Gil Bor

Title: The Kepler problem - new symmetries via projective geometry

Abstract. The Kepler orbits form a 3-parameter family of plane curves, consisting of all conics (ellipses, parabolas and hyperbolas) sharing a focus at some fixed point. I will describe symmetry properties of this family, as well as certain natural 2-parameter subfamilies, such as those of fixed energy or angular momentum.

The standard technique for studying such symmetries is via a PDE system for the infinitesimal symmetries (a well known method due to S Lie, nowadays usually computer assisted). I will describe instead a projective geometric construction, exploiting a duality between Kepler's plane and Minkowski's 3-space parametrizing the space of Kepler orbits.

This is joint work with Connor Jackman (Heidelberg). Reference: Arnold J Math, 2022. arxiv.org/abs/2106.02823

Andreas Cap

Title: Poisson transforms, the BGG complex and discrete series representations

Abstract: My talk reports on recent joint work with C. Harrach (Vienna) and P. Julg (Orleans). The transforms we consider map differential forms (possibly with values in an appropriate vector bundle) on a parabolic homogeneous space G/P to differential forms on G/K, where $K \subset G$ is the maximal compact subgroup. It turns out that such transforms can be constructed by algebraic methods and this construction also provides information on their properties. A first natural task is to understand which transforms produce harmonic forms on G/K, and it turns out that this is closely related to the BGG machinery on G/P. We will then describe specific transforms on ordinary forms in the case that G has real rank one, so G/K is (real, complex or quaternionic) hyperbolic space. In this case, one obtains interesting relations between the BGG complex on G/P and discrete series representations of G (with trivial infinitesimal character). The main motivation for these developments come from P. Julg's program to prove specific instances of the Baum-Connes conjecture from non-commutative geometry.

Sean Curry

Title: The d-bar-b problem

Abstract: I'll present an approach to studying the local solvability of the inhomogeneous tangential Cauchy-Riemann equations on strongly pseudoconvex CR manifolds. This is joint work in progress with Peter Ebenfelt.

Mike Eastwood

Title: The Killing tensors on complex projective space

Abstract: The Killing tensors of arbitrary rank on complex projective space are determined. I'll start by recalling the corresponding story for the round sphere and then explain how to modify this story for the Fubini-Study metric. The ingredients are from parabolic geometry, even though the topic itself lies outside the usual parabolic realm.

Jaehyun Hong

Title: Geometric structures modeled on smooth horospherical varieties of Picard number one

Abstract: Parabolic geometry deals with local equivalence problems of geometric structures modeled on homogeneous varieties G/P, where G is a reductive group and P is a parabolic subgroup. Compared to homogeneous variety G/P, little is known for local equivalence of geometric structures modeled on almost homogeneous varieties. For example, the existence of Cartan connections is not guaranteed. In this talk we explain how to apply the method of W-normal complete step prolongations we developed recently, to solve a local equivalence problem for geometric structures modeled on smooth horospherical varieties of Picard number one. This is joint work partially with T. Morimoto and partially with S.-Y. Kim.

Jun-Muk Hwang

Title: Characteristic conic connections and torsion-free principal connections

Abstract: We study the relation between torsion tensors of principal connections on G-structures and characteristic conic connections on associated cone structures. We formulate sufficient conditions under which the existence of a characteristic conic connection implies the

existence of a torsion-free principal connection. We verify these conditions for adjoint varieties of simple Lie algebras, excluding those of type $A_{\ell\neq 2}$ and C_ℓ. This is a joint work with Qifeng Li.

Sung-Yeon Kim

Title: Closed $SU(\ell, m)$-orbits in Grassmannians

Abstract: A closed $SU(\ell, m)$-orbit in a Grassmannian $Gr(p, q)$, $\ell + m = p + q$, is a homogeneous CR manifold with nondegenerate Levi form. In this talk, we study germs of smooth CR mappings sending a closed $SU(\ell, m)$-orbit into a closed $SU(\ell', m')$-orbit in Grassmannian manifolds. We classify such maps if the signature difference of the Levi forms of two orbits is small. As an application, we give a sufficient condition for a proper holomorphic mapping between bounded symmeric domains of type I to be the product of a canonical embedding and a holomorphic mapping into a subdomain.

Ilya Kossovskiy

Title: Sphericity and analyticity of a strictly pseudoconvex hypersurface in low regularity

Abstract: it is well known that the sphericity of a strictly pseudoconvex real hypersurface in a complex manifold amounts to the vanishing of its Chern-Moser tensor. The latter is built from the principal curvature components of the respective Cartan connection. The curvature construction here appeals to the 6-jet of the hypersurface at a point, and thus requires regularity of the hypersurface of class at least C^6. The problem of checking the sphericity in lower regularity than C^6 is open. In our joint work with Zaitsev, we apply our recent theorem on the analytic regularizability of a strictly pseudoconvex hypersurface to find a necessary and sufficient condition for the sphericity of a strictly pseudoconvex hypersurfaces of arbitrary regularity starting with C^3. Further, we obtain a simple condition for the analytic regularizability of hypersurfaces of the respective classes. Surprisingly, despite of the seemingly analytic nature of the problem, our technique is geometric and is based on the Reflection Principle in SCV.

Boris Kruglikov

Title: Large automorphism groups of parabolic geometries.

Abstract: We discuss maximal and submaximal global symmetry dimensions, i.e. dimensions of automorphism groups of parabolic geometries. This problem in the general context is largely algebraic. Under an additional restriction of compactness of the group the problem is well-studied. If we impose an additional restriction of compactness of the manifold with parabolic geometry, the problem becomes much more complicated. Joint work with Henrik Winther.

Omid Makhmali

Title: Zero-curvature subconformal contact manifolds and dispersionless integrability in dimension five

Abstract: It is well-known that the notion of dispersionless integrability is related to Einstein-Weyl structures and self-dual conformal structures in dimension three and four, respectively. We extend this relation to dimension five using certain subconformal contact manifolds with vanishing curvature, which are examples of parabolic geometries. We discuss twistorial constructions and symmetry reductions in this case, as well as a classification of parabolic geometries that are related to dispersionless integrability. This is a joint work with Boris Kruglikov.

Benjamin McMillan

Title: Embeddable 235 distributions

Abstract: Given two manifolds, each equipped with a tangent subplane distribution, one can ask whether there exists an embedding of one manifold into the other that respects the distributions. As one of the simplest non-trivial cases, I discuss the problem of determining when a 235 manifold can be embedded into the space of isotropic 2-planes in a symplectic six dimensional vector space, subject to the constraint that the 3-distribution of the domain is sent to the 4-distribution on the codomain. The answer to this question depends on not just the Cartan quartic of the 235 distribution, but on higher order (non-harmonic) curvature as well.

Tohru Morimoto

Title: Classify the systems of linear differential equations

Abstract: I would like to understand the variety and the extent of the systems of linear differential equations locally around generic

points. First recalling basic notions about differential equations on filtered manifolds, I will briefly explain what I know from our recent works Doubrov- Machida -Morimoto 2021 and Doubrov -Morimoto 2023. Then I will pose and discuss a few problems toward a classification of the systems of linear differential equations.

Igor Zelenko

Title: Triviality of classification of rank 2 distributions in 6-dimensional manifolds with vanishing Wilczynski invariants

Abstract: Wilczynski invariants are fundamental invariants of non-degenerate curves in projective space introduced by Ernest Wilczynski in 1905. Applying the symplectification procedure of Doubrov and myself (2009), one can use them in order to construct $n-4$ invariants of rank 2 distributions on manifolds of any dimension greater or equal than 5 , called the generalized Wilczynski invariants. If $n=5$, there is only one Wilczynski invariant, and it coincides with the E. Cartan covariant binary biquadratic form. E. Cartan showed that, if this invariant vanishes, the distribution is locally equivalent to the most symmetric distribution with a small growth vector $(2,3,5)$. We proved that similar results hold for rank 2 distributions with vanishing generalized Wilczynski invariants for $n=6$, namely they are locally equivalent to the flat distribution with a parabolic (the most degenerate) Tanaka symbol x at the word *parabolic* here is not related to parabolic geometries but comes from the classification of Tanaka symbols in this case via the signature of certain canonical line of symmetric forms on the fibers of distribution). This work is based on the joint work with Haoshen Li.