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

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会议时间：2020 年 8 月 1 日和 8 月 3 日全天(详见日程安排)

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日 程 安 排

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	开幕式	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

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

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

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	闭幕式	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 $\{f_n(x)\}_{n\geq 0}$ satisfy a recurrence relation of the form

$$f_{n+1}(x) = a_n(x)f_n(x) + b_n(x)f_n'(x) + c_n(x)f_{n-1}(x)$$

for some polynomials $a_n(x), b_n(x), c_n(x)$ 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 $F(q) = \sum_{n=-\infty}^{\infty} (-1)^{\delta}(an+b)q^{(cn^2+dn)/2}$. 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 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 $t_{n,k}=\binom{n}{k}n^{n-k}$. In this talk, we will show the total positivity of some matrices related to $t_{n,k}$.

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 $\{\alpha_n\}_{n\geq 0}$ such that

$$\frac{a_{n-1}a_{n+1}}{a_n^2} = 1 + \sum_{i=1}^{m} \frac{r_i(\log n)}{n^{\alpha_i}} + o\left(\frac{1}{n^{\beta}}\right),$$

where m is a nonnegative integer, α_i are real numbers, $r_i(x)$ are rational functions of x and $0 < \alpha_1 < \alpha_2 < \cdots < \alpha_m < \beta.$

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 $\overline{p}(n)$ the number of partitions of n and by $\overline{N}(a,M,n)$ 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:

$$\overline{D}(a,M)=\sum_{n=0}^{\infty}\left(\overline{N}(a,M,n)-\frac{\overline{p}(n)}{M}\right)q^n.$$

Using Appell–Lerch sum properties, we decompose $\overline{D}(a,M)$ 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 ϕ 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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