract: To a hypersurface D of projective space one can attach the sheaf $T\langle D\rangle$ of logarithmic vector fields along D. This sheaf plays an important role in singularities and arrangements. I will discuss the interplay between $T\langle D\rangle$ and the projective dual of D and deduce some properties of the graded module of section of $T\langle D\rangle$ via Kempf-Lascoux-Weyman resolutions, with special attention to discriminants of adjoint orbits for classical groups. This is a report on work in progress with S. Marchesi and V. Benedetti.

Benoît Guerville (RIMS Kyoto University)
Title: *Combinatorial study of the moduli space of line arrangements*
Abstract: In their study of the moduli space of line arrangements with 8 lines, Nazir and Yoshinaga introduced the combinatorial-class of inductively connected arrangement. These arrangements verify a combinatorial properties which induces that their moduli spaces are Zariski-open subsets of irreducible algebraic varieties. Pushing their concept a step further, we will show how to obtain an upper-bound of the number of irreducible components of the moduli space of a given line arrangement. This process will also

produce an upper-bound of the dimension of the moduli space. Such a combinatorial approach will be useful to efficiently compute the moduli space.

Akihiro Hashimoto (Kyushu University)
Title: *Projective dimensions of graphic arrangements*
Abstract: An arrangement of hyperplanes is a finite set of codimension-one vector subspaces in a vector space. It has been studied by algebraic, algebraically geometric, and combinatorial methods. What I am mainly interested in is the algebraic side of hyperplane arrangements, especially the logarithmic derivation module of an arrangement. There are a lot of problems about it.

In my talk, I would like to introduce the research related to projective dimensions of the logarithmic derivation module of graphic arrangements. About projective-dimension-zero, a lot of studies that are mainly about Terao's addition-deletion theorem have been done for decades, but about projective-dimension-one or more, there are few studies about it. The main purpose of my lecture is to share the results.

Table of contents 1. An introduction to graph theory and hyperplane arrangements 2. SPOG graphs 3. Graphic arrangements of projective dimension two or more

Akihiro Higashitani (Osaka University)
Title: *Period collapse in characteristic quasi-polynomials of non-central hyperplane arrangements*
Abstract: The notion of characteristic quasi-polynomials was introduced by Kamiya-Takemura-Terao in 2011 for non-central integral hyperplane arrangements. One of central topics concerning with characteristic quasi-polynomials is the problem when period collapse happens, i.e., when the minimum period is strictly less than the lcm period. In this talk, we show that any period collapse can happen. More precisely, we prove that for any positive integers s and p such that s divides p, there exists a non-central hyperplane arrangement whose characteristic quasi-polynomial has the minimum period s and the lcm period p. This talk is based on the joint work with Tan Nhat Tran and Masahiko Yoshinaga.

Shizuo Kaji (Kyushu University)
Title: *Modelling preference with hyperplane arrangement*
Abstract: Modelling preference data collected from many individuals with various tastes is a subject of preference learning. A person's preference on a set of options, such as political parties and film genres, can be modelled by a (partial) order on the set. There are two major approaches to modelling preference data; based on the distance between orders and based on a utility function defined over the set of options. These approaches lack flexibility (or are biased) since too much structure is forced on the preference data to be modelled by the mathematical structure that the models utilise. Instead, we rely on a geometric entity, hyperplane arrangement, to model preference data. Given n points in the Euclidean ball, we have an arrangement of n(n-1)/2 equidistant planes. This defines a probability distribution on the symmetric group S_n, where the probability of a permutation(=ranking) is proportional to the volume of the compartment corresponding to it. For ranking data given in the form of the histogram over S_n, we construct an algorithm to find the coordinates of n points so that the resulting probability distribution fits well with the data. The geometric and combinatorial structure of hyperplane arrangement provides a good balance of flexibility and regularisation. This is joint work with T. Abe, A. Horiguchi, and Y. Watanabe.

Lukas Kühne (University of Bielefeld)
Title: *On connected subgraph arrangements*
Abstract: In this talk I will discuss arrangements of hyperplanes whose normal vectors are given by connected subgraphs of a fixed graph. These include the resonance arrangement and certain ideal subarrangements of Weyl arrangements. We characterize

those which are free, simplicial, factored, or supersolvable. In particular, such an arrangement is free if and only if the graph is a cycle, a path, an almost path, or a path with a triangle attached to it.

Based on joint work with Michael Cuntz.

Paul Mücksch (Kyushu University)
Title: *Modular flats of oriented matroids and poset quasi-fibrations*
Abstract: A central result in the topology of complex hyperplane arrangements, due to Falk, Randell and Terao, states that supersolvability of their intersection lattice implies that their complements are $K(\pi, 1)$-spaces.

The homotopy type of the complement of a complexified real hyperplane arrangement can be modeled by a nice regular CW-complex introduced by Salvetti. The Salvetti complex can be constructed for any oriented matroid – a combinatorial abstraction of a real hyperplane arrangement.

In my talk, I will present a novel combinatorial way to prove that supersolvability of the geometric lattice of an oriented matroid implies the asphericity of its Salvetti complex. In particular, this extends Falk, Randell and Terao's result to non-realizable oriented matroids.

Norihiro Nakashima (Nagoya Institute of Technology)
Title: *A condition for the extended Shi arrangements of type A to be hereditarily free*
Abstract: In this talk, we prove that the cone of the extended Shi arrangement of type A is hereditarily free if and only if the dimension is less than six. For this purpose, we define a class of arrangements which contains the extended Shi arrangements of type A, using digraphs. We also show that this class is closed under the restriction by defining a contraction of the digraph that is different from the usual one. This is joint work with Shuhei Tsujie.

Yasuhide Numata (Hokkaido University)
Title: *On regions of Shi and Ish hyperplane arrangement of type B*
Abstract: We consider Shi and Ish hyperplane arrangement of type B_n. We introduce combinatoral objects which parametrize regions of Shi arrangement of type B. We also introduce combinatorial objects which parametrize regions of Ish arrengement of type B. In this talk we discuss the counting problem of these combinatorial objects. This talk is based on the joint work with Tsujie and Yazawa.

Kyoji Saito (RIMS Kyoto University)
Title: *TBA*
Abstract: TBA

Yuuki Shiraishi (Osaka University)
Title: *A Frobenius manifold for l-Kronecker quiver*
Abstract: This talk is based on the joint work with A. Ikeda (Josai), T. Otani (Osaka) and A. Takahashi (Osaka). A Frobenius manifold is, roughly speaking, a complex manifold whose tangent sheaf can be regarded as a family of commutative Frobenius algebras such that their ring structures and compatible symmetric non-degenerate bilinear forms become flat and so on. I will explain how to make this structure from the Weyl group invariant theory associated to ℓ-Kronecker quiver $K(\ell)$ and its relation to the space of stability conditions for the derived category of the path algebra for $K(\ell)$.

Avi Steiner (University of Mannheim)
Title: *"Symmetrizing" logarithmic derivations with respect to matroid duality*
Abstract: Of interest to people who study both hyperplane arrangements and commutative algebra are the homological properties of the module of logarithmic derivations of a hyperplane arrangement A. I will introduce the "ideal of pairs", which is a sort of "symmetrization" of this module of logarithmic derivations with respect to matroid duality. This is an ideal which simultaneously "sees" many of the homological properties of both the arrangement and its dual.

Sakumi Sugawara (Hokkaido University)
Title: *Double coverings and integral local system cohomology of arrangements*
Abstract: It is a central question in the topology of hyperplane arrangements whether several topological invariants are combinatorially determined, for example, the rank of twisted cohomology groups of the complement, and the torsions in the homology of Milnor fibers or covering spaces. In this talk, we give a formula on the 2-torsion of double coverings, which refines the formula conjectured by Papadima-Suciu. We also discuss the recent study on integral local system cohomology groups of arrangements. This is partially joint work with Suguru Ishibashi (ARISE analytics, inc.) and Masahiko Yoshinaga (Osaka University).

Zixuan Wang (Osaka University)
Title: *On Free Deformations of Graphic Arrangements and Free Coxeter Multiarrangements*
Abstract: Graphic arrangements can be thought of as the subarrangements of Coxeter arrangements of type A. It is well known that Coxeter arrangements are free. Some researchers classify the free graphic arrangements, and give the graphical interpretation of the exponents of free graphic arrangements. We are interested in the free deformations of graphic arrangements. We consider the subarrangements Shi(G) of Shi arrangements associated with a graph G.

Studying the freeness of multiarrangements is a great way to study freeness of hyperplane arrangements. Many researchers try to classify the free Coxeter multiarrangements. It is a hard work. Even the free multiplicities of Coxeter arrangements of type A have not been solved. I will introduce some free Coxeter multiarrangements and their multiderivations.

So Yamagata (Fukuoka University)
Title: *A classificaion of combinatorial types of discriminantal arrangements*
Abstract: Manin and Schechtman introduced a family of arrangements of hyperplanes generalizing classical braid arrangements, which they called the discriminantal arrangements. Athanasiadis proved a conjecture by Bayer and Brandt providing a full description of the combinatorics of discriminantal arrangements in the case of very generic arrangements. Libgober and Settepanella described a sufficient geometric condition for given arrangements to be non very generic in terms of the notion of dependency for a certain arrangement. Settepanella and the author generalized the notion of dependency introducing r-sets and K_T-vector sets, and provided a sufficient condition for non very genericity but still not convenient to verify by hand. In this talk, I give a classification of the r-sets, and a more explicit and tractable condition for non very genericity.

Toru Yamaguchi (Kyushu University)
Title: *Free path of hyperplane arrangement*
Abstract: A hyperplane arrangement is a finite set of hyperplanes in a vector space, and a hyperplane arrangement such that its logarithmic derivation module is a free module is especially called a free arrangement.

In free arrangements, the arrangement in which one hyperplane is deleted from a free have been well studied, and much has been shown about their structure. On the other hand, the arrangement in which some hyperplanes are deleted from free has not been well studied.

In this talk, I will introduce a conjecture by Lukas Kühne about a path to delete some hyperplanes to preserve the free, which will help in such research, and give a proof.

Masahiko Yoshinaga (Osaka University)
Title: *TBA*
Abstract: TBA