Title: Gorenstein Spherical Fano Varieties

Abstract: We introduce the combinatorial description of Gorenstein spherical Fano varieties, i.e. projective spherical varieties with ample and Cartier anticanonical divisor, in terms of certain polytopes (generalizing the G/H-reflexive polytopes in the horospherical case due to Pasquier). In this setting, it is natural to ask for a classification in fixed dimension which is known to be finite by work of Alexeev and Brion. The results in the toric case rely on the notion of toric automorphisms, i.e. automorphisms of the algebraic torus which extend to an automorphism of the toric variety. We suggest two possible notions of automorphisms for spherical varieties, both generalizing toric automorphisms, and then have a look at the classification in dimension 3. The first part of the talk is based on joint work with Giuliano Gagliardi.

5. Kiumars Kaveh, University of Pittsburgh, USA

Title: Gröbner Theory and Tropical Geometry on Spherical Varieties

Abstract: Let G be a connected reductive algebraic group. I will talk about a Gröbner theory for multiplicity-free G-algebras, as well as a tropical geometry for subschemes in a spherical G-homogeneous space G/H. We will discuss the notions of a spherical tropical variety and a fundamental theorem of tropical geometry in this context. We also propose a definition for a spherical amoeba in G/H and talk about the principle that amoeba approaches the tropical variety. This is directly related to the (Archimedean) Cartan decomposition for G/H. A particular case of this states that "invariant factors" of a matrix (over Laurent series) are a limit of its "singular values". This is a joint work with Chris Manon and builds on the recent work of Tassos Vogiannou.

6. Shin-Young Kim, Korea Institute for Advanced Studies

Title: Geometric Structures Modeled on Horospherical Varieties.

Abstract: Geometric structures modeled on rational homogeneous manifolds are studied to characterize rational homogeneous manifolds and to prove their deformation rigidity. To generalize these characterizations and deformation rigidity results to quasihomogeneous varieties, we first study horospherical varieties and geometric structures modeled on horospherical varieties. Using Cartan geometry, we prove that a geometric structure modeled on a smooth projective horospherical variety of Picard number one is locally equivalent to the standard geometric structure when the geometric structure is defined on a Fano manifold of Picard number one. As a application of variety of minimal rational tangents (VMRT), we can characterize B-type and F-type horopherical varieties using a rational curve on it and geometric structures arising from VMRT.

7. Kevin Langlois, Heinrich Heine Universität, Germany

Title: Reductive Group Actions with Spherical Orbits

Abstract: In this talk, we will present old and new results on actions of connected reductive groups. We will concentrate to the biregular/ birational classifications in the special case where the orbits are spherical.

8. Duo Li, Yau Mathematical Sciences Center, Tsinghua University, China

Title: Characterizations of Projective Spaces and Quadrics

Abstract: In this paper, we show that if the tangent bundle of a smooth projective variety is strictly nef, then it is isomorphic to a projective space; if a projective variety X^n $(n > 4)$ has strictly nef $\Lambda^2 TX$, then it is isomorphic to P^n or quadric Q^n. We also prove that on elliptic curves, strictly nef vector bundles are ample, whereas there exist Hermitian flat and strictly nef vector bundles on any smooth curve with genus $g \geq 2$. This is a joint work with Xiaokui Yang.

9. Qifeng Li, Korea Institute for Advanced Study, Korea

Title: Pseudo-effective and Nef Cones on Spherical Varieties

Abstract: In this talk, we will show that nef cycle classes on smooth complete spherical varieties are effective, and the products of nef cycle classes are also nef. Let X be a smooth projective spherical variety such that its effective cycle classes of codimension k are nef, where $1 \leq k \leq \dim(X) - 1$. We study the properties of X. In particular we study in detail the cases when X is a toric variety, a toroidal variety, or a horospherical variety. Finally, as an application we show that smooth projective horospherical varieties with nef tangent bundles are rational homogeneous spaces.

10. Boris Pasquier, Montpellier University, France

Title: Horospherical Pairs with Klt Singularities

Abstract: One of the biggest family of pairs we can consider in the log Minimal Model Program (MMP) is the family of pairs with klt (Kawamata log terminal) singularities. The MMP for $\mathbb{Q}$-factorial spherical varieties was described by M.Brion in 1993. In 2015, I described explicitely an MMP for $\mathbb{Q}$-Gorenstein horospherical varieties. (Note that if X is a $\mathbb{Q}$-Gorenstein horospherical variety then $(X, 0)$ has klt singularities.) In order to generalize this description to horospherical pairs with klt singularities, we need to know which pairs have klt singularities. After an introduction of the theory, I will explain how to prove the following result, using Bott-Samelson resolutions.

Let X be a horospherical G-variety and let D be an effective $\mathbb{Q}$-divisor of X that is stable under the action of a Borel subgroup B of G and such that $D + K_X$ is $\mathbb{Q}$-Cartier. Then the pair (X, D) has klt singularities if and only if $\lfloor D \rfloor = 0$.

11. Clélia Pech, University of Kent, UK

Title: Rational Curves on Horospherical Varieties of Picard Rank One

Abstract: In this talk I will report on joint work in progress with R. Gonzales, N. Perrin and A. Samokhin on rational curves and quantum cohomology for a family of quasi-homogeneous varieties with horospherical group actions. Using a classification

of these varieties by B. Pasquier we study the moduli spaces of stable maps and deduce a quantum Chevalley-type formula for the quantum multiplication by the hyperplane class. Some of the varieties we consider have particularly well-behaved moduli spaces of stable maps, and in these cases we obtain a more precise description of the quantum cohomology.

12. Maarten Van Pruijssen, Universität Paderborn, Germany

Title: Classification of Multiplicity Free Systems

Abstract: Let (G, H) be a spherical pair of connected reductive groups defined over the complex numbers and consider the induction of an irreducible H-representation to G. If we induce the trivial representation of H, then we get a G-module that decomposes multiplicity free into irreducible G-submodules. If moreover the pair (G, H) is symmetric, then we can describe this module by means of orthogonal polynomials.

There are more irreducible H-representations whose induction to G decomposes multiplicity free and under an extra condition these can be classified. I will discuss this classification.

For several examples the induced modules can be described by vector valued orthogonal polynomials that are eigenfunctions of a commutative algebra of differential operators. I will report on some aspects of this description (joint work with Koelink (Nijmegen, the Netherlands) and Román (Córdoba, Argentina)).

To understand these examples in a more general framework, we investigate certain combinatorial data that is attached to the items in the classification. One of the goals is to understand the inversion of the involved branching rules. I will discuss some results of this on-going research (joint with Pezzini (Erlangen, Germany)).

13.Eitan Sayag, Ben-Gurion University of the Negev, Israel

Title: Spherical Functions, Spherical Distributions and their Applications

Abstract: Periods of automorphic forms provides an important tool to classify automorphic represenations and arise time and time again in problems with arithmetic origin. Motivated by that, I shall describe some of our investigation of local counterparts of these periods that involve representation theory and invariant harmonic analysis on p-adic and real spherical spaces. The results I plan to report on include:

- Quantitative generalizations of Howe-Moore phenomena regarding decay of generalized matrix coefficients in the real case.
- Qualitative generalizations of Howe/Harish-Chandra character expansions in the p-adic case

I shall explain how to use the results on generalized matrix coefficients to obtain new results on counting lattice points in the realm of real Spherical spaces. If time permits I will explain the role of Bernstein center in studying distributions in the p-adic case allowing tight control on the singularities of generalized characters on p-adic Spherical spaces.

My lecture will be based on joint works with B. Krötz, F. Knop and H. Schlichtkrull regarding decay of functions and on a joint work with Avraham Aizenbud and Dmitry Gourevitch regarding the regularity of certain distributions.

14. Bart Van Steirteghem, FAU Erlangen–Nürnberg & Medgar Evers College, City University of New York, USA

Title: Combinatorial Characterization of the Weight Monoids of Smooth Affine Spherical Varieties

Abstract: Let G be a connected complex reductive group. A well known theorem of I. Losev's says that a smooth affine spherical G-variety X is uniquely determined by its weight monoid, which is the set of irreducible representations of G that occur in the coordinate ring of X. This theorem had been conjectured by F. Knop, who also used it to show that multiplicity free (real) Hamiltonian manifolds are classified by their moment polytope and generic isotropy group.
I will present a combinatorial characterization of the weight monoids of smooth affine spherical varieties. It was obtained in joint work with G. Pezzini, using the combinatorial theory of spherical varieties and a smoothness criterion of R. Camus. I will also discuss some applications developed with Pezzini and K. Paulus.

15. Henrik Schlichtkrull, Department of Mathematical Sciences, University of Copenhagen, Danmark

Title: The Classification of Reductive Real Spherical Spaces

Abstract: A homogeneous space G/H of a real reductive Lie group G is called spherical if minimal parabolic subgroups of G admit open orbits on G/H, and absolutely spherical if the complexification $G_{\mathbb{C}}/H_{\mathbb{C}}$ is spherical. All absolutely spherical spaces are spherical, but not vice versa. In the talk I shall present a recent classification of the real spherical spaces with G simple and H reductive. There will also be a discussion of the more general case of G semisimple.

The talk is based on joint work with F.Knop, B.Krötz and T.Pecher.

16. Ronan Terpereau, Institut de Mathmatiques de Bourgogne, France

Title: Embeddings of Horospherical Homogeneous Spaces into Algebraic Stacks

Abstract: The study of equivariant embeddings of tori into algebraic varieties, also known as toric varieties, is a well-known topic of algebraic geometry. In a recent work, Geraschenko and Satriano considered the equivariant embeddings of tori into algebraic stacks and proved that they are always quotient stacks of toric varieties. In this talk, I will explain the idea of their proof, give some examples, and also explain how their result might extend to the larger class of equivariant embeddings of horospherical homogeneous spaces into algebraic stacks.

17. Dmitry Timashev, Faculty of Mechanics and Mathematics, Lomonosov Moscow State University, Russia

Title: On Real Orbits on Spherical Varieties

Abstract: Given a complex spherical homogeneous space X equipped with a real structure compatible with a fixed real structure on the acting complex reductive group G, the real locus $X(\mathbb{R})$ is usually not homogeneous under $G(\mathbb{R})$. A natural problem is to describe $G(\mathbb{R})$-orbits in $X(\mathbb{R})$. I will discuss it in the talk, paying special attention

to the case of a symmetric space. In that case, a solution was announced in a book of A. Borel and L. Ji. However, the arguments therein are incomplete and the answer seems to be incorrect in general. I will provide a patch to this solution based on Galois cohomology. This result is a part of a joint project with S. Cupit-Foutou.

18. Kiwamu Watanabe, Saitama University, Japan

Title: Fano Manifolds with Nef Tangent Bundle

Abstract: As a generalization of Mori's characterization of the projective space, Campana and Peternell conjectured that the only Fano manifolds with nef tangent bundle are rational homogeneous. In this talk, we introduce recent results on the conjecture, paying special attention to my joint work with R. Muñoz, G. Occhetta, L. E. Solá Conde and J. A. Wiśniewski.