	First week					Second week				
	Room H 0110, Straße des 17. Juni 135, 10623 Berlin					Lecture Hall ZIB, Takustraße 7, 14195 Berlin				
	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
9:30 - 10:30	de Loera	Barvinok	Barvinok	de Loera	de Loera	Vallentin	Blekherman	Blekherman	Vallentin	Vallentin
10:30 - 11:00	coffee	coffee	coffee	coffee	coffee	coffee	coffee	coffee	coffee	coffee
11:00 - 12:30	exercise dL	exercise B	exercise B	exercise dL	exercise dL	exercise V	exercise Bl	exercise Bl	exercise V	exercise V
12:30 - 14:00	lunch	lunch	lunch	lunch	lunch	lunch	lunch	lunch	lunch	lunch
14:00 - 15:00	Barvinok	de Loera	Bobenko	Barvinok	de Loera	Blekherman	Vallentin	Grötschel	Blekherman	Vallentin
15:00 - 15:30	coffee	coffee	coffee	coffee	coffee	coffee	coffee	coffee	coffee	coffee
15:30 - 16:30	Barvinok	de Loera	Joswig	Barvinok	exercises	Blekherman	Vallentin	Ziegler	Blekherman	exercises
16:30 - 18:00	exercise B	exercise dL	3 x students	exercise B	exercises	exercise Bl	exercise V	3 x students	exercise Bl	exercises

Each speaker has 6 x 1h = 360min lecture time
Each course has 4 exercise sessions, each is 90min

Jesus de Loera (UC Davis)	**Convex geometry arising in optimization:** This course will be about the many fascinating problems in convex geometry that arise in the context of convex and discrete optimization. The following selected topics (some of many possible) will be covered: The combinatorial geometry of augmentation algorithms in optimization (e.g., geometry of the simplex method); global optimization of polynomials: integration and summation methods; Caratheodory, Helly, and Radon theorems in optimization.	Frank Vallentin (U Köln)	**Packings, coverings, and embeddings:** It will be shown how to use semidefinite optimization in discrete geometry. Covered topics will include: Finding upper bounds for geometric packing problems, constructing optimal lattice sphere coverings, and computing low-distortion embeddings of finite metric spaces into Euclidean spaces.
Alexander Barvinok (U Michigan)	**Integer points in polyhedra:** Some highlights of the course are: polyhedra, valuations, Euler characteristic and polarity; exponential valuations (discrete and continuous) as extensions of volumes and the number of integer points to unbounded polyhedra; Brion's Theorem, cone decompositions, continued fractions and their extensions; Ehrhart polynomial and its ramifications; efficient algorithms for counting integer points.	Greg Blekherman (Georgia Tech)	**Convex geometry of nonnegative polynomials:** The course will be about the convex geometry of the cones of nonnegative polynomials and sums of squares. Simple geometric considerations, such as facial structure, symmetries, and structure of the dual cone will lead to new insights in real algebraic geometry.
Bobenko	Variational methods in discrete differential geometry	Grötschel	Optimization, Applications, Convex Geometry
Joswig	On the tropical geometry of the interior-point method in linear programming	Ziegler	Polytopes - Some Examples from Berlin

Student talks at TU Berlin		Student talks at FU Berlin	
Charu Goel	**Some applications of sum of squares representations of even symmetric forms** In 1888, Hilbert gave a complete characterisation of the pairs $(n,2d)$ for which a n-ary $2d$-ic form non-negative on $\mathbb{R}^n$ can be written as sums of squares of other forms, namely $\mathcal{P}_{n,2d} = \Sigma_{n,2d}$ if and only if $n=2$, $d=1$, or $(n,2d)=(3,4)$, where $\mathcal{P}_{n,2d}$ and $\Sigma_{n,2d}$ are respectively the cones of positive semidefinite (psd) and sum of squares (sos) forms (real homogenous polynomials) of degree $2d$ in n variables. This talk presents our analogue of Hilbert's characterisation under the additional assumptions of even symmetry on the given form, and few applications of sos representations of even symmetric forms. We show that for the pairs $(n,2d)=(3,2d)_{d\geq6}$, $(n,8)_{n\geq5}$ and $(n,2d)_{n\geq4,d\geq7}$ there are even symmetric psd not sos n-ary $2d$-ic forms. Moreover, assuming the existence of even symmetric psd not sos n-ary decics and dodecics for $n\geq4$, we establish that an even symmetric n-ary $2d$-ic psd form is sos if and only if $n=2$ or $d=1$ or $(n,2d)=(n,4)_{n\geq3}$ or $(n,2d)=(3,8)$. We then give necessary and sufficient conditions for an even symmetric sos form to be a sum of binomial squares (sobs) for the pairs $(n,2)$, $(2,2d)_{d=2,3}$, $(n,4)_{n\geq3}$ (using Ghasemi-Marshall's coefficient tests) and show that for the pairs $(2,2d)_{d\geq4}$, $(3,8)$ there exists even symmetric sos forms that are not sobs. Finally we interpret our results on even symmetric psd forms not being sos in terms of preorderings. This talk is partially based on joint work with S. Kuhlmann and B. Reznick.	Robert Thijs Kozma	**New Density Bounds and Optimal Ball Packings for Hyperbolic Space** In this talk we consider horoball packings of hyperbolic spaces. We introdude the notion of horoball type, and demonstrate its utility by showing the nonuniqueness result for optimal ball packing configurations of $\mathbb{H}^3$. We proceed to show that it is possible to exceed the conjectured 4-dimensional packing density upper bound due to L. Fejes-Tóth (Regular Figures, 1964). We give several examples of horoball packing configurations that yield higher densities of ≈ 0.71644896 where horoballs are centered at the ideal vertices of certain Coxeter simplex tilings.
Zafeirakis Zafeirakopoulo	**Polyhedral Omega: A linear Diophantine system solver** Polyhedral Omega is a new algorithm for solving linear Diophantine systems(LDS), i.e., for computing a multivariate rational function representation of the set of all non-negative integer solutions to a system of linear equations and inequalities. Polyhedral Omega combines methods from partition analysis with methods from polyhedral geometry. In particular, we combine MacMahon's iterative approach based on the Omega operator and explicit formulas for its evaluation with geometric tools such as Brion decomposition and Barvinok's short rational function representations. In this way, we connect two branches of research that have so far remained separate, unified by the concept of symbolic cones which we introduce. The resulting LDS solver Polyhedral Omega is significantly faster than previous solvers based on partition analysis and it is competitive with state-of-the-art LDS solvers based on geometric methods. Most importantly, this synthesis of ideas makes Polyhedral Omega by far the simplest algorithm for solving linear Diophantine systems available to date. This is joint work with Felix Breuer.	Bennet Goeckner	**A non-partitionable Cohen-Macaulay complex** In joint work with Art Duval, Caroline Klivans, and Jeremy Martin (my advisor), we construct a non-partitionable Cohen-Macaulay simplicial complex, which disproves a longstanding conjecture by Stanley. Due to an earlier result of Herzog, Jahan, and Yassemi, this construction also disproves the conjecture that Stanley depth is always greater than or equal to depth.
Judit Abardia	**The role of the Rogers-Shephard inequality in the characterization of the difference body** The difference body of a convex body is defined as the Minkowski sum of the convex body with its symmetric with respect to the origin. Different characterization results are known for the difference body operator. These characterization results rely on the basic properties of the difference body such as continuity, additivity, SL(n)-covariance, Minkowksi valuation or symmetric image. It is known that the volume of the difference body of a convex body is bounded from above and from below by the volume of the body itself. The (sharp) upper bound is known as Rogers- Shephard inequality. The (sharp) lower bound follows from the Brunn-Minkowski inequality. In this talk we will discuss the role of both inequalities in characterizing the difference body operator. For instance, we will prove that it is the only operator from the space of convex bodies to the origin-symmetric ones which is continuous, GL(n)-covariant and satisfies a Rogers-Shephard inequality. Finally, we will show how the situation changes if the hypothesis of GL(n)-covariance is removed. This a joint ongoing project with Andrea Colesanti and Eugenia Saorín Gómez.	Zeljka Stojanac	**Tensor theta norms** The tensor nuclear norm is NP-hard to compute and thus not suitable for applications such as low rank tensor recovery. To overcome this problem, it has been suggested to use sums of nuclear norms of matricizations of the corresponding tensor. However, this approach does not respect well the tensor structure. We introduce new tensor norms (theta norms) whose unit-norm balls are convex relaxations of the tensor unit nuclear norm ball. These norms are computable in polynomial time via semidefinite programming. This approach is based on the theta bodies – a recent concept from computational algebraic geometry – which relies heavily on the Groebner basis of an appropriately defined polynomial ideal. We explicitly give semidefinite programs for the computation of the θ_k-norm. We also present numerical experiments for order three tensor recovery via θ_1-norm minimization. This is joint work with Holger Rauhut, available at http://arxiv.org/abs/1505.05175 .