2020年解析组合学研讨会



会 议 手 册



会议时间： 2020年8月1日， 8月3日

承办单位： 曲阜师范大学 数学科学学院

山东·曲阜

会 议 指 南

**会议信息：**

会议形式：线上会议

会议交流：微信群组

会议平台：腾讯会议

8月1日会议ID：942 886 838

<https://meeting.tencent.com/s/wlgaVAkW32XW>

8月3日会议ID：432 766 676

https://meeting.tencent.com/s/HmrgO5oM5Vvt

**会议时间：**2020年8月1日和8月3日全天(详见日程安排)

**联系人：**刘 丽 13508970087

苏循团 15065593721



日 程 安 排

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| --- | --- | --- | --- |
| 8月1日(周六)上午8:30-11:20 | | | |
| 时间 | 报告题目 | 报告人 | 主持人 |
| 8:30-8:40 | 王毅老师致辞 | 刘丽 | |
| 8:40-9:10 | Liu and Wang's real-rootedness criterion and its applications | 杨立波 | 刘丽 |
| 9:10-9:40 | Ramanujan's theta functions and partition congruences | 谷珊珊 | 杨立波 |
| 9:40-10:10 | Túran inequalities and Laguerre inequalities for combinatorial sequences | 王星炜 | 谷珊珊 |
| 10:10-10:20 | 休息 | | |
| 10:20-10:50 | The (q,t)-log-concavity of an overpartition analogue of q-binomial coefficients | 苏循团 | 王星炜 |
| 10:50-11:20 | Combinatorics of Hexagonal lattice | 牟丽丽 | 苏循团 |

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| 8月1日(周六)下午14:30-17:10 | | | |
| 时间 | 报告题目 | 报告人 | 主持人 |
| 14:30-15:00 | Total positivity from a generalized cycle index polynomial | 祝宝宣 | 牟丽丽 |
| 15:00-15:30 | Polynomials and polytopes | 郭龙 | 祝宝宣 |
| 15:30-16:00 | Multivariate stable Eulerian polynomials on segmented permutations | 张彪 | 郭龙 |
| 16:00-16:10 | 休息 | | |
| 16:10-16:40 | Total positivity of some matrices that enumerate rooted labeled trees | 陈曦 | 张彪 |
| 16:40-17:10 | Eigenvalue inequalities for Hermitian matrices and totally positive matrices | 郑赛男 | 陈曦 |

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| 8月3日(周一)上午8:30-11:10 | | | |
| 时间 | 报告题目 | 报告人 | 主持人 |
| 8:30-9:00 | The asymptotic higher order Túran inequality and the higher order log-concavity | 侯庆虎 | 郑赛男 |
| 9:00-9:30 | On the enumeration of simultaneous core partitions with restrictions | 严慧芳 | 侯庆虎 |
| 9:30-10:00 | Ramanujan’s partial theta functions and q-orthogonal polynomials | 孙慧 | 严慧芳 |
| 10:00-10:10 | 休息 | | |
| 10:10-10:40 | The inverse Kazhdan-Lusztig polynomial of a matroid | 解红叶 | 孙慧 |
| 10:40-11:10 | Dyson’s rank, overpartitions and Appell-Lerch sums | 张文静 | 解红叶 |

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| 8月3日(周一)下午14:30-17:20 | | | |
| 时间 | 报告题目 | 报告人 | 主持人 |
| 14:30-15:00 | Congruences for Appell-Lerch Sums | 夏先伟 | 张文静 |
| 15:00-15:30 | Combinatorics of Hybrid Sets | 陈绍示 | 夏先伟 |
| 15:30-16:00 | On 132-avoiding up-down words of even length | 郜璐璐 | 陈绍示 |
| 16:00-16:10 | 休息 | | |
| 16:10-16:40 | The e-positivity of two families of (claw, 2K\_2)-free graphs | 李孟星 | 郜璐璐 |
| 16:40-17:10 | Sextet polynomials of hexagonal systems | 李冠儒 | 孙华 |
| 17:10-17:20 | 杨立波老师总结 | 苏循团 | |

学 术 报 告 摘 要

**Liu and Wang's real-rootedness criterion and its applications**

**杨立波 南开大学**

Many combinatorial polynomial sequences  satisfy a recurrence relation of the form



for some polynomials  with real coefficients. For such polynomial sequences, Liu and Wang gave a very useful criterion for proving their real-rootedness. In this talk I will share some experiences to use Liu and Wang's criterion to prove some conjectures, including Brändén’s conjectures on the Boros-Moll polynomials and Stanley's conjectures on the Stern poset.

**Ramanujan's theta functions and partition congruences**

**谷珊珊 南开大学**

Define  We establish a dissection identity for this function, and use it to derive congruence properties for the coefficients of F(q). As an application, we deduce several infinite families of congruences for l-regular partitions and l-regular bipartitions.

**Túran inequalities and Laguerre inequalities for combinatorial sequences**

**王星炜 南开大学**

In this talk, we will investigate the Túran inequalities and Laguerre inequalities for some celebrated combinatorial sequences, such as the partition function, the overpartition function, the Bernoulli numbers. Moreover, we will consider the relation among these inequalities and Riemann zeta function.

**The (q,t)-log-concavity of an overpartition analogue of q-binomial coefficients**

**苏循团 曲阜师范大学**

The (strong) q-log-concavity of q-binomial coefficients has been extensively investigated. Recently, [Dousse](https://mathscinet.ams.org/mathscinet/search/author.html?mrauthid=1036858) and Kim introduced an overpartition analogue of q-binomial coefficients, which is a generating function for the number of overpartitions fitting inside a rectangle. They also studied the (q,t)-log-concavity for this kind of polynomials. In this talk, we show a generalized version for the (q,t)-log-concavity which unifies several results obtained by Dousse and Kim [J. Combin. Theory Ser. A 158 (2018)].

**Combinatorics of Hexagonal lattice**

**牟丽丽 辽宁师范大学**

In this talk we consider the combinatorial properties of Hexagonal lattice. Let e(n) be the number of n-element order ideals in Hexagonal lattice. We give the enumeration of e(n) by showing a bijection between the order ideals and the Schroder paths. Further, we get the formulae of flag f- and h-vectors of Hexagonal lattice.

**Total positivity from a generalized cycle index**

**polynomial**

**祝宝宣 江苏师范大学**

Log-concavity and almost log-convexity of the cycle index polynomials were proved by Bender and Canfield [J. Combin. Theory Ser. A 74 (1996)]. Schirmacher [J. Combin. Theory Ser. A 85 (1999)] extended them to q-log-concavity and almost q-log-convexity. Motivated by these, we consider the stronger properties total positivity from the Toeplitz matrix and Hankel matrix. By using exponential Riordan array methods, we give some criteria for total positivity of the triangular matrix of coefficients of the generalized cycle index polynomials, the Toeplitz matrix and Hankel matrix of the polynomials sequence in terms of the exponential formula, the logarithmic formula and the fractional formula. Finally, we apply our criteria to some triangular arrays satisfying some recurrence relations, including Bessel triangles of two kinds and their generalizations, the Lah triangle and its generalization, the idempotent triangle and some triangles related to binomial coefficients. We not only get total positivity of these lower-triangles, and q-Stieltjes moment properties and 3-q-log-convexity of their row-generating functions, but also prove that their triangular convolutions preserve Stieltjes moment property.

**Polynomials and polytopes**

**郭龙 南开大学**

Polynomials and polytopes are central objects in algebraic combinatorics. In this talk, we shall discuss the Newton polytopes of several important families of polynomials in algebraic combinatorics, including for example Schubert polynomials, Grothendieck polynomials, key polynomials. We develop a combinatorial algorithm to determine the vertices of the Newton polytopes of Schubert and key polynomials. As an application, we prove that the vertices of the Newton polytope of a key polynomial can be generated by permutations in a Bruhat order interval, settling a conjecture proposed by Cara Monical, Neriman Tokcan and Alex Yong. This is joint work with Neil J.Y. Fan.

**Multivariate stable Eulerian polynomials on segmented permutations**

**张彪 天津师范大学**

Recently, Nunge studied Eulerian polynomials on segmented permutations, namely generalized Eulerian polynomials, and further asked whether their coefficients form unimodal sequences. In this paper, we prove the stability of the generalized Eulerian polynomials and hence confirm Nunge’s conjecture. Our proof is based on Brändén’s stable multivariate Eulerian polynomials. By acting on Brändén’s polynomials with a stability-preserving linear operator, we get a multivariate refinement of the generalized Eulerian polynomials. To prove Nunge’s conjecture, we also develop a general approach to obtain generalized Sturm sequences from bivariate stable polynomials. This work is joint with Xutong Zhang.

**Total positivity of some matrices that enumerate rooted labeled trees**

**陈曦 大连理工大学**

It is known that the number of rooted trees on the vertex set [n+1] in which exactly k children of the root are lower-numbered than the root is . In this talk, we will show the total positivity of some matrices related to .

**Eigenvalue inequalities for Hermitian matrices and totally positive matrices**

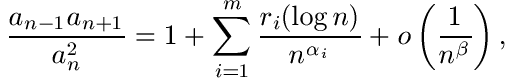
**郑赛男 东北财经大学**

We present a characterization of eigenvalue inequalities between two Hermitian matrices by means of inertia indices. As applications, we deal with some classical eigenvalue inequalities for Hermitian matrices in a simple and unified approach. We also give a common generalization of eigenvalue inequalities for (Hermitian) normalized Laplacian matrices of simple (signed, weighted, directed) graphs. On the other hand, it is well known that the eigenvalues of totally positive matrices are all real. We give a short proof of the eigenvalue inequalities for totally positive matrices.

**The asymptotic higher order Túran inequality and the higher order log-concavity**

**侯庆虎 天津大学**

We consider the higher order Tur\'an inequality and higher order log-concavity for sequences  such that



where m is a nonnegative integer,  are real numbers,  are rational functions of x and



We will give a sufficient condition on the higher order Tur\'an inequality and the r-log-concavity for n sufficiently large. Most P-recursive sequences fall in this frame.

**On the enumeration of simultaneous core partitions with restrictions**

**严慧芳 浙江师范大学**

Simultaneous core partitions have been widely studied since Anderson's work on the enumeration of (s,t)-core partitions. In this talk, we will present some results on the enumeration of simultaneous core partitions with restrictions. In particular, we derive the number and the largest size of (s,s+2)-core partitions with distinct parts for odd s, confirming two conjectures posed by Straub. We show that the number of (s,s+1)-core partitions \lambda with parts that are multiples of p is equal to the the Raney number, confirming a conjecture posed by Amdeberhan. We also prove that self-conjugate (s,s+1,… , s+k)-core partitions are equinumerous with symmetric (s, k)-Dyck paths, paralleling a result of Amdeberhan and Leven for ordinary (s,s+1, …, s+k)-core partitions.

**Ramanujan’s partial theta functions and q-orthogonal polynomials**

**孙慧 南开大学**

In the Lost Notebook, Ramanujan stated numerous identities for functions that closely related to the ordinary theta functions. These functions were named “partial theta functions” by Andrews. Warnaar discovered a very beautiful formula on the sum of two partial theta functions, which is an extension of the famous Jacobi triple product identity. Andrews and Warnaar further gave another representation for this identity, which is in the form of the product of two partial theta functions. In this talk, we will introduce a relation between the big q-Jacobi polynomials and the Andrews–Warnaar’s result. We also obtain an extension of it, which is a three-term identity for partial theta functions and is derived by applying a range of classic summation and transformation formulas for basic hypergeometric series. It unifies many results on partial theta functions.

**The inverse Kazhdan-Lusztig polynomial of a matroid**

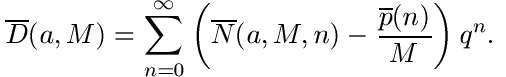
**解红叶 天津工业大学**

In analogy with the classical Kazhdan-Lusztig polynomials for Coxeter groups, Elias, Proudfoot and Wakefield introduced the concept of Kazhdan-Lusztig polynomials for matroids. Gedeon, Proudfoot and Young noted that both the classical Kazhdan-Lusztig polynomials and the matroid Kazhdan-Lusztig polynomials can be considered as special cases of the Kazhdan-Lusztig-Stanley polynomials for locally finite posets. In the framework of Kazhdan-Lusztig-Stanley polynomials, we study the inverse of Kazhdan-Lusztig-Stanley functions and define the inverse Kazhdan-Lusztig polynomials for matroids. We further show that the inverse Kazhdan-Lusztig polynomials can be used to directly compute the Kazhdan-Lusztig polynomials for uniform matroids. Similar to the Kazhdan-Lusztig polynomial of a matroid, we conjecture that the coefficients of its inverse Kazhdan-Lusztig polynomial are nonnegative and log-concave. This is a joint work with Alice L. L. Gao.

**Dyson's rank, overpartitions and Appell-Lerch sums**

**张文静 湖南大学**

Denote by  the number of partitions of n and by  the number of overpartitions of n with rank congruent to a modulo M. We study the 3-dissection properties of ranks for overpartitions modulo 6. In this case, -1 appears as a unit root, so that double poles occur in the generating function. We prove two identities of generalized Lambert series by taking limits in Chan's identities, which are useful in generating various formulas with similar poles. Moreover, we find and prove a general formula for Dyson's ranks by considering the deviation of the ranks from the average:



Using Appell–Lerch sum properties, we decompose into modular and mock modular parts, so that the mock modular component is supported on certain arithmetic progressions, whose modulus we can control.

**Congruences for Appell-Lerch Sums**

**夏先伟 江苏大学**

In 2012, Chan discovered a number of congruences for Ramanujan's  function, which is a Appell-Lerch sum. Motivated by Chan's work, we prove some new congruences modulo powers of 2 and 3 for some Appell-Lerch sums. Moreover, we confirm a conjecture on congruences modulo 5 for a Appell-Lerch sum given by Chan by using the theory of modular forms and an identity due to Hirschhorn and Mortenson. This work is joint with Yan Fan, Weiding Hu and Liuquan Wang.

**Combinatorics of Hybrid Sets**

**陈绍示 中科院数学与系统科学研究院**

Hybrid sets are generalizations of sets and multisets, in which the multiplicities of elements can take any integers. This construction was proposed by Whitney in 1933 in terms of characteristic functions. Hybrid sets have been used by combinatorists to give combinatorial interpretations for several generalizations of binomial coefficients and Stirling numbers and by computer scientists to design fast algorithms for symbolic domain decompositions. We present in this paper some combinatorial results on subsets and partitions of hybrid sets. This is a joint work with Stephen M. Watt (University of Waterloo).

**On 132-avoiding up-down words of even length**

**郜璐璐 西北工业大学**

In this paper, we shall consider the structure of 132-avoiding up-down words of even length, which are counted by the Narayana numbers. In order to give an alternative (combinatorial) proof, we introduce the notion of cut-pairs that allow us to subdivide the set of related words into equivalence classes. We then provide a combinatorial argument to show that the number of equivalence classes is given by the Catalan numbers.

**The e-positivity of two families of (claw, 2K\_2)-free graphs**

**李孟星 南开大学**

In 1995, Stanley defined the chromatic symmetric function and conjectured that the chromatic symmetric function of (3+1)-free incomparability graph is e-positive. In this talk, I present the e-positivity of generalized pyramid graphs and 2K\_2-free unit interval graphs, which solve one problem proposed by Hamel, Hoàng and Tuero, and another problem considered by Foley, Hoàng and  Merkel.

**Sextet polynomials of hexagonal systems**

**李冠儒 大连理工大学**

The sextet polynomial is the first genuine mathematical object introduced within the aromatic sextet theory. In this talk, we investigate analytic properties of sextet polynomials of hexagonal systems, especially for the pyrene chains. For general hexagonal systems, we also show the distribution of real zeros of sextet polynomials.

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