# WORKSHOP ABSTRACT

### Tensor decomposition and hyperplane arrangements

Alexandru Dimca
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*Abstract:* In this talk we give information on symmetric tensors in $n$ variables of Waring rank $n + 1$.

### Hypertoric varieties and hyperplane arrangements

Takahiro Nagaoka
Kyoto University,
Kyoto, Japan

*Abstract:* Hypertoric varieties are algebraic varieties, defined as an analogue of toric varieties. As the geometric properties of (projective) toric varieties can be studied by the associated polytopes, hypertoric varieties can be studied by its associated hyperplane arrangements. In this talk, I will introduce hypertoric varieties with examples and pictures. Then, I will discuss the classification of singularities of affine hypertoric varieties and counting its good resolutions in terms of associated hyperplane arrangements.

**A basis of the cohomology ring of a regular nilpotent Hessenberg variety**

Tatsuya Horiguchi

Osaka University,
Osaka, Japan

*Abstract:* Hessenberg varieties are subvarieties of a full flag variety. This subject lies at the intersection of, and makes connections between, many research areas such as algebraic geometry and topology, representation theory, and combinatorics. In particular, the cohomology ring of a regular nilpotent Hessenberg variety can be described by the logarithmic derivation module of the ideal arrangement. In this talk, I would like to explain a basis of the cohomology ring of a regular nilpotent Hessenberg variety in terms of the root system in type A. This is joint work with Makoto Enokizono, Takahiro Nagaoka, Akiyoshi Tsuchiya.

**A combinatorial description of the exponents of $\mathbf{A_1^2}$ restrictions of Weyl arrangements**

Tan Nhat Tran

Hokkaido University
Sapporo, Japan

*Abstract:* Let $\mathcal{A}$ be a Weyl arrangement in an $\ell$-dimensional Euclidean space. Using a case-by-case argument, Orlik-Terao (1993) proved that any restriction of $\mathcal{A}$ is free. Prior to this, Orlik-Solomon (1983) had completely determined the exponents of these arrangements by exhaustion. However, describing theoretically their exponents is still a difficult task. A classical result, due to Orlik-Solomon-Terao (1986), asserts that the exponents of any $A_1$ restriction i.e., the restriction of $\mathcal{A}$ to a hyperplane, are given by $\{m_1, \ldots, m_{\ell-1}\}$, where $\exp(\mathcal{A}) = \{m_1, \ldots, m_\ell\}$ with $m_1 \leq \ldots \leq m_\ell$. As a next step after Orlik-Solomon-Terao towards understanding the exponents of restrictions, we are especially doing the investigation on the $A_1^2$ restrictions i.e., the restrictions of $\mathcal{A}$ to subspaces $X$ of the type $A_1^2$. In this talk, we will present a description of the exponents of such restrictions in terms of the classical notion of related roots by Kostant (1955). This is a joint work with Takuro Abe and Hiroaki Terao.

**Takuro Abe: Combinatorics of the addition-deletion theorems for free arrangements**

Takuro Abe

Institute of Mathematics for Industry
Kyushu University
Kyushu, Japan

*Abstract:* The most useful result to check/prove the freeness of arrangements is Terao's addition-deletion theorem. We show that this is combinatorial. Namely, if you are given an arrangement and its addition/deletion, then whether they are free or not depends only on the intersection lattice. Based on them, we introduce two classes of free arrangements called the divisionally and additionally free arrangements in which Terao's conjecture is true.

**Coboundary polynomials of Coxeter arrangements and Catalan arrangements**

Norihiro Nakashima

Nagoya Institute of Technology
Nagoya, Japan

*Abstract:* The Tutte polynomial gives us many interesting information of graphs and hyperplane arrangements. In particular the characteristic polynomial can be computed by this polynomial. Crapo introduced the coboundary polynomial for a matroid, which is essentially equivalent to the Tutte polynomial. Also the Hamming weight enumerator for the matroid of an error correcting code is transformed from the coboundary polynomial. In this talk I present a computation of coboundary polynomials for the matroids of Coxeter arrangements and Catalan arrangements. This is join work with S. Tsujie.

**Double coverings of arrangement complements and 2-torsion in Milnor fiber homology**

Masahiko Yoshinaga

Hokkaido university,
Sapporo, Japan

*Abstract:* We prove that mod 2 Betti numbers of double coverings of arrangement complements are combinatorially determined. Applying this result to the icosidodecahedral arrangement (which is an arrangement of 16 planes in $\mathbb{R}^3$ related to the icosidodecahedron) we conclude that the first homology group of its Milnor fiber has 2-torsion.

**Arrangement groups, lower central series, and Massey products**

Alex Suciu

Northeastern University,
Boston, USA

*Abstract:* I will discuss some recent advances in our understanding of fundamental groups of complements of complex hyperplane arrangements, with emphasis on associated graded and holonomy Lie algebras, as well as Massey products in positive characteristic. The talk will be based on current joint work with Rick Porter.