School of Mathematical Sciences, Hebei Normal University

Autumn Workshop on Algebraic Combinatorics

Shijiazhuang, China, November 8–9, 2025

Abstracts

Shijiazhuang, China – 2025

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Editors
Sergey Goryainov, Hebei Normal University
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Contents

General Information

Venue: The Autumn Workshop on Algebraic Combinatorics will take place at the room D-102 of the School of Mathematical Sciences of Hebei Normal University, Shijiazhuang, China on November 8–9, 2025.

Main goal: The organisers aim to create a good opportunity for senior and young mathematicians in the field of algebtaic combinatorics to exchange their ideas.

Language: The official language of the event is English.

Program: The program includes eighteen 40-minute invited talks.

Organisers:
Sergey Goryainov, Hebei Normal University
Liping Yuan, Hebei Normal University

Organised by: School of Mathematical Sciences, Hebei Normal University

Sponsors:
National Natural Science Foundation of China
Natural Science Foundation of Hebei Province
School of Mathematical Sciences, Hebei Normal University

Website: `https://sgoryainov.github.io/AWAC2025/`

Timetable

Autumn Workshop on Algebraic Combinatorics November 8-9, 2025 Hebei Normal University	
November 8 Saturday	November 9 Sunday
8:15-8:55 Jack Koolen	8:15-8:55 Willem Haemers
9:00-9:40 Sam Adriaensen	9:00-9:40 Wei Wang
9:40-10:05 Break	
10:05-10:45 Tao Feng	10:05-10:45 Thomas Karam
10:50-11:30 Meng-Yue Cao	10:50-11:30 Huiqiu Lin
11:30-13:30 Lunch	
13:30-14:10 Yan Zhu	13:30-14:10 Da Zhao
14:15-14:55 Denis Krotov	14:15-14:55 Vladislav Kabanov
15:00-15:40 Elena Konstantinova	15:00-15:40 Anwita Bhowmik
15:40-16:15 Break	
16:15-16:55 Anna Taranenko	16:15-16:55 Ruilin Ma
17:00-17:40 Alexandr Valyuzhenich	17:00-17:40 Weihao Yan
17:40-19:30 Dinner	

Program

Saturday, November 8

08:00 - 08:15	Opening workshop
08:15 - 08:55	Jack Koolen: *An improved bound for strongly regular graphs*
09:00 - 09:40	Sam Adriaensen: *Directions of point sets in affine planes*
9:40 - 10:05	Break
10:05 - 10:45	Tao Feng: *Cyclic difference families, perfect difference families and their applications*
10:50 - 11:30	Meng-Yue Cao: *On signed graphs with fixed smallest eigenvalue*
11:30 - 13:30	Lunch
13:30 - 14:10	Yan Zhu: *Euclidean designs from spherical embedding of Q-polynomial coherent configurations*
14:15 - 14:55	Denis Krotov: *On latin-square graphs avoiding K33*
15:00 - 15:40	Elena Konstantinova: *Cubic Pancake graphs*
15:40 - 16:15	Break
16:15 - 16:55	Anna Taranenko: *Eigenfunctions, perfect colorings and related structures for hypergraphs*
17:00 - 17:40	Alexandr Valyuzhenich: *On strong nodal domains for eigenfunctions of Hamming graphs*
17:40 - 19:30	Dinner

Sunday, November 9

08:15 - 08:55	Willem Haemers: *An algebra for weighted threshold graphs*
09:00 - 09:40	Wei Wang: *Generalized spectral characterizations of Eulerian graphs: revisited*
9:40 - 10:05	Break
10:05 - 10:45	Thomas Karam: *The ranks of tensors and their applications*
10:50 - 11:30	Huiqiu Lin: *Steklov eigenvalues of graphs*
11:30 - 13:30	Lunch
13:30 - 14:10	Da Zhao: *Attempts on Haemers' conjecture*
14:15 - 14:55	Vladislav Kabanov: *Creating divisible design graphs using affine designs*
15:00 - 15:40	Anwita Bhowmik: *Divisible design graphs with selfloops*
15:40 - 16:15	Break
16:15 - 16:55	Ruilin Ma: *A new infinite family of divisible design graphs related to antipodal distance-regular graphs of diameter 3*
17:00 - 17:40	Weihao Yan: *New infinite families of divisible design graphs, which are covers of strongly regular polar graphs*
17:40 - 19:30	Dinner

Abstracts

Invited talks are listed alphabetically with respect to the Presenting Author

Invited Talks

Directions of point sets in affine planes

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An *affine plane* of order q is a $2-(q^2,q,1)$ design. The classical construction, denoted $\mathrm{AG}(2,q)$, has a vector space $\mathbb{F}_q^2$ as point set, and the affine lines of the space as blocks (or *lines*). The lines come in $q+1$ parallel classes, and to each parallel class we assign a *slope* or *direction.* A set S of q points is said to *determine* a direction d if some line with slope d is spanned by two points of S. Note that d is **not** determined by S if and only if every line with slope d intersects S in exactly one point. A classical result states that a set S of q points in $\mathrm{AG}(2,q)$ that determines at most $\frac{q+1}{2}$ directions must be a translate of a vector subspace of $\mathbb{F}_q^2$ over some subfield of $\mathbb{F}_q$.

Recently, the problem was generalized to study sets of kq points for some integer k. We say that S is *equidistributed* from direction d if all lines with slope d intersect S in k points, and we call d a *special* direction otherwise. Surprisingly, every translation plane (which includes all planes $\mathrm{AG}(2,q)$) has a set with exactly 3 special directions.

In this talk, I will discuss some of these new result, and some other generalizations of the classical problem of determined directions. This is based on joint work with Bence Csajbók, Tamás Szőnyi, and Zsuzsa Weiner [1, 2]

References

[1] Sam Adriaensen, Tamás Szőnyi, Zsuzsa Weiner *Multisets with few special directions and small weight codewords in Desarguesian planes*, Des. Codes Cryptogr., to appear.

[2] Sam Adriaensen, Zsuzsa Weiner *Points below a parabola in affine planes of prime order*, Bull. Belg. Math. Soc. Simon Stevin, Vol.32, No. 3, August 2025, 332-342.

Divisible design graphs with selfloops

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A k-regular graph Γ on v vertices is called a divisible design graph (DDG for short) with parameters $(v, k, \lambda_1, \lambda_2, m, n)$ if the vertex set V of Γ can be partitioned into m classes each of size n such that any two distinct vertices of the same class have precisely λ_1 common neighbours and any two distinct vertices of different classes have precisely λ_2 common neighbours. DDG's were introduced in [3] as a bridge between (group) divisible designs and graphs, and the graphs under consideration were undirected and without loops. In this work, we introduce a natural extension of DDGs to include possible selfloops (LDDG's for short) and develop a basic theory for the same. We describe two infinite families of such graphs, some members of which are (undirected) DDG's. We state some theoretical results including the spectrum of such LDDG's. We also classify all examples satisfying parameter restrictions. Finally, we discuss a procedure called dual Seidel switching, which constructs new LDDGs from others. This is based on joint work with Bart De Bruyn and Sergey Goryainov [2].

References

[1] W. H. Haemers, H. Kharaghani, M. A. Meulenberg, *Divisible design graphs*, Journal of Combinatorial Theory Series A, Volume 118, 2011, p. 978–992.

[2] A. Bhowmik, B. De Bruyn, S. Goryainov, *Divisible design graphs with selfloops*, Discrete Mathematics, Volume 349, Issue 3, 2026, p. 114824.

On signed graphs with fixed smallest eigenvalue

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Let G be a graph with smallest eigenvalue $\lambda_{\min}(G)$. In 1973, Hoffman [1] showed that: (i) for any real number $\lambda \leq -1$, if $\lambda_{\min}(G) \geq \lambda$, then there exists a positive integer $t = t_\lambda$, such that G is $\{K_{1,t}, \widetilde{K_{2t}}\}$-free; (ii) for any integer t, if G is $\{K_{1,t}, \widetilde{K_{2t}}\}$-free, then there exists a positive integer $\lambda = \lambda_t$, such that $\lambda_{\min}(G) \geq \lambda$. In 2016, Kim, Koolen and Yang [2] gave a structure theory for graphs with fixed smallest eigenvalue.

In this talk, I will present a generalization of these results to signed graphs. Let (G, σ) be a signed graph with smallest eigenvalue $\lambda_{\min}((G, \sigma))$. We showed that: (i) for any real number $\lambda \leq -1$, if $\lambda_{\min}((G, \sigma)) \geq \lambda$, then there exists a positive integer $t = t_\lambda$, such that (G, σ) is $\{(K_{1,t}, +), (K_t, -)\ (\widetilde{K_{2t}}, +), \widehat{K_{2t}}\}$-switching-free; (ii) for any integer t, if (G, σ) is $\{(K_{1,t}, +), (K_t, -), (\widetilde{K_{2t}}, +), \widehat{K_{2t}}\}$-switching-free, then there exists a positive integer $\lambda = \lambda_t$, such that $\lambda_{\min}((G, \sigma)) \geq \lambda$. Moreover, we gave a structure theory for signed graphs with fixed smallest eigenvalue. In the end, I will introduce an application of our method on signed graphs with smallest eigenvalue greater than $-1 - \sqrt{2}$.

This is based on a joint work with Prof. Koolen and Mr. Liu Jing-Yuan.

References

[1] A.J. Hoffman, *On spectrally bounded graphs*, A Survey of Combinatorial Theory, 1973, 277-283.

[2] H.K. Kim, J.H. Koolen, and J.Y. Yang. *A structure theory for graphs with fixed smallest eigenvalue*, Linear Algebra Appl., 504, 2016, 1-13.

Cyclic difference families, perfect difference families and their applications

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Let v be a positive odd integer. A (v,k,λ)-perfect difference family (PDF) is a collection $\mathcal{F}$ of k-subsets of $\{0,1,\ldots,v-1\}$ such that the multiset $\bigcup_{F\in\mathcal{F}}\{x-y : x,y\in F, x>y\}$ covers each element of $\{1,2,\ldots,(v-1)/2\}$ exactly λ times. Perfect difference families are a special class of perfect systems of difference sets. This talk shows that a $(v,4,\lambda)$-PDF exists if and only if $\lambda(v-1)\equiv 0 \pmod{12}$, $v\geq 13$, and $(v,\lambda)\notin\{(25,1),(37,1)\}$. This result resolves a nearly 50-year-old conjecture posed by Bermond. Perfect difference families find applications in radio astronomy, optical orthogonal codes for optical code-division multiple access systems, geometric orthogonal codes for DNA origami, difference triangle sets, additive sequences of permutations, and graceful graph labelings. Perfect difference families can be also seen as a special kind of cyclic difference families. This talk will also give a survey on the recent progress on constructions for cyclic difference families.

References

[1] Hengrui Liu, Tao Feng, Xiaomiao Wang, Menglong Zhang, *Perfect difference families, perfect systems of difference sets and their applications*, arXiv:2510.20446.

[2] C. Zhao, Y. Chang, and T. Feng, *The existence of optimal $(v,4,1)$ optical orthogonal codes achieving the Johnson bound*, IEEE Trans. Inform. Theory, 70 (2024), 8746–8757.

[3] C. Zhao, B. Zhao, Y. Chang, T. Feng, X. Wang, and M. Zhang, *Cyclic relative difference families with block size four and their applications*, J. Combin. Theory Ser. A, 206 (2024), 105890.

An algebra for weighted threshold graphs

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Threshold graphs are generated from one vertex by repeatedly adding a vertex adjacent to all existing vertices or adding an isolated vertex. In the weighted threshold graph, we add a new vertex in step i, which is connected to all existing vertices by an edge of weight w_i. In this work, we consider the set $\mathcal{A}_n$ consisting of all Laplacian matrices of weighted threshold graphs of order n. We show that $\mathcal{A}_n$ forms a commutative algebra and find a common basis of eigenvectors for the matrices in $\mathcal{A}_n$. It follows that the eigenvalues of each matrix in $\mathcal{A}_n$ can be represented as a linear transformation of the weights. The talk is based on [1].

References

[1] Yingyue Ke, Willem H. Haemers, Piet Van Mieghem *The Laplacian matrix of weighted threshold graphs*, Electronic J. Linear Algebra, Vol. 41, 2025, 529-537.

Creating divisible design graphs using affine designs

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A k-regular graph with v vertices is called a divisible design graph if its vertex set can be partitioned into m classes of size n, and any two distinct vertices in the same class have λ_1 common neighbours, and any two vertices from different classes have λ_2 common neighbours [5], [1]. Recently, we presented in [6] and [7] several new constructions that generate infinite sequences of divisible design graphs. These constructions develops ideas of W.D. Wallis [10], D.G. Fon-Der-Flaass [2], and M. Muzychuk [9]. Some of the divisible design graphs from [6] were used in [8] to construct the new strongly regular graphs with the parameters of the complement symplectic graphs. Possible divisible design graphs suitable for constructing strongly regular graphs were studied in [3] and [4]. In our talk we discourse old and introduce a new prolific constructions of infinite families of divisible design graphs with new parameters.

We use a symmetric 2-design with parameters (m, κ, λ) and m affine designs $AR(q, r)$. Let q be a power of 2 and let $\kappa = (q^2r - 1)/(q - 1)$ be the number of parallel classes of blocks in affine designs. then there are divisible design graphs with parameters

$v = q^2rm, \quad k = qr(q^2r - 1)/(q - 1), \lambda_1 = qr(qr - 1)/(q - 1), \quad \lambda_2 = \lambda r, m, \quad n = q^2r,$

and

$v = q^3r(qr - 1)/(q - 1), \quad k = q^2r(qr - 1)/(q - 1), \lambda_1 = qr(qr - q)/(q - 1), \quad \lambda_2 = qr(qr - 1)/(q - 1),$ $m = q^2(qr - 1)/(q - 1), \quad n = qr.$

References

[1] D. Crnković, W. H. Haemers, *Walk-regular divisible design graphs*, Designs, Codes and Cryptography, 72, 2014, 165–175.

[2] D.G. Fon-Der-Flaass, *New prolific constructions of strongly regular graphs*, Adv. Geom., 2, 2002, 301–306.

[3] A.L. Gavrilyuk, V.V. Kabanov, *Strongly regular graphs decomposable into a divisible design graph and a Hoffman coclique*. Des. Codes Cryptogr., 92, 2024, 1379–1391.

[4] A.L. Gavrilyuk, V.V. Kabanov, *Strongly regular graphs decomposable into a divisible design graph and a Delsarte clique*. Des. Codes Cryptogr. 93, 2025, 2177–2189 .

[5] W.H. Haemers, H. Kharaghani, M. Meulenberg, *Divisible design graphs*, J. Combinatorial Theory, Series A, 118, 2011, 978–992.

[6] V.V. Kabanov, *New versions of the Wallis-Fon-Der-Flaass construction to create divisible design graphs*, Discrete Mathematics, 345, 2022, Article ID 113054.

[7] V.V. Kabanov, *Construction of divisible design graphs using affine designs*, Discrete Mathematics, 349, 2026, Article ID 114717.

[8] V.V. Kabanov, *A new construction of strongly regular graphs with parameters of the complement symplectic graph*, Electron. J. Comb., 30, 2023, # P1.25.

[9] M. Muzychuk, *A generalization of Wallis-Fon-Der-Flaass construction of strongly regular graphs*, J. Algebr. Comb., 25, 2007, 169–187.

[10] W.D. Wallis, *Construction of strongly regular graphs using affine designs*, Bull. Austral. Math. Soc., 4, 1971, 41–49.

The ranks of tensors and their applications

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This talk will address the ranks of tensors, notions of complexity on tensors that extend the matrix rank each in their own way. The ranks of tensors have been successfully applied to several areas such as (among many more others) communication complexity, circuit complexity, quantum information theory, data compression, machine learning, and network analysis, yet despite that, much of the basic understanding of these ranks is still in its very early stages. We will begin by recalling the origins of some of the rank notions on tensors (such as the tensor rank, the slice rank, the partition rank, the R-rank and the subrank) as well as some of the above applications. Next, we will review some of the major advances in the accelerating development of the basic theory of the ranks of tensors that have been witnessed by the last ten years, and in turn some of the resulting improvements in applications. Thereafter, we will focus specifically on the extension of several basic properties of the rank of matrices to the ranks of tensors: first on which generalisations hold for all tensors, and then on how they may be qualitatively strengthened further for specific classes of tensors. Finally, we will outline directions of research that we believe would make progress on central difficulties behind several basic but open questions regarding these ranks.

Cubic Pancake graphs

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A classical and celebrated result [1] states that two random permutations of a set of n elements almost surely generate either the symmetric or the alternating group of degree n, and similar results hold when more generators are considered. In particular, the symmetric group can always be generated by a transposition together with the n-cycle, or by any set of $n-1$ transpositions.

Our interest lies in describing sets of three prefix reversals that generate the entire symmetric group. The importance of fixed–degree pancake graphs, in particular, cubic pancake graphs as models of networks was shown in [2]. The authors have considered cubic pancake graphs as induced subgraphs of the pancake graph and have identified the combinatorial necessary conditions for a triple of distinct prefix reversals to generate the symmetric group. Using these necessary conditions, six generating sets were obtained by showing that the set can simulate the three generators of the shuffle-exchange permutation network generated by the right and left shuffles, and the transposition of the first two elements.

We use the following approach to get other generating sets, and to describe in group–theoretical terms necessary and sufficient conditions for these sets to generate the symmetric group. Let $H = \langle r_n, r_m, r_k \rangle$, where $n > m > k$ acts on $\Omega = \{1, \ldots, n\}$. Then we consider different cases on m and k such that $H = \mathrm{Sym_n}$ with utilizing results from group theory about generating sets of $\mathrm{Sym_n}$. In particular, all the generating sets for $k = 2$ and $k = 3$ are characterized. Some other sets are also considered, and structural properties of the corresponding Cayley graphs are discussed. In particular, some results on diameters obtained in [3] are shown.

The work is supported by the Mathematical Center in Akademgorodok under the agreement No. 075-15-2025-348 with the Ministry of Science and Higher Education of the Russian Federation.

The talk is based on joint paper with Saúl A. Blanco, Mikhail P. Golubyatnikov, Natalia V. Maslova, and Luka A. Nikiforov.

References

[1] John D. Dixon, The probability of generating the symmetric group, Electronic J. Combinatorics, 12, 2005, #R56, 1-5.

[2] Douglas W. Bass, I. Hal Sudborough, Pancake problems with restricted prefix reversals and some corresponding Cayley networks, Electronic J. Combinatorics, 12, 2005, #R56, 1 Journal of Parallel and Distributed Computing, 63, 2003, 327–336.

[3] A. Chervov, D. Fedoriaka, E. Konstantinova, and et al., CayleyPy Growth: Efficient growth computations and hundreds of new conjectures on Cayley graphs (Brief version), arXiv, 2025, `https://doi.org/10.48550/arXiv.2509.19162`.

An improved bound for strongly regular graphs

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Sims showed that there are for primitive strongly regular graphs with fixed smallest eigenvalue $-m$ except for a finite number of them they belong two families of graphs. Later in 1979, Neumaier made this bound explicit. In this talk we will improve this bound by Neumaier. This is based on joint work with Chenhui Lv, Greg Markowsky and Jongyook Park.

On latin-square graphs avoiding K33

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We discuss the problem of existence of latin squares without a substructure consisting of six elements (r_1, c_2, l_3), (r_2, c_3, l_1), (r_3, c_1, l_2), (r_2, c_1, l_3), (r_3, c_2, l_1), (r_1, c_3, l_2), where (r, c, l) means that the cell in the rth row and cth column contains the symbol l.

·	**A**	**B**
A	·	**C**
B	**C**	·

Equivalently, the corresponding latin square graph does not have an induced subgraph isomorphic to $K_{3,3}$. The exhaustive search [1] says that there are no such latin squares of order from 3 to 11, and there are only two $K_{3,3}$-free latin squares of order 8, up to equivalence. We repeat the search, establishing also the number of latin m-by-n rectangles for each m and n less or equal to 11. As a switched combination of two orthogonal latin squares of order 8, we construct a $K_{3,3}$-free (universally noncommutative) latin square of order 16.

1	0	2	5	6	11	4	13	15	8	10	9	12	3	14	7
0	1	5	2	11	6	13	4	8	15	9	10	3	12	7	14
2	3	7	0	4	9	6	15	10	13	11	8	14	1	12	5
3	2	0	7	9	4	15	6	13	10	8	11	1	14	5	12
4	5	10	1	0	15	9	14	2	11	12	13	8	7	3	6
5	4	1	10	15	0	14	9	11	2	13	12	7	8	6	3
10	7	4	3	13	14	0	11	12	9	2	15	5	6	8	1
7	10	3	4	14	13	11	0	9	12	15	2	6	5	1	8
8	9	15	14	12	7	10	3	0	5	1	6	2	13	4	11
9	8	14	15	7	12	3	10	5	0	6	1	13	2	11	4
11	14	8	13	10	5	12	1	7	6	0	3	4	15	2	9
14	11	13	8	5	10	1	12	6	7	3	0	15	4	9	2
6	13	12	11	3	8	2	7	4	1	14	5	9	0	10	15
13	6	11	12	8	3	7	2	1	4	5	14	0	9	15	10
12	15	6	9	2	1	5	8	14	3	4	7	10	11	13	0
15	12	9	6	1	2	8	5	3	14	7	4	11	10	0	13

The problem can be generalized to the study of $K_{k+2,k+2}$-free collections of k mutually orthogonal latin squares. For example, among the two linear pairs of orthogonal latin squares over GF(7), one is $K_{4,4}$-free and the other is not.

This is joint work with Aleksandr Krotov.

References

[1] A. Brouwer, I. M. Wanless, *Universally noncommutative loops*, Bull. Inst. Comb. Appl. 61, 2011, 113–-115.

Steklov eigenvalues of graphs

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In this talk, we will survey recent results on Steklov eigenvalues of graphs.

A new infinite family of divisible design graphs related to antipodal distance-regular graphs of diameter 3

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We consider only simple graphs. A *divisible design graph* with parameters $(v, k, \lambda_1, \lambda_2, m, n)$ is a k-regular graph on v vertices such that its vertex set can be partitioned into m classes of size n where any two distinct vertices from the same class have exactly λ_1 common neighbours and any two vertices from different classes have exactly λ_2 common neighbours. Divisible design graphs were introduced in [3] as a bridge between graph theory and the theory of group divisible designs. Since then, tens of constructions of divisible design graphs have been introduced.

In [1, Proposition 12.5.1], a construction of antipodal distance-regular graphs of diameter 3 was given. This construction uses a vector space of an even dimension equipped with a nondegenerate symplectic bilinear form. The construction admits the vector spaces over all finite fields $\mathbb{F}_q$. In our work we show that in the case when q is even it is possible to slightly modify this construction by plugging a difference set in $\mathbb{F}_q^+$ into it. This leads to a new infinite family of divisible design graphs. In the talk we discuss this modification and connection of the resulting graphs with the parabolic affine polar graphs.

The authors of [1] further discuss a few generalisations of the construction of distance-regular graphs given in [1, Proposition 12.5.1]. In our work we show that one of these generalisations, which depends on a subgroup A in $\mathbb{F}_q^+$, can be modified by plugging a difference set in the quotient group of $\mathbb{F}_q^+/A$ into it. This leads to a wider infinite family of divisible design graphs, which includes the family of divisible design graphs mentioned above. The main goal of this talk is to discuss this wider family of divisible design graphs.

This is joint work with Bart De Bruyn, Sergey Goryainov and Ruihan Xie.

References

[1] A.E. Brouwer, A. Cohen, A. Neumaier, *Distance-regular graphs*, Springer, Heidelberg, 1989.

[2] W. H. Haemers, H. Kharaghani, M. A. Meulenberg, *Divisible design graphs*, Journal of Combinatorial Theory, Series A, 118 (2011) 978–992.

Eigenfunctions, perfect colorings and related structures for hypergraphs

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Perfect colorings (equitable partitions) of graphs have many applications in algebraic combinatorics. We say that a coloring of vertices of a hypergraph is *perfect* if any two vertices of the same color have the same set of color ranges of incident hyperedges.

In this talk, we establish that perfect colorings of hypergraphs have almost the same algebraic and spectral properties as those for graphs. Moreover, we show that certain combinatorial structures can be represented as perfect colorings of specific hypergraphs or as eigenfunctions of multidimensional circulant matrices generated by an abelian group.

The talk is based on [1] and on recent joint work with Vladimir Potapov.

References

[1] A .A. Taranenko, *Perfect colourings of hypergraphs*, Linear and Multilinear Algebra, vol. 73, no. 9, 2025, pp. 1566-1590.

On strong nodal domains for eigenfunctions of Hamming graphs

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The Laplacian matrix of the n-dimensional hypercube has $n+1$ distinct eigenvalues $2i$, where $0 \leq i \leq n$. In 2004, Bıyıkoğlu, Hordijk, Leydold, Pisanski and Stadler [1] initiated the study of eigenfunctions of hypercubes with the minimum number of weak and strong nodal domains. In particular, they proved that for every $1 \leq i \leq \frac{n}{2}$ there is an eigenfunction of the hypercube with eigenvalue $2i$ that have exactly two strong nodal domains. Based on computational experiments, they conjectured that the result also holds for all $1 \leq i \leq n-2$. In this work, we confirm their conjecture for $i \leq \frac{2}{3}(n-\frac{1}{2})$ if i is odd and for $i \leq \frac{2}{3}(n-1)$ if i is even. We also consider this problem for the Hamming graph $H(n,q)$, $q \geq 3$ (for $q=2$, this graph coincides with the n-dimensional hypercube), and obtain even stronger results for all $q \geq 3$.

This is a joint work with Konstantin Vorob'ev.

References

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Generalized spectral characterizations of Eulerian graphs: revisited

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Let G be an Eulerian graph on n vertices with adjacency matrix A and characteristic polynomial $\phi(x)$. We show that when n is even (resp. odd), the square-root of $\phi(x)$ (resp. $x\phi(x)$) is an annihilating polynomial of A, over $\mathbb{F}_2$. The result was achieved by applying the Jordan canonical form of A over the algebraic closure $\bar{\mathbb{F}}_2$. Based on this, we show that a family of Eulerian graphs are determined by their generalized spectrum among all Eulerian graphs, which significantly simplifies and strengthens the previous result. This is a joint work with Kunyue Li and Hao Zhang.

New infinite families of divisible design graphs, which are covers of strongly regular polar graphs

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We consider only simple graphs. A *divisible design graph* with parameters $(v, k, \lambda_1, \lambda_2, m, n)$ is a k-regular graph on v vertices such that its vertex set can be partitioned into m classes of size n where any two distinct vertices from the same class have exactly λ_1 common neighbours and any two vertices from different classes have exactly λ_2 common neighbours. Divisible design graphs were introduced in [3] as a bridge between graph theory and the theory of group divisible designs. Since then, tens of constructions of divisible design graphs have been introduced.

In [1, Proposition 12.5.3], a construction of antipodal distance-regular graphs of diameter 3 was given. This construction uses a vector space of dimension 2 equipped with a nondegenerate symplectic bilinear form. Note that the construction admits the vector spaces over all finite fields $\mathbb{F}_q$. Another ingredient of the construction above is a subgroup N of index $r \geq 2$ in $\mathbb{F}_q^*$. In our work we show that it is possible to slightly modify this construction by plugging a difference set in the (cyclic) quotient group $\mathbb{F}_q^+/N$ into it and letting the dimension of the vector space be an arbitrary positive even integer. This leads to a new infinite family of divisible design graphs that are r-covers of the corresponding symplectic strongly regular polar graphs [2, Section 2.5].

Further, we mimic the construction of divisible design graphs above by replacing the symplectic bilinear form with a bilinear (resp. sesquilinear) form obtained by the polarisation of hyperbolic, elliptic and parabolic quadratic forms (resp. by the polarisation of the Hermitian form). This gives a few more infinite families of r-covers of strongly regular polar graphs (see [2, Section 2.6, Section 2.7]). These infinite families of r-covers contain infinite subfamilies of non-trivial divisible design graphs in the elliptic, parabolic and Hermitian cases.

This is joint work with Bart De Bruyn and Sergey Goryainov.

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Attempts on Haemers' conjecture

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Haemers conjectures that almost all graphs are determined by their spectra, in other words almost all graphs have no cospectral mate or "one can hear the shape of almost all graphs". Suppose $G \sim \mathcal{G}(n,p)$ is a random graph with each edge chosen independently with probability p with $0 < p < 1$. Then

$$\Pr(G \text{ is not controllable}) + \sum_{\ell=2}^{n^{n^2}} \Pr(G \text{ has a generalized copsectral mate with level } \ell) \to 0$$

as $n \to \infty$ implies that almost all graphs are determined by their generalized spectra. It is known that almost all graphs are controllable. We show that almost all graphs have no cospectral mate with fixed level ℓ, namely

$$\Pr(G \text{ has a copsectral mate with level } \ell) \to 0$$

as $n \to \infty$ for every $\ell \geq 2$. The result can also be interpreted in the framework of random symmetric integral matrices.

This talk is based on joint work with Wei Wang.

Euclidean designs from spherical embedding of Q-polynomial coherent configurations

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Coherent configurations are the generalization of association schemes. It is known that the spherical embedding of Q-polynomial association schemes can form spherical t-designs. The concept of Q-polynomial coherent configuration was introduced by Suda in 2022. In this talk, we discuss the spherical embedding of Q-polynomial coherent configuration. We will present a necessary and sufficient condition when the embedding becomes a Euclidean t-design (on two concentric spheres). In addition, if we further assume each fiber is a P-polynomial association scheme, then $t \leq 10$.

List of Participants

1. Sam Adriaensen (Vrije Universiteit Brussel)
2. Anwita Bhowmik (Hebei Normal University)
3. Meng-Yue Cao (University of Science and Technology of China)
4. Xi Chen (Hebei Normal University)
5. Tao Feng (Beijing Jiaotong University)
6. Sergey Goryainov (Hebei Normal University)
7. Willem Haemers (Tilburg University)
8. Vladislav Kabanov (Hebei Normal University)
9. Thomas Karam (Shanghai Jiao Tong University)
10. Elena Konstantinova (Three Gorges Mathematical Research Center & China Three Gorges University & Mathematical Center in Akademgorodok & Sobolev Institute of Mathematics & Novosibirsk State University)
11. Jack Koolen (University of Science and Technology of China)
12. Denis Krotov (Sobolev Institute of Mathematics)
13. Huiqiu Lin (East China University of Science and Technology)
14. Zhiming Liu (Hebei Normal University)
15. Ruilin Ma (Hebei Normal University)
16. Anna Taranenko (Sobolev Institute of Mathematics)
17. Alexandr Valyuzhenich (Hebei Normal University)
18. Wei Wang (Xi'an Jiaotong University)
19. Ruihan Xie (Hebei Normal University)
20. Weihao Yan (Hebei Normal University)
21. Da Zhao (East China University of Science and Technology)
22. Yan Zhu (University of Shanghai for Science and Technology)

Hebei Normal University (HEBNU)

From its inception, Hebei Normal University has embraced the mission of reform and innovation, aiming to enlighten the public and fostering a strong red gene and revolutionary tradition. The university has been deeply involved in the great journey of national rejuvenation, always sharing the same destiny with the Chinese nation' s struggle for independence, freedom, democracy, and prosperity. Distinguished figures such as revolutionaries Deng Yingchao, Liu Qingyang, Guo Longzhen, Yang Xiufeng, Kang Shien, Rong Gaotang, patriotic scholars Liang Shuming, Zhang Shenfu, Tang Yongtong, academicians Yan Luguang, Hao Bolin, Li Shushen, He Hong, and sports elites Xu Shaofa, Cai Zhenhua, along with Li Zhanshu, a member of the Standing Committee of the 19th CPC Central Committee Politburo and Chairman of the 13th National People's Congress Standing Committee, have all studied or worked at HEBNU. From its early days as a "school" to its current status as a prestigious academic institution, Hebei Normal University, born in the era of "educating the nation to save the country", upholds the school motto of "Caring for the World and Seeking True Knowledge", continuously nurturing talents dedicated to national rejuvenation and patriotism.

The university firmly upholds the great banner of Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, adheres to the comprehensive leadership of the Party, fully implements the Party's educational policies for the new era, and remains committed to the socialist direction of running schools, leading the development of the university's endeavors with high-quality Party building. The university has been awarded titles such as "Flagship Unit of Grassroots Party Building", "Advanced Grassroots Party Organization", and "Civilized Unit" by the Provincial Party Committee and Government. One college has been recognized as a national benchmark for Party building work, and five Party branches have been selected as national model Party branches in higher education institutions.

In 2011, the university moved to a new campus covering 1,829 acres, with a library collection of 3.3 million volumes and access to over 70 Chinese and foreign language databases. The university currently has 24,936 undergraduate students, 5,870 master's students, 644 doctoral students, and 11,198 students in continuing education programs, spread across 23 schools and departments, along with an independent college (Huihua College).

HEBNU offers 86 undergraduate majors, 26 master's degree programs in first-level disciplines, 23 professional master's degree programs, 11 doctoral degree programs in first-level disciplines, 1 professional doctoral degree program, and 10 postdoctoral research stations. The disciplines span 11 fields: philosophy, economics, law, education, literature, history, science, engineering, medicine, management, and art. The university has one national key discipline, seven disciplines under the Hebei Province "Double First-Class" initiative, one national key discipline cultivation project in provincial universities, four strong characteristic disciplines (clusters) in provincial universities, and 14 key disciplines in provincial universities. In the 2023 Soft Science China University Ranking, 80 programs of HEBNU were listed, with 39 ranked among the top 50 nationwide and 7 ranked among the top 10.

The university has made continuous progress in scientific research, undertaking several significant research projects, including the National Key R&D Program, Major Projects of New Transgenic Organisms Breeding, Major Science and Technology Infrastructure Projects of the National Development and Reform Commission, National Natural Science Foundation Key Projects, Key International (Regional) Cooperation Research Projects, Regional Innovation Development Joint Fund Projects, Excellent Youth Science Fund Projects, National Social Science Foundation Major Bidding Projects, and key projects of the National Qing History Compilation Project, among others. The research group led by Academician Sun Daye won the National Natural Science Award, marking a significant achievement for Hebei Province.

HEBNU is committed to advancing research innovation platforms and think tank construction. The university currently hosts 1 Ministry of Education Key Laboratory, 2 Ministry of Education Humanities and Social Sciences Key Research Bases, 1 National Language and Literature Promotion Base, 1 Ministry of Education Collaborative Innovation Center co-established by the Ministry and Province, and 3 Ministry of Education National and Regional Research Filing Centers. Additionally, the university has 19 Hebei Provincial Key Laboratories, Technology Innovation Centers, Engineering Research Centers, and Fundamental Discipline Research Centers, 16 Key Research Bases for Humanities and Social Sciences, 2 International Cooperation Bases, 3 Collaborative Innovation Centers, and 3 New Think Tanks at the provincial level and above, totaling over 50 research and innovation platforms. The university's ability to serve economic construction and social development has been significantly enhanced.

The university remains focused on its fundamental task of cultivating virtue and nurturing talents, always remembering its original mission of “educating people for the Party and the nation”. It continuously improves its educational standards, striving to cultivate a new generation of talents committed to national rejuvenation. HEBNU has been recognized as a National Key Marxist College, with 14 programs passing the second-level certification for teacher education programs. The university boasts 34 national first-class undergraduate program construction sites, 21 national first-class courses, 1 innovative talent cultivation experimental zone, 6 special program construction sites, 4 comprehensive reform pilot projects for programs, 6 high-quality resource-sharing courses, 1 high-quality video open course, 4 high-quality online open courses, 4 experimental teaching demonstration centers, 1 virtual simulation experimental teaching project, and 3 professional degree graduate training practice bases. The university has been recognized as one of the “Top 50 Universities in China for Graduate Employment” and is included in the Ministry of Education’s “Excellence in Secondary School Teacher Training” reform project. In recent years, HEBNU has won 6 national teaching achievement awards (1 first prize, 5 second prizes).

The university has established a comprehensive teacher education system covering preschool, basic, higher, vocational, ethnic, and special education, emphasizing all six educational levels equally. HEBNU actively engages in the “Rural Teacher Internship Support Program”, effectively serving the development of rural basic education and contributing to rural revitalization. The university hosts the National Primary and Secondary School Key Teacher Training Base, the National Key Construction Vocational Education Teacher Training Base, the Ministry of Education Higher Education Counselors Training and Research Base, the Hebei Provincial Vocational Education Research Institute, the Education Science Research Institute, the Discipline Education Research Institute, the Hebei Province Primary and Secondary School Teacher Continuing Education Center, the Hebei Province Higher Education Teacher Training Center, the Hebei Province Modern Educational Technology Center, and the Hebei Province Main Node of the China Education and Research Network. The university remains attuned to the forefront of the times, seizing opportunities in the development of artificial intelligence, and has been approved for the Ministry of Education’s projects for “AI-Enhanced Teacher Workforce”, “5G+Smart Education”, and the “AI Education Research and Application Center”, supporting the transformation and high-quality development of teacher education in Hebei Province. By developing non-teacher education programs in response to social demands, HEBNU has established a new talent cultivation model that integrates teacher education with non-teacher education programs.

HEBNU currently employs 2,601 faculty and staff members, including 1,633 full-time teachers. Among the staff, 382 hold senior titles, and 919 hold associate senior titles. The university has 1 academician of the Chinese Academy of Sciences, 1 National High-Level Talent Team, 1 National Teaching Team, 1 National Teaching Master, 1 National “Ten Thousand Talents Plan” Teaching Master, 2 National Youth Talents, 16 experts receiving special government allowances from the State Council, and 1 National “Hundred Thousand Talent Project” recipient and expert with outstanding contributions to the nation. Additionally, HEBNU has 2 recipients of the National Excellent Young Scientists Fund and 213 provincial and above-level outstanding experts.

Hebei Normal University is committed to high-level international cooperation and exchanges with over 200 foreign universities. It is a recipient of the “Chinese Government Scholarship” and the “International Chinese Language Teachers Scholarship” programs and offers undergraduate, master’s, doctoral education, and Chinese language education in cooperation with more than 40 countries. The university has established 2 Confucius Institutes, 1 Confucius Classroom, 1 Portuguese-Chinese Bilingual High School, 1 Overseas College, and 2 Overseas Preparatory Academies. It has also sent Chinese language teacher volunteers to more than 20 countries, actively participating in the international promotion of the Chinese language.

河北师范大学简介

河北师范大学是河北省人民政府与教育部共建的省属重点骨干大学，河北省“双一流”建设一层次高校。学校起源于 1902 年创建于北京的顺天府学堂和 1906 年创建于天津的北洋女师范学堂，具有 120 多年的发展历史和光荣的办学传统。1996 年 6 月，原河北师范大学、河北师范学院与创建于 1952 年的河北教育学院、创建于 1984 年的河北职业技术师范学院合并，组建成新的河北师范大学。2014 年，河北省人民政府、教育部决定共建河北师范大学。

建校之初，河北师范大学就以革故鼎新、开启民智为使命，奠定鲜亮红色基因，积淀光荣革命传统，笃行于民族复兴伟大征程，始终同中华民族争取独立、自由、民主、富强的进步事业同呼吸、共命运。老一代革命家邓颖超、刘清扬、郭隆真、杨秀峰、康世恩、荣高棠，著名爱国主义学者梁漱溟、张申府、汤用彤，两院院士严陆光、郝柏林、李树深、贺泓，体育界精英许绍发、蔡振华，中共十九届中央政治局常委、十三届全国人大常委会委员长栗战书等都曾在师大工作学习。从创办初期的“学堂”到今天誉满燕赵的学术殿堂，诞生于“兴教救国”时代大潮中的河北师范大学秉承“怀天下、求真知”的校训精神，薪火相传，弦歌不辍，培养了一大批致力于民族振兴、爱国报国的栋梁之才。

学校高举习近平新时代中国特色社会主义思想伟大旗帜，坚持党的全面领导，全面贯彻新时代党的教育方针，坚持社会主义办学方向，以高质量党建引领学校事业高质量发展。学校先后被省委、省政府授予基层党建红旗单位、先进基层党组织、文明单位等称号。1 个学院入选全国党建工作标杆院系，5 个党支部入选全国高校党建工作样板党支部。2011 年，学校整体迁入新校区办学。新校区占地 1829 亩，馆藏图书 330 万册，中外文数据库 70 余个。在校本科生 24936 人、硕士研究生 5870 人、博士研究生 644 人，成人教育学生 11198 人。设有 23 个学院（系），1 个独立学院（汇华学院）。

学校现有本科专业 86 个，硕士一级学科学位授权点 26 个、硕士专业学位授权点 23 个，博士一级学科学位授权点 11 个、博士专业学位授权点 1 个，博士后科研流动站 10 个。学科专业覆盖哲学、经济学、法学、教育学、文学、历史学、理学、工学、医学、管理学、艺术学等 11 个学科门类。现有国家重点学科 1 个，河北省“双一流”建设学科 7 个、省高校国家重点学科培育项目 1 个、省高校强势特色学科（群）4 个、省高校重点学科 14 个。2023 软科中国大学专业排名中，学校共 80 个专业上榜，其中 39 个专业位居全国前 50 名，7 个专业位居全国前 10 名。

学校科学研究不断取得新进展。承担了一批国家重点研发计划，国家转基因生物新品种培育重大专项，国家发改委重大科技基础设施项目，国家自然科学基金重点项目、重点国际（地区）合作研究项目、区域创新发展联合基金项目、优秀青年科学基金项目，国家社科基金重大招标项目和国家清史纂修工程主体类项目等具有较大影响的科研项目。孙大业院士课题组获国家自然科学二等奖，填补了河北省的空白。

学校大力推进科研创新平台和智库建设。现有教育部重点实验室 1 个、教育部人文社会科学重点研究基地 2 个、国家语言文字推广基地 1 个、教育部省部共建协同创新中心 1 个、教育部国别和区域研究备案中心 3 个；河北省学科重点实验室、技术创新中心、工程研究中心、基础学科研究中心 19 个、人文社会科学重点研究基地 16 个、国际合作基地 2 个、协同创新中心 3 个、新型智库 3 个。省部级以上科研创新平台 50 余个，服务经济建设和社会发展能力明显增强。

学校聚焦立德树人根本任务，牢记“为党育人、为国育才”初心使命，不断提高办学水平，着力培养担当民族复兴大任的时代新人。获批全国重点马克思主义学院，14 个专业通过师范类专业第二级认证，拥有国家级一流本科专业建设点 34 个、一流本科课程 21 门、人才培养模式创新实验区 1 个、特色专业建设点 6 个、专业综合改革试点项目 4 项，精品资源共享课程 6 门、精品视频公开课 1 门、精品在线开放课程 4 门，实验教学示范中心 4 个、虚拟仿真实验教学项目 1 项、专业学位研究生培养实践基地 3 个，中国专业学位案例中心案例库收录教学案例 34 篇；省级一流专业建设点 18 个、一流本科课程 47 门、本科教育创新高地 7 个、品牌特色专业 8 个、专业综合改革试点项目 5 项、精品在线开放课程 14 门、虚拟仿真实验教学项目 10 项、课程思政示范课程 9 门、实验教学示范中心 5 个、虚拟仿真实验教学中心 2 个、课程思政教学研究示范中心 1 个。学校获评“全国毕业生就业典型经验高校 50 强”，入选教育部“卓越中学教师培养计划”改革项目实施院校。近年来，共获得 6 项国家级教学成果奖（一等奖 1 项，二等奖 5 项）。

学校建立了涵盖学前教育、基础教育、高等教育、职业教育、民族教育、特殊教育“六教并重”的全学段、全学科教师教育体系。深入开展顶岗实习支教工程，有效服务农村基础教育发展，助力乡村振兴。设有全国中小学骨干教师培训基地、全国重点建设职业教育师资培训基地、教育部高校辅导员培训和研修基地、河北省职业教育研究所、教育科学研究所、学科教育研究所、河北省中小学教师继续教育中心、河北省高等学校师资培训中心、河北省高校现代教育技术中心、中国教育科研网河北省主节点等机构。学校紧盯时代发展前沿，抢抓人工智能发展机遇，获批教育部“人工智能助推教师队伍建设”“5G+ 智慧教育”“人工智能教育研究与应用中心”建设项目，助力我省教师教育模式变革和高质量发展。面向社会需求发展非师范专业，形成了师范专业与非师范专业共同发展的人才培养新格局。

学校现有在职教职工 2601 人，其中专任教师 1633 人。在职教职工中，正高职人员 382 人，副高职人

员 919 人。其中中国科学院院士 1 人，拥有全国高校黄大年式教师团队 1 个、国家级教学团队 1 个、国家教学名师 1 人，国家“万人计划”教学名师 1 人，国家青年人才 2 人，国务院特殊津贴专家 16 人、国家“百千万人才工程”人选者、国家有突出贡献的中青年专家 1 人，国家优秀青年基金获得者 2 人，省级以上各类优秀专家 213 人次。河北师范大学坚持高水平开放合作，和 200 多所国外大学开展交往，是“中国政府奖学金”和“国际中文教师奖学金”项目接收单位，与 40 多个国家开展本、硕、博学历教育和汉语语言教育。建有 2 所孔子学院、1 所孔子课堂、1 所葡中双语高中、1 所海外学院、2 所海外预科学院。向 20 多个国家选派汉语教师志愿者，积极参与汉语国际推广。

进入新时代，开启新征程。全校上下正以党的二十大精神为指引，坚守师范教育初心，赓续百廿办学荣光，落实立德树人根本任务，踔厉奋发、笃行不怠，向着建设高水平综合性师范大学的目标稳步迈进，为奋力谱写中国式现代化建设河北篇章、实现中华民族伟大复兴作出新的更大贡献。

（相关数据截止至 2024 年 3 月）

School of Mathematical Sciences

Historical Evolution

The School of Mathematical Sciences at Hebei Normal University has three origins: the former Mathematics Department of Hebei Normal University, the Mathematics Department of the former Hebei Teachers College, and the Mathematics Department of the former Hebei College of Education. The Mathematics Department of Hebei Normal University was established in early 1950, evolving from the Department of Physics and Chemistry of Hebei Normal College in Tianjin. In August 1956, it was relocated to Shijiazhuang and became the Mathematics Department of Shijiazhuang Teachers College, later renamed the Mathematics Department of Hebei Normal University in 1962. The Mathematics Department of Hebei Teachers College originated from the Mathematics Department of Hebei Normal Junior College in 1951, renamed as the Mathematics Department of Hebei Beijing Teachers College in 1956, and incorporated the Mathematics Department of Beijing Railway Teachers College in 1961. After relocating to Xuanhua, Zhangjiakou in 1969, it was renamed the Mathematics Department of Hebei Teachers College and moved to Shijiazhuang City in 1981. The Mathematics Department of Hebei College of Education was established in 1986. In 1996, the four schools merged to form the new Hebei Normal University, and in November 1998, the Mathematics Departments of the former Hebei Normal University, Hebei Teachers College, and Hebei College of Education merged to form the Mathematics Department of Hebei Normal University. In January 2000, it merged with the Computer Science Department to form the School of Mathematics and Information Science. In April 2019, after the separation of the Computer Science Department into the School of Computer and Cyber Security, the School of Mathematics and Information Science was renamed the School of Mathematical Sciences in October 2019.

Disciplinary Development

The Mathematics discipline of Hebei Normal University was among the first to be authorized to confer master's degrees after the formal establishment of the degree system in China in the early 1980s. It was authorized to confer doctoral degrees in Basic Mathematics and Applied Mathematics in 1998 and 2006, respectively. It established a postdoctoral research station in 2007 and was approved as a first-level doctoral degree-granting discipline in 2011, becoming the first in Hebei Province. Over the years, with key support from Hebei Province and the university, the Mathematics discipline has achieved significant development. In 2005, it was selected as a prominent characteristic discipline in Hebei Province. In 2013, it was identified as a national key discipline cultivation discipline by Hebei universities, and in 2016, it was identified as a “Double First-Class” discipline construction site in Hebei Province. In the fourth round of national disciplinary assessment announced by the Ministry of Education, Mathematics was classified as a Category B discipline, especially achieving new breakthroughs in the fifth round. While advancing academic development, Mathematics has actively served societal needs, establishing platforms for basic theoretical research and applied R&D. Currently, it has several provincial-level research platforms, including the Hebei Province Basic Mathematics Basic Discipline Research Center, Hebei Applied Mathematics Center, Hebei Province Key Laboratory of Computational Mathematics and Applications, Hebei Province Collaborative Innovation Center for Digital Education, Hebei Province International Joint Research Center for Mathematics and Interdisciplinary Sciences, and Hebei Province Foreign Academician Workstation. Additionally, the Hebei Mathematical Society is affiliated with our college.

Scientific Research

The Mathematics discipline has distinctive research teams in operator algebra and operator theory, intelligent computing and applications, combinatorial mathematics, differential equations, and dynamical systems. Since 2018, it has undertaken 58 projects funded by the National Natural Science Foundation of China, including one key project, one international (regional) cooperation and exchange key project, and one National Science Fund for Distinguished Young Scholars project. It has undertaken 44 provincial and ministerial projects, winning one second prize and two third prizes of the Hebei Provincial Natural Science Award; it has hosted 25 high-level international and national academic conferences. In terms of scientific research, Mathematics has created several firsts for the university: the first National Science Fund for Distinguished Young Scholars project, the first introduction of overseas high-level talent program awardees, the first introduction of winners of the National Science Fund for Distinguished Young Scholars, and the only national excellent doctoral dissertation.

Talent Cultivation

The Mathematics discipline is an important talent cultivation base for middle school mathematics teachers in Hebei Province. It has maintained a high-quality tradition of education over the years, with significant achievements in undergraduate and graduate education and a continuous emergence of talented individuals. Currently, the discipline offers three undergraduate majors: Mathematics and Applied Mathematics, Applied Statistics, and Data Computing and Applications, enrolling over 370 undergraduates annually, with the Mathematics and Applied Mathematics major being a national first-class undergraduate major construction point. The first-level discipline of Mathematics enrolls over 10 doctoral students and over 70 master's students annually. The college sends hundreds of doctoral and master's graduates to research institutes at home and abroad every year, many of whom have become key forces in universities and research institutions. Notable alumni include Liu Jianya, Distinguished Young Scholar of China and Vice President of Shandong University; Li Zenghu, Distinguished Young Scholar of China and Professor at Beijing Normal University; Liu Peidong, Distinguished Young Scholar of China and Professor at Peking University; Guo Junyi, Vice Chairman of the 12th Council of the Chinese Mathematical Society and Professor at Nankai University; Feng Rongquan, Secretary of the Mathematics Discipline Appraisal Group of the Seventh Academic Degrees Committee of the State Council and Professor at Peking University; Wang Yanfei, Distinguished Young Scholar of China and Researcher at the Institute of Geology and Geophysics, Chinese Academy of Sciences; Zhang Meizhi, Vice Chairman of the Standing Committee of the Hebei Provincial People's Congress and Chairman of the Hebei Provincial Committee of the China Democratic League; and Liu Minghui, President of China Gas Holdings Limited. Currently, in the field of basic education in Hebei Province, more than a hundred graduates of the Mathematics discipline hold school-level leadership positions, and over 90 are special-grade teachers and senior teachers.

Faculty Strength

The Mathematics discipline has a strong faculty, currently comprising 34 professors, 41 associate professors, 4 foreign full-time and part-time teachers (including 1 high-end foreign expert from the National Bureau of Foreign Experts), and 25 teachers with overseas experience. The faculty team includes 2 national distinguished experts, 2 experts receiving the State Council Special Allowance, 2 recipients of the National Natural Science Foundation of China Overseas Joint Fund (Outstanding Young B), 2 recipients of the National Science Fund for Distinguished Young Scholars, 2 awardees of the Ministry of Education's New Century Excellent Talents, 1 Chinese Academy of Sciences Hundred Talents Program awardee, 1 recipient of the National Excellent Doctoral Dissertation, 1 Hebei Yan Zhao Scholar, 2 recipients of the Hebei Province Outstanding Youth Fund, 2 Hebei Province outstanding young and middle-aged experts with significant contributions, 1 Hebei Province teaching master, and 1 Hebei Province outstanding returned personnel.

Applied Research

While achieving fruitful results in basic research, the discipline has also made breakthroughs in applied research. Relying on the Mathematics discipline, the college has established the Software College and the Internet of Things Research Institute through school-enterprise cooperation, providing a platform for the integration of Mathematics with Information, Geography, Electronics, and other disciplines. In 2013, it was approved as Hebei Province's first collaborative innovation center focused on educational technology –the "Hebei Province Collaborative Innovation Center for Digital Education". In 2015, the center's "Smart City and Educational Equity" project won the Global Smart City Project Award at the 5th Barcelona Smart City Expo and Global Summit, becoming the only Chinese project to receive this honor. Its E • School educational product, through digital and networked transformation of "teaching" and "learning", has effectively promoted reform and educational equity in basic education, currently being piloted in 24 primary and secondary schools in Hebei Province. Currently, the college is undertaking the development of the "BeitaiTianyuan" national general-purpose scientific computing software –Image Processing Toolbox research and development project, expected to achieve new breakthroughs in applied research.

河北师范大学数学科学学院简介

历史沿革

河北师范大学数学科学学院的起源有三个分支，即原河北师范大学数学系、原河北师范学院数学系、原河北教育学院数学系。原河北师范大学数学系成立于 1950 年初，是从天津河北师范学院理化系分立发展起来的，1956 年 8 月迁至石家庄，建立石家庄师范学院数学系，1962 年更名为河北师范大学数学系。河北师范学院数学系发端于 1951 年河北师范专科学校的数学科，1956 年更名为河北北京师范学院数学系，1961 年北京铁道师范学院数学系并入，1969 年迁至张家口宣化后，更名为河北师范学院数学系，1981 年随原河北师范学院迁至石家庄市。河北教育学院数学系成立于 1986 年。1996 年四校合并成立新的河北师范大学，1998 年 11 月原河北师范大学数学系、原河北师范学院数学系、原河北教育学院数学系合并成立了河北师范大学数学系，2000 年 1 月与计算机系合并组建数学与信息科学学院。2019 年 4 月，计算机系从数学与信息科学学院分离并入计算机与网络空间安全学院后，数学与信息科学学院于 2019 年 10 月更名为数学科学学院。

学科发展

河北师范大学数学学科是上世纪 80 年代初我国正式建立学位制度后首批获得硕士学位授予权的学科，1998 年和 2006 年分别获得基础数学和应用数学博士学位授予权，2007 年设立博士后科研流动站，2011 年获批博士学位授权一级学科，是目前河北省首个的数学学科博士学位授权点。多年来，在河北省及学校的重点建设下，数学学科得到了长足发展。2005 年数学学科入选河北省强势特色学科，2013 年被确定为河北省高校国家重点学科培育学科，2016 年被确定为河北省“双一流”建设世界一流学科建设点。在教育部公布的全国第四轮学科评估结果中，数学学科进入 B 类学科，特别是在第五轮学科评估中取得新突破。数学学科在推进学术发展的同时积极服务社会需求，建立了基础理论研究、应用研发等多个平台，目前拥有河北省基础数学基础学科研究中心、河北应用数学中心、河北省计算数学与应用重点实验室、河北省数字教育协同创新中心、河北省数学与交叉科学国际联合研究中心、河北省外国院士工作站等省级科研平台。此外，河北省数学会也挂靠在我院。

科学研究

数学学科建有算子代数与算子理论、智能计算及应用、组合数学、微分方程与动力系统等特色研究团队，2018 年以来承担国家自然科学基金项目 58 项，其中包括国家自然科学基金重点项目 1 项，国际 (地区) 合作与交流重点项目 1 项，国家优秀青年科学基金项目 1 项。承担省部级项目 44 项，获河北省自然科学奖二等奖 1 项、三等奖 2 项；举办高水平国际和全国性学术会议 25 次。在科学研究方面，数学学科创造了多项学校第一：首次获批国家自然科学基金优秀青年基金项目，首次引进海外高层次人才计划入选者，首次引进国家优秀青年科学基金项目获得者，获得了唯一一篇全国优秀博士学位论文。

人才培养

数学学科是河北省中学数学师资的重要人才培养基地，多年来一直保持高质量的育人传统，在本科教育和研究生教育方面成果显著，人才辈出。目前，数学学科设有数学与应用数学、应用统计学和数据计算及应用三个本科专业，年招收本科生 370 余人，其中数学与应用数学专业是国家级一流本科专业建设点；数学一级学科每年招收博士研究生 10 余人、硕士研究生 70 余人。学院每年为国内外科研院所输送博士、硕士研究生百余人，其中，许多已成为国内外高校和科研机构的骨干力量。国家杰出青年基金获得者、山东大学副校长刘建亚，国家杰出青年基金获得者、北京师范大学教授李增沪，国家杰出青年基金获得者、北京大学教授刘培东，中国数学会第十二届理事会副理事长、南开大学教授郭军义，第七届国务院学位委员会数学学科评议组秘书、北京大学教授冯荣权，国家杰出青年基金获得者、中国科学院地质与地球物理研究所研究员王彦飞，河北省人大常委会副主任、民进河北省委主委张妹芝，中国燃气控股有限公司总裁刘明辉等都是我校数学专业的优秀毕业生。目前，在河北省基础教育领域，数学学科毕业生中有百余人担任校级领导职务，特级教师及正高级教师 90 余人。

师资力量

数学学科师资力量雄厚，目前有正高职称教师 34 人，副高职称人员 41 人，外籍专兼职教师 4 人（含国家外专局高端外国专家 1 人），具有海外经历教师 25 人。教师团队中有国家级特聘专家 2 人、国务院特殊津贴专家 2 人、国家自然科学基金海外联合基金（杰青 B）获得者 2 人、国家优秀青年基金获得者 2 人、教育部新世纪优秀人才 2 人、中科院百人计划 1 人、全国百篇优博论文获得者 1 人、河北省燕赵学者 1 人、河北省杰出青年基金获得者 2 人、河北省有突出贡献的中青年专家 2 人、河北省教学名师 1 人、河北省优秀回国人员 1 人。

应用研究

在基础研究取得丰硕成果的同时，应用研究也取得了突破性进展。依托数学学科，通过校企合作方式创建了软件学院、物联网研究院，为数学与信息、地理以及电子等学科的交叉融合提供了平台。2013 年获批了河北省第一个面向教育技术领域的协同创新中心——“河北省数字教育协同创新中心”。2015 年该中心申报的“智慧城市与教育公平”荣获第五届巴塞罗那智慧城市博览会暨全球峰会全球智慧城市项

目大奖，成为我国唯一获此殊荣的项目；开发的 E• School 教育产品，通过“教”与“学”方式的数字化、网络化变革，有力推动了基础教育领域改革和教育公平，目前已被河北省教育厅在 24 所中小学试用。目前，学院承担了“北太天元”国产通用型科学计算软件—图像处理工具箱研发项目的研发工作，有望在应用研究领域取得新突破。