

The 36th KIAS Combinatorics Workshop

**KIAS
Seoul, Korea
March 13–14, 2026**

Contents

1	General Information	3
2	Schedule and Abstracts	4
3	List of Participants	13

1 General Information

Title The 36th KIAS Combinatorics Workshop

Date March 13–14, 2026

Venue KIAS, Seoul, Korea

Homepage <http://events.kias.re.kr/h/combinatorics/>

Invited Speakers

Seonghyuk Im (KIAS)

Seok-Zun Song (Jeju National University)

Jae-baek Lee (Yonsei University)

Seunghun Lee (Keimyung University)

Jing Liu (Shandong University)

Jaeseong Oh (Sungkyunkwan University)

Eero Rätty (IBS ECOPRO)

Gyu-cheol Shin (Kangwon National University)

Organizers

Jaehoon Kim (KAIST)

Jang Soo Kim (Sungkyunkwan University)

Jeong Han Kim (KIAS)

Seog-Jin Kim (Konkuk University)

Sang June Lee (Kyung Hee University)

Jongyook Park (Kyungpook National University)

Seunghyun Seo (Kangwon National University)

2 Schedule and Abstracts

1st Day: March 13 (Friday)

13:00–14:00 Registration and Opening

————— **Session A** ————— Chair: Seog-Jin Kim

14:00–14:40 **Seok-Zun Song.** *Linear operators that preserve some combinatorial properties*

14:50–15:30 **Seunghun Lee.** *Polytopes with large transversal ratio*

15:30–16:00 Coffee break

————— **Session B** ————— Chair: Young Soo Kwon

16:00–16:40 **Jing Liu.** *Proof of a conjecture on Young tableaux with walls*

16:50 - 17:30 **Eero Rätty.** *Logical convergence laws for small permutation classes*

18:00–20:00 Dinner

2nd Day: March 14 (Saturday)

09:30–10:20 Breakfast (Sandwich and Coffee)

————— **Session C** ————— Chair: Sang June Lee

10:20–11:00 **Seonghyuk Im.** *Embedding loose hypertrees into hypergraphs*

11:10–11:50 **Jaeseong Oh.** *Combinatorics of orthogonal polynomials and Random matrix theory*

12:00–13:30 Lunch

————— **Session D** ————— Chair: Seunghyun Seo

13:30–14:10 **Gyucheol Shin.** *Quasi-modularity in MacMahon partition variants and prime detection*

14:20–15:00 **Jae-baek Lee.** *The Ramsey multiplicity problem*

Speaker: Seok-Zun Song

Affiliation: Jeju National University

Title: Linear operators that preserve some combinatorial properties

Abstract

In this talk, we introduce Linear Preserver Problems with some examples. We show characterizations of the linear operators that preserve minimum rank of an undirected (bipartite) graphs as following:

Theorem. Let F be any field and $T : G_n \rightarrow G_n$ be a linear operator. Then the following are equivalent:

- (1) T preserves minimum rank.
- (2) T preserves minimum ranks 1 and k for some $2 \leq k \leq n - 1$.
- (3) T strongly preserves minimum rank 1.
- (4) T is a vertex permutation.

We also consider some combinatorial properties of matrices and graphs and their linear preservers.

Speaker: Seunghun Lee

Affiliation: Keimyung University

Title: Polytopes with large transversal ratio

Abstract

The transversal ratio of a polytope P is the minimum proportion of vertices of P required to intersect each facet of P . The weak chromatic number of P is the minimum number of colors required to color the vertices of P so that no facet is monochromatic.

We will construct an infinite family of d -polytopes for each $d \geq 5$ whose transversal ratio approaches 1 as the number of vertices grows. In particular, this implies that the weak chromatic number for d -polytopes is unbounded for each $d \geq 5$. The previous best known lower bounds on the supremum of the transversal ratio for d -polytopes for $d \geq 5$ were $2/5$ for odd d by Novik and Zheng, and $1/2$ for even d by Holmsen, Pach, and Tverberg. In the case of simplicial $(d - 1)$ -spheres, the best known lower bounds were $1/2$ for $d = 5$ and $6/11$ for $d = 6$ by Novik and Zheng.

This is joint work with Michael Gene Dobbins.

Speaker: Jing Liu

Affiliation: Shandong University

Title: Proof of a conjecture on Young tableaux with walls

Abstract

Banderier, Marchal, and Wallner considered Young tableaux with walls, which are similar to standard Young tableaux, except that local decreases are allowed at some walls.

In this work, we prove a conjecture of Fuchs and Yu concerning the enumeration of two classes of three-row Young tableaux with walls. Combining with the work by Chang, Fuchs, Liu, Wallner, and Yu leads to the verification of a conjecture on tree-child networks proposed by Pons and Batle. This conjecture was regarded as a specific and challenging problem in the Phylogenetics community until it was finally resolved by the present work.

Joint work with Zhicong Lin, Feihu Liu, Jiahang Liu, and Guoce Xin.

Speaker: Eero Rätty

Affiliation: IBS ECOPRO

Title: Logical convergence laws for small permutation classes

Abstract

A permutation class \mathcal{F} is said to be small if it has growth-rate less than κ , where $\kappa \approx 2.20557$. Vatter established a structural classification result on small permutation classes and conjectured that every small permutation class has a rational generating function. The conjecture was later settled by Albert, Ruškuc and Vatter.

In this talk, I will discuss our recent result which states that every small permutation class satisfies a monadic second-order convergence law. Given a small permutation class \mathcal{F} , we construct a regular language $L_{\mathcal{F}}$ and a length-preserving bijection $f_{\mathcal{F}} : L_{\mathcal{F}} \rightarrow \mathcal{F}$ that is both a first-order and monadic second-order homomorphism, i.e. for every first-order or monadic second-order sentence Ψ in \mathcal{F} there exists a first-order sentence or monadic second-order sentence Φ in $L_{\mathcal{F}}$ so that

$$f_{\mathcal{F}}^{-1}(\{\sigma \models \Psi : \sigma \in \mathcal{F}\}) = \{w \models \Phi : w \in L_{\mathcal{F}}\}.$$

Combining this with the well known first-order closure property of regular languages, i.e. the fact that for every regular language L and first-order sentence Ψ , the set $K = \{w \models \Psi : w \in L\}$ is also a regular language, our main result follows.

Joint work with Klas Markström.

Speaker: Seonghyuk Im

Affiliation: KIAS

Title: Embedding loose hypertrees into hypergraphs

Abstract

In 2001, Komlós, Sárközy, and Szemerédi proved that every sufficiently large n -vertex graph with minimum degree at least $(1/2 + \gamma)n$ contains all spanning trees with maximum degree at most $cn/\log n$. We extend this result to hypergraphs by considering *loose hypertrees*, which are linear hypergraphs obtained by successively adding edges that share exactly one vertex with a previous edge.

For all $k > \ell \geq 2$, we determine asymptotically optimal ℓ -degree conditions that ensure the existence of all rooted spanning loose hypertrees, without any degree condition, in terms of the $(\ell - 1)$ -degree threshold for the existence of a perfect matching in $(k - 1)$ -graphs.

As a corollary, we also asymptotically determine the ℓ -degree threshold for the existence of bounded degree spanning loose hypertrees in k -graphs for $k/2 < \ell < k$, confirming a conjecture of Pehova and Petrova in this range.

This talk based on a joint work with Yaobin Chen and Junchi Zhang.

Speaker: Jaeseong Oh

Affiliation: Sungkyunkwan University

Title: Combinatorics of orthogonal polynomials and Random matrix theory

Abstract

Random matrix theory has yielded fundamental results like Wigner's semicircle law and the celebrated Harer-Zagier formula.

This talk outlines Kerov's classical proof of the Harer-Zagier formula. We will highlight its elegant connection to the combinatorial theory of orthogonal polynomials, particularly Hermite polynomials. Finally, we will introduce recent generalizations using q -Hermite polynomials and related structures.

This is based on joint works with Sung-Soo Byun, Peter Forrester, and Yeong-Gwang Jung.

Speaker: Gyucheol Shin

Affiliation: Kangwon National University

Title: Quasi-modularity in MacMahon partition variants and prime detection

Abstract

MacMahon partition function $M_k(n)$, introduced by MacMahon in 1920, is defined as the sum of the products of the part multiplicities for partitions of n with k distinct part sizes.

In this talk, I will explain how this combinatorial object has attracted number theorists by establishing the quasi-modularity of the level N MacMahon partition function, obtained using polynomials introduced by Lehmer in his study of cyclotomic polynomials. As applications, I will explain how this result leads to a new class of q -series, called prime-detecting expressions, including analogues and extensions of the expressions proposed by Craig, van Ittersum, and Ono. If time permits, I will also discuss some recent results on MacMahon partition functions from a number-theoretic viewpoint.

This is a joint work with Soon-Yi Kang and Toshiki Matsusaka.

Speaker: Jae-baek Lee

Affiliation: Yonsei University

Title: The Ramsey multiplicity problem

Abstract

Ramsey's Theorem asserts that any sufficiently large graph, no matter how disordered, must inevitably contain a certain type of pattern. The Ramsey multiplicity problem extends this concept quantitatively: it asks how many copies of a fixed pattern are guaranteed as the size of the graph increases.

A graph H is said to be *common* if the number of monochromatic copies of H is asymptotically minimized by a random colouring. It is well known that the disjoint union of two common graphs may be uncommon; e.g., K_2 and K_3 are common, but their disjoint union is not. We investigate the commonality of disjoint unions of multiple copies of K_3 and K_2 . As a consequence of our results, we obtain the first example of a pair of uncommon graphs whose disjoint union is common. Fox and Wigderson recently identified a large family of graphs whose Ramsey multiplicity constants are attained by "Turán colourings". We focus on finding smaller graphs whose Ramsey multiplicity constants are achieved by Turán colourings. While their constructions require graphs with at least 10^{66} vertices, we identify such a graph on only 10 vertices.

This is based on joint work with Jonathan Noel.

3 List of Participants

1. Ahn, Jungho (Inha University)
2. Baek, Ingyu (Yonsei University)
3. Byoun, JeongWan (Hanyang University)
4. Chae, Jihyo (Yonsei University)
5. Chang, Yeonsu (Hanyang University)
6. Cho, Minho (KIAS)
7. Cho, Younggwang (Sungkyunkwan University)
8. Choi, ILKYO (Hankuk University of Foreign Studies / IBS)
9. Choi, Jigang (KAIST & IBS DIMAG)
10. Choi, Mujin (KAIST & IBS DIMAG)
11. Choi, Myungho (Kyunggi High School)
12. Chu, Hojin (KIAS)
13. Chung, Jaehoon (KIAS, CAINS)
14. Daimari, Nightingale (Sungkyunkwan University)
15. Dolores, Eric (Yonsei University)
16. Eom, Taehyun (GIST)
17. Hong, Taehee (Seoul National University)
18. Huynh, Tony (IBS DIMAG)
19. Im, Bokhee (Chonnam National University)
20. Im, Seonghyuk (KIAS)
21. Jung, Jaewoo (DGIST)
22. Jung, YeongHun (KAIST)
23. Kim, Hyobeen (Chonnam National University)
24. Kim, Hyungu (KAIST & IBS DIMAG)
25. Kim, Minseo (KAIST)
26. Kim, Ringi (Inha University)
27. Kim, Sangwook (Chonnam National University)

28. Kim, Seog-Jin (Konkuk University)
29. Kim, Seokbeom (KAIST & IBS DIMAG)
30. Kwon, Hyemin (KIAS)
31. Kwon, O-joung (Hanyang University)
32. Kwon, Young Soo (Yeungnam University)
33. Lee, Dohyeon (KAIST & IBS DIMAG)
34. Lee, Hojoon (Sungkyunkwan University)
35. Lee, Hyunwoo (KAIST & IBS ECOPRO)
36. Lee, Jae-baek (Yonsei University)
37. Lee, Myounghwan (Hanyang University)
38. Lee, Sang June (Kyung Hee University)
39. Lee, Seok Hyeong (Seoul National University)
40. Lee, Seunghun (Keimyung University)
41. Lim, Eunsung (Yonsei University)
42. Liu, Jing (Sungkyunkwan University & Shandong University)
43. Nam, Hayan (Konkuk University)
44. Oh, Jaeseong (Sungkyunkwan University)
45. Oum, Sang-il (Institute for Basic Science)
46. Park, Boram (Seoul National University)
47. Park, Hyemi (Hanyang university)
48. Park, Jihwan (Seoul National University)
49. Park, Jihye (Yeungnam University)
50. Park, Jongyook (Kyungpook National University)
51. Park, Wonjung (Yonsei University)
52. Rätty, Eero (IBS ECOPRO)
53. Seo, Seunghyun (Kangwon National University)
54. Shin, Gyucheol (Kangwon National University)
55. Shin, Heesung (Inha University)
56. Song, Seok-Zun (Jeju National University)