School of Mathematical Sciences, Hebei Normal University

International Combinatorial Conference

Shijiazhuang, China, October 17–19, 2026

Abstracts

Shijiazhuang, China – 2026

Abstracts of the International Combinatorial Conference, Shijiazhuang, Hebei Normal University, School of Mathematical Sciences, 2026. – p. 44.

Editors
Sergey Goryainov, Hebei Normal University
Liping Yuan, Hebei Normal University

Contents

General Information **4**

Timetable **5**

Program **6**

Plenary Talks **8**

Short Talks **26**

List of Participants **37**

Hebei Normal University (HEBNU) **38**

河北师范大学简介 **40**

School of Mathematical Sciences **42**

河北师范大学数学科学学院简介 **44**

General Information

Venue: The International Combinatorial Conference will take place at the room D203 of the School of Mathematical Sciences of Hebei Normal University, Shijiazhuang, China on October 17–19, 2026.

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

Language: The working language of the event is English.

Program: The program includes seventeen 40-minute plenary talks and ten short 25-minute talks.

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

Organised by: School of Mathematical Sciences, Hebei Normal University

Sponsors:
Innovation Center for Mathematics and Data Science ("111" Center)
National Natural Science Foundation of China
Natural Science Foundation of Hebei Province
School of Mathematical Sciences, Hebei Normal University

Website: `https://sxxy.hebtu.edu.cn/a/icc2026/`

Timetable

<table>
<tr><th colspan="3">International Combinatorial Conference
October 17-19, 2026
Hebei Normal University</th></tr>
<tr><td>October 17
Saturday</td><td>October 18
Sunday</td><td>October 19
Monday</td></tr>
<tr><td rowspan="2">9:00-9:40
Akihiro Munemasa</td><td rowspan="2">9:00-9:40
Willem Haemers</td><td>9:00-9:25
Jim Wittebol</td></tr>
<tr><td>9:25-9:50
Thijs van Veluw</td></tr>
<tr><td colspan="2">9:40-10:05
Break</td><td>9:50-10:10
Break</td></tr>
<tr><td rowspan="2">10:05-10:45
Jack Koolen</td><td rowspan="2">10:05-10:45
Wei Wang</td><td>10:10-10:35
Hong-Jun Ge</td></tr>
<tr><td>10:35-11:00
Jingyuan Liu</td></tr>
<tr><td>10:50-11:30
Tao Feng</td><td>10:50-11:30
Ilia Ponomarenko</td><td>11:05-11:30
Jiafu He</td></tr>
<tr><td colspan="2">11:30-13:30
Lunch</td><td>11:30-13:30
Lunch</td></tr>
<tr><td rowspan="2">13:30-14:10
Ziqing Xiang</td><td rowspan="2">13:30-14:10
Chi Hoi Yip</td><td>13:30-13:55
Ruihan Xie</td></tr>
<tr><td>13:55-14:20
Ruilin Ma</td></tr>
<tr><td>14:15-14:55
Yan Zhu</td><td>14:15-14:55
Gary Greaves</td><td>14:20-14:45
Letian Zhang</td></tr>
<tr><td>15:00-15:40
Ferdinand Ihringer</td><td>15:00-15:40
Sam Adriaensen</td><td></td></tr>
<tr><td colspan="2">15:40-16:20
Break</td><td></td></tr>
<tr><td>16:20-17:00
Da Zhao</td><td>16:20-17:00
Yanbo Zhang</td><td></td></tr>
<tr><td>17:05-17:45
Qianqian Yang</td><td>17:05-17:45
Bart De Bruyn</td><td></td></tr>
<tr><td rowspan="2">17:50-18:30
Tianxiao Zhao</td><td>17:50-18:15
Zhao Kuang Tan</td><td rowspan="2"></td></tr>
<tr><td>18:15-18:40
Haoran Zhu</td></tr>
<tr><td colspan="2">18:40-20:00
Dinner</td><td></td></tr>
</table>

Program

Saturday, October 17

09:00 - 09:40	Akihiro Munemasa: *A family of antipodal distance-regular cover of complete graphs arising from skew generalized Hadamard matrices*
9:40 - 10:05	Break
10:05 - 10:45	Jack Koolen: *The regular two-graph on 276 vertices, revisited*
10:50 - 11:30	Tao Feng: *The asymptotic existence of designs having a nesting: an application of a hypergraph matching theorem*
11:30 - 13:30	Lunch
13:30 - 14:10	Ziqing Xiang: *Three recent results*
14:15 - 14:55	Yan Zhu: *Graphical designs from independent sets and equitable partitions*
15:00 - 15:40	Ferdinand Ihringer: *The Structure of Boolean Degree d Functions on the Grassmann Graph*
15:40 - 16:20	Break
16:20 - 17:00	Da Zhao: *Random graphs determined by spectrum with various edge density*
17:05 - 17:45	Qianqian Yang: *Recent results on sesqui-regular graphs with smallest eigenvalue at least* -3
17:50 - 18:30	Tianxiao Zhao: *On the existence problems of strongly regular graphs*
18:40 - 20:00	Dinner

Saturday, October 18

09:00 - 09:40	Willem Haemers: *Spectral Determination of Cubic Graphs*
9:40 - 10:05	Break
10:05 - 10:45	Wei Wang: *Generalized Spectral Characterizations Under Graph Operations*
10:50 - 11:30	Ilia Ponomarenko: *Automorphism groups and isomorphism testing for almost all direction graphs*
11:30 - 13:30	Lunch
13:30 - 14:10	Chi Hoi Yip: *Intersecting families and nonvanishing multivariate polynomials over finite fields*
14:15 - 14:55	Gary Greaves: *How to design a graph with three eigenvalues*
15:00 - 15:40	Sam Adriaensen: *A construction of tight sets in finite classical polar spaces*
15:40 - 16:20	Break
16:20 - 17:00	Yanbo Zhang: *Ramsey goodness of large books beyond chromatic surplus one*
17:05 - 17:45	Bart De Bruyn: *On Neumaier graphs with four or five eigenvalues*
17:50 - 18:15	Zhao Kuang Tan: *Neumaier graphs of coherent rank five*
18:15 - 18:40	Haoran Zhu: *Eigenvalue multiplicity of the wreath product Cayley graphs*
18:40 - 20:00	Dinner

Monday, October 19

09:00 - 09:25	Jim Wittebol: *The weight distribution bound for polar collinearity graphs*
09:25 - 09:50	Thijs van Veluw: *A unifying framework of existing and new constructions of Neumaier graphs*
9:50 - 10:10	Break
10:10 - 10:35	Hong-Jun Ge: *On co-edge-regular graphs with four distinct eigenvalues*
10:35 - 11:00	Jing-Yuan Liu: *On signed graph with smallest eigenvalue at least* -3 *and their lattices*
11:05 - 11:30	Jiafu He: *Some advances in path-critical Ramsey numbers*
11:30 - 13:30	Lunch
13:30 - 13:55	Ruihan Xie: *Divisible design graphs obtained by plugging a divisible difference set into a construction for antipodal distance-regular graphs of diameter 3*
13:55 - 14:20	Ruilin Ma: *A generalisation of a matrix construction of divisible design graphs*
14:20 - 14:45	Letian Zhang: *On Delsarte cliques in the collinearity graphs of nets*

Abstracts

Plenary and short talks are listed alphabetically with respect to the Presenting Author

Plenary Talks

A construction of tight sets in finite classical polar spaces

Sam Adriaensen
Vrije Universiteit Brussel
sam.adriaensen@vub.be

A finite classical polar space Π is an incidence geometry embedded in a projective spaces over a finite field satisfying the "all-or-one axiom", and is typically associated with a polarity $\perp$ (which is orthogonal complementation with respect to a reflexive sesqui-linear form). The subspaces of largest dimension in Π are called generators.

There is a great interest in point sets in Π with strong regularity properties. For example, a tight set S in Π is a set of points which attains equality in a natural upper bound on the number of collinearities between points of S. Equivalently, the characteristic vector of S is a linear combination of the characteristic vectors of generators (as point sets).

In this talk, we will discuss a construction of tight sets of points in hyperbolic quadrics. We use Segre varieties embedded in the quadric to lift familiar objects such as the split Cayley hexagon and commutative semifields to tight sets in the quadric.

This is based on joint work with Jan De Beule, Jozefien D'haeseleer, and Morgan Rodgers.

On Neumaier graphs with four or five eigenvalues

Bart De Bruyn
Ghent University, Belgium
Bart.DeBruyn@UGent.be

A *Neumaier graph* is an edge-regular graph with a regular clique. Such a graph is said to have parameters $(v, k, \lambda; e, s)$ if it is a k-regular graph on v vertices having a clique of size s such that every edge is contained in λ triangles and every vertex outside C is adjacent with exactly e vertices inside C.

Neumaier graphs which are not strongly regular are called *strictly Neumaier graphs*; they have at least four eigenvalues. Till recently, all known strictly Neumaier graphs had at least six distinct eigenvalues. In my talk, I will discuss two recent results from the papers [1, 2]. First, we show that Neumaier graphs with exactly four eigenvalues cannot exist, and subsequently we describe a family of (strictly) Neumaier graphs, and construct inside this family 25 nonisomorphic Neumaier graphs with exactly five eigenvalues, all of which have parameters $(v, k, \lambda; e, s) = (48, 14, 2; 1, 2)$.

The talk is based on joint works with Aida Abiad, Jozefien D'Haeseleer, Rhys Evans, Sergey Goryainov and Jack Koolen.

Note: Very recently, a paper [3] occurred on the arXiv in which an infinite family of Neumaier graphs with exactly five eigenvalues was constructed (where the nexus e is moreover unbounded).

References

[1] A. Abiad, B. De Bruyn, J. D' haeseleer, J.H. Koolen, *Neumaier graphs with few eigenvalues*, Des. Codes Cryptogr. 90 (2022), 2003–2019

[2] B. De Bruyn, R.J. Evans, S. Goryainov, J.H. Koolen, *A family of Neumaier graphs containing examples with exactly five eigenvalues*, arXiv:2603.17029

[3] G. Greaves, K. Tan, *Neumaier graphs of coherent rank five*, arxiv.org/abs/2609.02218

The asymptotic existence of designs having a nesting: an application of a hypergraph matching theorem

Tao Feng
Beijing Jiaotong University
tfeng@bjtu.edu.cn

A nesting of a design is a way of extending each block by one point so that the resulting collection of larger blocks forms a design or a packing. In this talk, we study the asymptotic existence of nestings of balanced incomplete block designs (BIBDs), and explain how the problem can be transformed into a matching problem in an auxiliary hypergraph.

In particular, we show that, for $k \geq 2\lambda + 2$ and sufficiently large v, every (v, k, λ)-BIBD admits a nesting into a $(v, k + 1, \lambda + 1)$-packing. In the boundary case $k = 2\lambda + 1$, we also obtain the asymptotic existence of BIBDs having a perfect nesting for the admissible values of v. The main ingredient is a theorem of Delcourt and Postle on A-perfect matchings in bipartite uniform hypergraphs. We construct an auxiliary hypergraph whose A-perfect matchings correspond precisely to suitable choices of the points to be adjoined to the blocks.

We will also discuss related applications to cyclic designs and difference families, including an asymptotic solution to a generalization of Novák's conjecture. These results illustrate how hypergraph matching techniques provide a unified approach to several existence problems concerning nestings and disjoint difference families.

How to design a graph with three eigenvalues

Gary Greaves
Nanyang Technological University, Singapore
gary@ntu.edu.sg

Connected regular graphs with three distinct adjacency eigenvalues are precisely the strongly regular graphs. Their nonregular counterparts are much less understood. In this talk, I will describe a connection between biregular graphs with three eigenvalues and group divisible designs (GDDs). When one degree class of such a graph induces a complete multipartite graph, the edges between the two degree classes form the incidence relation of a GDD. Under suitable compatibility conditions, this construction can be reversed. I will explore the resulting interplay among GDDs, regular graphs with at most four distinct eigenvalues, and biregular graphs with three distinct eigenvalues, and show how it leads to new constructions of all three types of objects. This talk is based on joint work with Jose Yip.

Spectral Determination of Cubic Graphs

Willem H. Haemers
Tilburg University, The Netherlands
haemers@tilburguniversity.edu

For spectral determinations of regular graphs, the cubic graphs behave somewhat exceptional and often require a special treatment. We report on a number results that illustrate this claim. The presentation is based on [2].

References

[1] Willem H. Haemers *On perfect matchings, edge-colourings and eigenvalues of cubic graphs*, Linear Algebra and its Applications 750 (2026) 84–90.

The Structure of Boolean Degree d Functions on the Grassmann Graph

Ferdinand Ihringer
Southern University of Science and Technology
ihringer@sustech.edu.cn

The *Grassmann graph* $J_q(n,k)$ has the k-spaces of an n-dimensional vector spaces over the field with q elements as vertices, two vertices adjacent when they meet in dimension $k-1$. A Boolean degree d function on $J_q(n,k)$ are the 0-1-valued vectors in the image of the d-space-k-space incidence matrix. Alternatively, these are 0-1-valued vectors in the eigenspace $V_0 + \cdots + V_d$ of the Grassmann scheme. For $d = 1$, Boolean degree 1 functions have been classified by the author and others for small q and $J_q(n,k)$, $n-k \geq n_0(k,q)$ and $n-k, k \geq 2$. Here we will present a structural characterization for any d and $k, n-k \geq n_0(q)$. Additionally, we will discuss some applications. For instance, we show that for any given d and q, there are only finitely many designs of degree d in $J_q(n,k)$.

Joint work with Yuval Filmus.

The regular two-graph on 276 vertices, revisited

Jack Koolen
University of Science and Technology of China
koolen@ustc.edu.cn

This is based on ongoing joint work with Akihiro Munemasa

In this talk, I will discuss the regular two-graph on 276 vertices. This is a beautiful mathematical object which has automorphism group $Co_3.2$. We will classify certain graphs in the switching class of this two-graph, and show how you can use this classification to obtain a Euclidean 2-distance set of order 277 in the Euclidean space of dimension 23, which was found in 2025 by Hong-Jun Ge, Akihiro Munemasa and me. There many many Euclidean 2-distance sets of order 276 in dimension 23.

A family of antipodal distance-regular cover of complete graphs arising from skew generalized Hadamard matrices

Akihiro Munemasa
China University of Geosciences (Beijing)
munemasa@tohoku.ac.jp

M. Klin and C. Pech [2] showed that a skew generalized Hadamard matrix $R(H)$ of order n^2 can be constructed from a generalized Hadamard matrix H of order n. This result is then used to construct an antipodal distance-regular cover of the complete graph K_{n^2}. Note that this process can be iterated to give an infinite family of skew generalized Hadamard matrices $\{R^n(H)\}_{n=1}^{\infty}$ from a given generalized Hadamard matrix H. Among the small generalized Hadamard matrix tabulated in [2, Table 2], the smallest one giving rise to a distance-regular antipodal cover which is not distance-transitive is

$$H_6 = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 2 & 2 & 1 \\ 0 & 1 & 0 & 1 & 2 & 2 \\ 0 & 2 & 1 & 0 & 1 & 2 \\ 0 & 2 & 2 & 1 & 0 & 1 \\ 0 & 1 & 2 & 2 & 1 & 0 \end{bmatrix} \in \mathbb{Z}_3^{6\times 6}.$$

Klin and Pech pointed out that this generalized Hadamard matrix is equivalent to the semibiplane announced in [1].

In this talk, we show that the matrix H_6 gives rise to an infinite family of antipodal distance-regular 3-covers of complete graphs K_{36^n} for $n = 1, 2, \ldots$, each of which is not arc-transitive, in particular, not distance-transitive. This is established by counting the number of edges in the neighborhood of two different edges, in the antipodal distance-regular 3-cover obtained from $R^n(H_6)$.

This is based on joint work with Takuya Ikuta.

References

[1] Z. Janko, T. Van Trung, Two new semibiplanes, J. Combin. Theory Ser. A 33 (1982), 102–105.

[2] M. Klin, C. Pech, A new construction of antipodal distance regular covers of complete graphs through the use of Godsil–Hensel matrices, Ars Math. Contemp. 4 (2011) 205–243.

Automorphism groups and isomorphism testing for almost all direction graphs

Ilia Ponomarenko
St. Petersburg Department of Steklov Mathematical Institute, Russia
inp@pdmi.ras.ru
(joint with Mikhail Muzychuk)

Let $\mathbb{F}$ be a finite field. For a set of directions $D \subseteq \mathrm{PG}(1,\mathbb{F})$, the *direction graph* has vertex set $\mathbb{F}^2$, with two distinct vertices adjacent if and only if the line joining them in $\mathrm{AG}(2,\mathbb{F})$ has direction in D. It is proved that, as $|\mathbb{F}| \to \infty$ through odd prime powers, almost all direction graphs X satisfy $\mathrm{Aut}(X) \leq \mathrm{A\,L}(2,\mathbb{F})$; here "almost all" refers to the uniform distribution on direction sets. Moreover, we identify a class containing almost all direction graphs such that isomorphism between a graph in this class and any direction graph over the same field can be tested in time polynomial in $|\mathbb{F}|$.

Generalized Spectral Characterizations Under Graph Operations

Wei Wang
Xi'an Jiaotong University
e-mail: wang_weiw@xjtu.edu.cn

A graph G is determined by its generalized spectrum if for any graph H, whenever H is cospectral with G and their complements are also cospectral, then H is isomorphic to G. In this talk, we present some recent results concerning the generalized spectral determination of graphs constructed via graph operations including line graphs, subdivision graphs, and others.

References

[1] Xinyu Dai, Yizhe Ji, Wei Wang, Hao Zhang, *On the generalized spectral characterization of line graphs*, preprint.

[2] Xinyu Dai, Yizhe Ji, Wei Wang, *On the generalized spectral characterization of subdivision graphs*, preprint.

[3] Xinyu Dai, Yizhe Ji, Wei Wang, *On the generalized spectral recognition of the rooted product with* P_2, preprint.

Three recent results

Ziqing Xiang
Southern University of Science and Technology
e-mail: xiangzq@sustech.edu.cn

I will discuss 3 of my recent results. First is on Haemers' conjecture for generalized spectrum, motivated by Wang's arithmetic condition on walk matrix. Second is on Berger-Charpin conjecture, where we use the theory of cyclotomic association schemes developed by Evdokimov-Ponomarenko. Third is on perfect codes and tight designs, related to Delsarte's conjecture.

Recent results on sesqui-regular graphs with smallest eigenvalue at least -3

Qianqian Yang
Shanghai University
qqyang@shu.edu.cn

Let $\lambda \geq 2$ be an integer. Classification results for strongly regular graphs with fixed smallest eigenvalue $-\lambda$ were obtained by Sims and, separately, by Neumaier.

Motivated by these results, we investigate sesqui-regular graphs, a broader class of regular graphs that includes strongly regular graphs as a subclass. We prove that every sesqui-regular graph with parameters (v, k, c) and smallest eigenvalue $-\lambda$ satisfies either $c \leq \lambda^2(\lambda - 1)$ or $v - k - 1 \leq \frac{(\lambda-1)^2}{4} + 1$. Furthermore, when $\lambda = 3$, we obtain a stronger result: either $c \leq 6$ or the graph belongs to an explicitly classified family.

This is joint work with Ruo-Lan Ding, Jack Koolen, Brhane Gebremichel, Masood Ur Rehman, and Jae Young Yang.

Intersecting families and nonvanishing multivariate polynomials over finite fields

Chi Hoi Yip
Hong Kong University of Science and Technology
machyip@ust.hk

Let $\mathcal{P}_{n,d}$ be the space of polynomials in n variables over $\mathbb{F}_q$ of degree at most d. Two polynomials $f, g \in \mathcal{P}_{n,d}$ *intersect* if $f(\mathbf{a}) = g(\mathbf{a})$ for some $\mathbf{a} \in \mathbb{F}_q^n$. A *star* consists of all polynomials $f \in \mathcal{P}_{n,d}$ satisfying $f(\mathbf{a}) = b$ for fixed $\mathbf{a} \in \mathbb{F}_q^n$ and $b \in \mathbb{F}_q$. In this talk, I will discuss the classification of maximum intersecting families in $\mathcal{P}_{n,d}$. When $n = 1$ and $d \geq 2$, it was previously shown that all maximum intersecting families are stars. We prove that the same conclusion holds for all $n \geq 2$ and $d \geq 2$ when q is odd. When q is even, however, the situation is more subtle, and interesting phenomena emerge. Joint work with Shamil Asgarli and Bence Csajbók.

Ramsey goodness of large books beyond chromatic surplus one

Yanbo Zhang
Hebei Normal University
ybzhang@hebtu.edu.cn

Nikiforov and Rousseau (*J. Combin. Theory Ser. B*, 2004) established Ramsey goodness of large books for complete graphs, and Fox, He, and Wigderson (*Adv. Comb.*, 2023) gave a quantitative proof avoiding the regularity lemma. Liu and Li (*J. Graph Theory*, 2025) subsequently characterized the fixed graphs for which large generalized books are Ramsey good under the assumption of chromatic surplus one. We extend their characterization to larger chromatic surplus and determine its sharp range of validity. Fix an integer $k \geq 2$, a graph H of order $h \geq 1$, and a graph G with chromatic number $p \geq 2$ and chromatic surplus s. In this talk, we show that, when $s \leq k$ for odd h and $s \leq k-1$ for even h, the equality $r(G, K_k + nH) = (p-1)(nh+k-1)+s$ holds for all sufficiently large n if and only if G is a subgraph of the join of a matching and a complete $(p-2)$-partite graph. This structural condition is sufficient for every $s \geq 1$, and both bounds are best possible for necessity. This is a joint work with Jiafu He.

Random graphs determined by spectrum with various edge density

Da Zhao
East China University of Science and Technology
zhaoda@ecust.edu.cn

Edwin van Dam and Willem Haemers conjectured that almost all graphs are determined by their spectra. Van Vu conjectured that almost all random symmetric ± 1 matrices are determined by their spectra. In this talk, we will review the recent progress on van Dam–Haemers conjecture and present new results. This includes but not limited to the work by Van de Berg, Van Werde, Wang, Wang, Wissing, Wu, Xiang, Xu, and Zhao [1–8].

References

[1] N. Van de Berg, A. Van Werde Are sparse graphs typically determined by their spectrum? on the arXiv. arXiv:2602.22757

[2] W. Wang and D. Zhao, Graph isomorphism and multivariate graph spectrum. *Advances in Applied Mathematics* **173** (2026) pp. 102994.

[3] W. Wang and S. Wu, On a generalization of the johnson-newman theorem to multiple rank-one perturbations. on the arXiv. arXiv:2512.12599.

[4] W. Wang and D. Zhao, Almost all graphs have no cospectral mate with fixed level. on the arXiv. arXiv:2509.05781.

[5] P. Wissing, Self-converse mixed graphs are extremely rare. *Discrete Mathematics* **345** (2022) pp. 112989.

[6] Z. Xiang, Natural graph spectra. on the arXiv. arXiv:2602.00936.

[7] Y. Xu and D. Zhao, Generalized block diagonal Laplacian spectrum of graphs. on the arXiv. arXiv:2511.23246.

[8] D. Zhao, Almost all graphs have no cospectral mates with height relative small to its order. on the arXiv. arXiv:2604.02165v2.

On the existence problems of strongly regular graphs

Tianxiao Zhao
Harbin Institute of Technology
zhaotianxiao@hit.edu.cn

Strongly regular graphs is an important family is graph theory. Each of them has four parameters (v, k, λ, μ) which should satisfy some feasible conditions. We applied a method based on the Euclidean representation of a graph, and enumerate all possible cases, to find possible $\mathrm{srg}(85, 14, 3, 2)$, and finally proved that such graph does not exist. We will also talk about some current results about directed strongly regular graphs.

References

[1] S. Shpectorov, T. Zhao, *Strongly regular graphs with parameters (85,14,3,2) do not exist,* , Journal of Combinatorial Theory, Series A, Volume 225, 2027, 106242.

Graphical designs from independent sets and equitable partitions

Yan Zhu
University of Shanghai for Science and Technology
zhuyan@usst.edu.cn

Graphical designs extend the notion of spherical designs to finite graphs through quadrature formulas. In this talk, we explore their connections with several combinatorial structures in regular graphs, including independent sets, equitable partitions, and completely regular subsets. We show that tight 2-independent sets give rise to graphical designs and apply this result to prove that q-ary Hamming codes are extremal designs in Hamming graphs. We also characterize extremal graphical designs in terms of equitable bipartitions and discuss constructions arising from completely regular subsets and their distance partitions.

Short Talks

On co-edge-regular graphs with four distinct eigenvalues

Hong-Jun Ge
University of Science and Technology of China
gehj22@mail.ustc.edu.cn

This is joint work with Edwin R. van Dam and Jack H. Koolen

A connected k-regular graph on v vertices is called co-edge-regular with parameters (v, k, μ) if every pair of distinct nonadjacent vertices has exactly μ common neighbours. The λ-level of a graph G is the number of distinct values of $|N(x) \cap N(y)|$ as xy ranges over the edges of G.

Tan, Koolen, and Xia conjectured that, for a fixed smallest eigenvalue under suitable largeness and density assumptions, every connected co-edge-regular graph with exactly four distinct eigenvalues must be either a clique extension of a strongly regular graph or a grid graph. Both have λ-level 2.

In this talk, we present a construction yielding infinite families of counterexamples. Every graph constructed is cospectral with a clique extension of a strongly regular graph, but has λ-level larger than 2.

The construction is based on group-divisible orthogonal arrays and parallel classes arising from vector spaces over finite fields. The graphs in this family have smallest eigenvalue -5 and λ-level 3. More strikingly, the coherent closure of each graph is the full matrix algebra, so its coherent rank attains the maximum possible value v^2, where v denotes its number of vertices.

These constructions show that, even in the co-edge-regular four-eigenvalue setting, spectral simplicity does not preclude either unbounded local complexity or maximal coherent-algebraic complexity.

Some advances in path-critical Ramsey numbers

Jiafu He
School of Mathematical Sciences, Hebei Normal University
jfhe.edu@gmail.com

If, in every red-blue edge-coloring of G, there is either a red copy of G_1 or a blue copy of G_2, then G is called a Ramsey graph for G_1 and G_2. Thus, when $r = R(G_1, G_2)$, the complete graph K_r is a complete Ramsey graph of minimum order. A natural question is how large a subgraph can be deleted from K_r while preserving the Ramsey property. When the deleted subgraph is required to be a path, this leads to the path-critical Ramsey number $R_\pi(G_1, G_2)$. In this talk, we study path-critical Ramsey numbers. We establish an improved general upper bound that takes into account the number of universal vertices. We also determine several new exact values for complete graphs versus fans and trees, books and generalized books versus trees, and paths versus paths.

On signed graph with smallest eigenvalue at least -3 and their lattices

Jing-Yuan Liu
University of Science and Technology of China
liujingyuan@mail.ustc.edu.cn

Graphs with smallest eigenvalue at least -2 can be represented by root lattices. In 2018 [1], Koolen et al. gives a result on (unsigned) graphs with smallest eigenvalue at least -3 and their associated lattices. This talk presents an extension of this theory to signed graphs.
We prove that every connected signed graph with smallest eigenvalue greater than $-3-\varepsilon$ and sufficiently large minimum valency has smallest eigenvalue at least -3, and its associated lattice is a sublattice of $\mathbb{Z}^n \oplus E_8^m$ for some n, m.
This is based on a joint work with Meng-Yue Cao, Jack H. Koolen, and Qianqian Yang.

References

[1] Jack H. Koolen, Jae Young Yang, Qianqian Yang, *On graphs with smallest eigenvalue at least −3 and their lattices*, Advances in Mathematics, 338, 2018, 847–864.

A generalisation of a matrix construction of divisible design graphs

Ruilin Ma
Hebei Normal University
2868414086@qq.com

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.

In [3, Construction 4.8], a construction of divisible design graphs was given. The idea was to inflate the entries of a regular symmetric Hadamard matrix constant diagonal (RSHCD) using the matrices I_n and $J_n - I_n$, where $n \geq 2$ is an integer, I_n is the identity matrix of order n and J_n is the all-ones matrix of the same order. In [1, Theorem 3.9], this construction was generalised by viewing the matrices I_n and $J_n - I_n$ as the incidence matrices of trivial complementary square designs and replacing them by the incidence matrices of complementary square designs that are not necessarily trivial.

In this talk we propose a further extension of the constructions above, where the square designs are replaced by square group divisible designs.

Joint work with Bart De Bruyn and Sergey Goryainov.

References

[1] D. Crnković, W. H. Haemers, *Walk-regular divisible design graphs*, Designs, Codes and Cryptography, 72 (2014) 165–175. https://doi.org/10.1007/s10623-013-9861-0

[2] W. H. Haemers, H. Kharaghani, M. A. Meulenberg, *Divisible design graphs*, Journal of Combinatorial Theory, Series A, 118 (2011) 978–992. https://doi.org/10.1016/j.jcta.2010.10.003

Neumaier graphs of coherent rank five

Zhao Kuang Tan
Nanyang Technological University
zhaokuan001@e.ntu.edu.sg

The coherent closure of a graph is the smallest coherent algebra containing its adjacency matrix, and its dimension is the coherent rank. A Neumaier graph with parameters $(v, k, \lambda; e, s)$ is a non-complete k-regular graph on v vertices in which every edge lies in λ triangles and which contains a clique of size s such that every vertex outside it has exactly $e \geq 1$ neighbours in it. Strongly regular graphs have coherent rank three. Greaves and Koolen [1] constructed the first strictly Neumaier graphs, that is, Neumaier graphs that are not strongly regular, and results of Abiad, De Bruyn, D'haeseleer and Koolen [2] imply that such graphs have coherent rank at least five. In earlier work [3], we found strictly Neumaier graphs of coherent rank six.

In this work, we present an infinite family of Neumaier graphs of coherent rank five, answering the existence question at the smallest possible coherent rank beyond the strongly regular case [4]. For every prime power $q \geq 7$ with $q \equiv 3 \pmod 4$, set $n = q + 1$. Each graph has precisely five distinct eigenvalues, Neumaier parameters

$$(n(n-1)(n-3),\ n^2(n-3)/2,\ n(n^2-n-8)/4;\ (n-2)^2/2,\ (n-1)(n-3)),$$

and its adjacency matrix lies in the Bose–Mesner algebra of the four-class association scheme of Holzmann, Kharaghani and Suda [5]. The construction combines a Hadamard matrix of order n with $n-3$ mutually orthogonal Latin squares of order $n-1$. Paley Hadamard matrices and Desarguesian Latin squares give the family, whose smallest member has parameters $(280, 160, 96; 18, 35)$.

This is joint work with Gary Greaves.

References

[1] G. Greaves, J. H. Koolen, *Edge-regular graphs with regular cliques*, European J. Combin., 71, 2018, 194–201.

[2] A. Abiad, B. De Bruyn, J. D'haeseleer, J. H. Koolen, *Neumaier graphs with few eigenvalues*, Des. Codes Cryptogr., 90, 2022, 2003–2019.

[3] G. Greaves, Z. K. Tan, *Neumaier graphs from cyclotomy with small coherent rank*, arXiv:2504.12026.

[4] G. Greaves, Z. K. Tan, *Neumaier graphs of coherent rank five*, arXiv:2609.02218, 2026.

[5] W. H. Holzmann, H. Kharaghani, S. Suda, *Mutually unbiased biangular vectors and association schemes*, in: Algebraic Design Theory and Hadamard Matrices, Springer Proc. Math. Stat., 133, 2015, 149–157.

A unifying framework of existing and new constructions of Neumaier graphs

Thijs van Veluw
Ghent University & Eindhoven University of Technology
thijs.vanveluw@ugent.be t.j.v.veluw@tue.nl

A Neumaier graph is a non-complete edge-regular graph containing a regular clique; it is called strictly Neumaier if it is not strongly regular. In this paper we present a construction using finite rings that unifies several known results and yields three new families, each containing infinitely many strictly Neumaier graphs. More precisely, we use finite rings to construct the edge-regular graphs with a partition of their vertex sets into regular cocliques of nexus 1 that are required in the construction of Neumaier graphs from [2]. This general algebraic framework to construct Neumaier graphs allows us to unify and recover the construction from [4], the construction from [1], and a special case of the construction from [3]. In addition to these existing constructions, we also use the proposed framework to obtain three new families of Neumaier graphs, that are based on the norm functions of extensions of finite fields, the ring of dual numbers over $\mathbb{F}_4$, and quotient rings of the Eisenstein integers.

This talk is based on joint work with Aida Abiad, Wouter Castryck, Maarten De Boeck, and Antonina Khramova.

References

[1] A. Abiad, W. Castryck, M. De Boeck, J. H. Koolen, and S. Zeijlemaker, *An infinite class of Neumaier graphs and non-existence results*, J. Combin. Theory Ser. A, 193, 2023, Paper No. 105684, 30 pp.

[2] R. J. Evans, S. Goryainov, E. Konstantinova, and A. D. Mednykh, *A general construction of strictly Neumaier graphs and a related switching*, Discrete Math., 346, no. 7, 2023, Paper No. 113384, 11 pp.

[3] G. R. W. Greaves and Z. K. Tan, *Neumaier graphs from cyclotomy with small coherent rank*, Finite Fields Appl., 115, 2026, Paper No. 102870, 28 pp.

[4] G. R. W. Greaves and J. H. Koolen, *Edge-regular graphs with regular cliques*, European J. Combin., 71, 2018, 194–201.

The weight distribution bound for polar collinearity graphs

Jim Wittebol
Vrije Universiteit Brussel
jim.wittebol@vub.be

The weight distribution bound for distance-regular graphs gives a lower bound on the Hamming weight of the eigenvectors corresponding to a chosen eigenvalue. Let us call an eigenvector that achieves the bound *optimal*. In [1], tightness of this bound was studied for the positive non-principal eigenvalue of some geometrically motivated strongly regular graphs; namely collinearity graphs of finite classical polar spaces and (hyperbolic or elliptic) affine polar spaces. The study of the same problem for negative eigenvalues remained largely open; apart from an example of an optimal eigenvector for $\mathrm{U}(4,q)$ in [1] and a full classification of optimal eigenvectors for $\mathrm{Sp}(4,q)$ in [2]. In this talk, we present a complete classification of optimal eigenvectors corresponding to the negative eigenvalue for the collinearity graphs of finite classical polar spaces and for hyperbolic and elliptic affine polar graphs. This is based on joint work with Sam Adriaensen [3].

References

[1] Rhys J. Evans, Sergey Goryainov, Leonid Shalaginov, *Tightness of the Weight-Distribution Bound for Strongly Regular Polar Graphs*, Journal of Combinatorial Designs, 33, no. 12, 2025, 435-445

[2] Bart De Bruyn, Sergey Goryainov, Willem H. Haemers, Leonid Shalaginov, *Divisible design graphs from the symplectic graph*, Designs, Codes and Cryptography, 93, no. 5, 2025, 1401-1424.

[3] Sam Adriaensen, Jim Wittebol, *On the weight distribution bound for the negative eigenvalue of polar collinearity graphs* (Preprint), https://arxiv.org/abs/2607.28153

Divisible design graphs obtained by plugging a divisible difference set into a construction for antipodal distance-regular graphs of diameter 3

Ruihan Xie
Hebei Normal University
3205761192@qq.com

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.

In [2], a construction of divisible design graphs was given. The idea was to plug a difference set of a quotient group into a known construction of antipodal distance-regular graphs of diameter 3.

In this talk we propose an extension of the construction above, where the difference sets are replaced divisible difference sets.

Joint work with Bart De Bruyn and Sergey Goryainov.

References

[1] D. Crnković, W. H. Haemers, *Walk-regular divisible design graphs*, Designs, Codes and Cryptography, 72 (2014) 165–175. https://doi.org/10.1007/s10623-013-9861-0

[2] B. De Bruyn, S. Goryainov, R. Ma, R. Xie, *Divisible design graphs obtained by plugging a difference set into a construction for antipodal distance-regular graphs of diameter 3*, Designs, Codes and Cryptography, Volume 94, article number 181, (2026). https://doi.org/10.1007/s10623-026-01850-w

[3] W. H. Haemers, H. Kharaghani, M. A. Meulenberg, *Divisible design graphs*, Journal of Combinatorial Theory, Series A, 118 (2011) 978–992. https://doi.org/10.1016/j.jcta.2010.10.003

On Delsarte cliques in the collinearity graphs of nets

Letian Zhang
Hebei Normal University
zhangletian9@gmail.com

A *strongly regular graph* is a regular graph Γ with v vertices and degree k such that Γ is neither complete nor edgeless, there exists an integer $\lambda \geq 0$ such that every two adjacent vertices have exactly λ common neighbours and there exists an integer $\mu \geq 0$ such that every two distinct non-adjacent vertices have exactly μ common neighbours. The tuple (v, k, λ, μ) is then said to be the *tuple of parameters* of this strongly regular graph.

Finite geometries provide various constructions of strongly regular graphs. One of them is given by the collinearity graphs of nets.

A *Delsarte clique* in a strongly regular graph is a clique whose size achieves the Delsarte upper bound for the size of a clique.

For the collinearity graphs of nets, the Delsarte bound is always tight and the net lines always serve as examples of Delsarte cliques. In their book [1] on the analogues of the classical Erdős-Ko-Rado theorem, Godsil and Meagher called such cliques *canonical*. Further, they discussed an upper bound for the degree of the net (given in terms of the order of the net) such that whenever the degree of a net is relatively small (that is, does not exceed the bound), then all the Delsarte cliques in the collinearity graph of the net are necessarily canonical (are lines, in other words). Then Godsil and Meagher observed that in the case when the order of the net is a perfect square (the upper bound is then integral) and the degree of the net is just above the upper bound, then non-canonical Delsarte clique are possible and moreover have the (geometric) structure of an affine plane in all known cases. So, a natural question arose [1, Problem 16.4.2]: is it true that in the case when the order of the net is a perfect square and the degree of the net is just above the upper bound, every non-canonical Delsarte clique always has the structure of an affine plane? In [2], the positive answer to this question was obtained for the class of Desarguesian nets. Moreover, it was shown that the "extremal" graph is unique and isomorphic to an affine polar graph.

In this talk we will discuss the general case (that is, the case of a general net of square order).

Joint work with Tao Feng, Sergey Goryainov and Elena Konstantinova.

References

[1] C. D. Godsil, K. Meagher, *Erdős-Ko-Rado Theorems: Algebraic Approaches*, Cambridge University Press (2015).

[2] S. Goryainov, C. H. Yip, *Extremal Peisert-type graphs without the strict-EKR property*, Journal of Combinatorial Theory, Series A, Volume 206, August 2024, 105887. https://doi.org/10.1016/j.jcta.2024.105887

Eigenvalue multiplicity of the wreath product Cayley graphs

Haoran Zhu
Nanyang Technological University, Singapore
zhuh0031@e.ntu.edu.sg

We show that the eigenvalues of the Cayley graph that arise from the standard representation of the symmetric group $\mathfrak{S}_n$ are contained in the spectra of wreath product Cayley graphs of generalised symmetric groups $C_m \wr \mathfrak{S}_n$. In particular, we discuss the integer eigenvalues of burnt pancake graphs [1] and lower bounds on eigenvalue multiplicities in generalised pancake graphs, confirming a conjecture of Blanco and Buehrle [2]. We also provide a representation-theoretic interpretation of this phenomenon. The key to these bounds is a reordering of the vertices indexing the adjacency matrix of an equitable quotient. This talk is based on joint work with Gary Greaves [3].

References

[1] S. A. Blanco and C. Buehrle, *Some integer values in the spectra of burnt pancake graphs*, Linear Algebra and its Applications, 703, 2024, 163–172.

[2] S. A. Blanco and C. Buehrle, *On the spectra of prefix-reversal graphs*, Linear Algebra and its Applications, 726, 2025, 71–90.

[3] G. Greaves and H. Zhu, *A note on some spectral properties of generalised pancake graphs*, Discrete Mathematics, 349(9), 2026, 115102.

List of Participants

Plenary speakers:

1. Sam Adriaensen (Vrije Universiteit Brussel)
2. Bart De Bruyn (Ghent University)
3. Tao Feng (Beijing Jiaotong University)
4. Gary Greaves (Nanyang Technological University)
5. Willem Haemers (Tilburg University)
6. Ferdinand Ihringer (Southern University of Science and Technology)
7. Jack Koolen (University of Science and Technology of China)
8. Akihiro Munemasa (China University of Geosciences)
9. Ilia Ponomarenko (St. Petersburg Department of Steklov Institute of Mathematics)
10. Wei Wang (Xi'an Jiaotong University)
11. Ziqing Xiang (Southern University of Science and Technology)
12. Qianqian Yang (Shanghai University)
13. Chi Hoi Yip (Hong Kong University of Science and Technology)
14. Yanbo Zhang (Hebei Normal University)
15. Da Zhao (East China University of Science and Technology)
16. Tianxiao Zhao (Harbin Institute of Technology)
17. Yan Zhu (University of Shanghai for Science and Technology)

Contributing speakers:

1. Hong-Jun Ge (University of Science and Technology of China)
2. Jiafu He (Hebei Normal University)
3. Jing-Yuan Liu (University of Science and Technology of China)
4. Ruilin Ma (Hebei Normal University)
5. Zhao Kuang Tan (Nanyang Technological University)
6. Thijs van Veluw (Eindhoven University of Technology & Ghent University)
7. Jim Wittebol (Vrije Universiteit Brussel)
8. Ruihan Xie (Hebei Normal University)
9. Letiang Zhang (Hebei Normal University)
10. Haoran Zhu (Nanyang Technological University)

Participants without a talk:

1. Xiao Ma (Southern University of Science and Technology of China)
2. Veronica Pasquarella (Hebei Normal University)
3. Weiguang Zhao (Southern University of Science and Technology of China)

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”入选者、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 for 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 evaluations announced by the Ministry of Education, Mathematics was classified as a Category B discipline, and achieved a new breakthroughs in the fifth round of evaluations. In 2024, the discipline of Mathematics was selected as a "Hebei Provincial Advantageous and Characteristic Discipline", and in 2025, it was selected as a reserve discipline for the "Double First-Class" construction during Hebei Province's "15th Five-Year Plan" period. While advancing academic development, Mathematics has actively served societal needs, establishing platforms for basic theoretical research and applied R&D. Currently, it has two national-level platforms, including the Hebei Base of the National Tianyuan Mathematical Center in Central China. It also 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. Additionally, the Hebei Mathematical Society is affiliated with our school.

Scientific Research

The Mathematics discipline has distinctive research teams in operator algebra and operator theory, intelligent computing and applications, combinatorics, differential equations and dynamical systems, control theory and operations research, etc. Over the past five years, it has undertaken 58 projects funded by the National Natural Science Foundation of China, including 1 key project of the National Natural Science Foundation of China, 1 international (regional) cooperation and exchange key project, and 1 National Science Fund for Distinguished Young Scholars project. It has undertaken 50 provincial and ministerial projects, and has received 1 Inaugural Frontier of Science Award, 2 Hebei Provincial Yan Zhao Friendship Awards, 1 Hebei Provincial Science and Technology Cooperation Award, 1 second prize and 2 third prizes of the Hebei Provincial Natural Science Award; it has hosted 46 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 510 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 20 doctoral students and over 100 master's students annually. The school sends hundreds of doctoral and master's graduates to research institutes both at home and abroad every year, many of whom have become key forces in universities and research institutions at home and abroad. Notable alumni include Liu Jianya, Member of the Chinese Academy of Sciences 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 7th 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 Association for Promoting Democracy; 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 100 are special-grade teachers and senior teachers.

Faculty Strength

The mathematics discipline has a strong faculty, with currently 91 full-time teachers, including 29 professors, 36 associate professors, 3 full-time foreign teachers, and 37 teachers with overseas experience. The faculty team includes 1 ICM 45-minute invited speaker, 4 nationally recognized talents, 2 experts receiving the State Council Special Allowance, 1 Vice Chairman of the Chinese Mathematical Society, 2 recipients of the Ministry of Education's New Century Excellent Talents Program, 1 recipient of the Chinese Academy of Sciences Hundred Talents Program, 1 recipient of the National Excellent Doctoral Dissertation Award, 1 Yan Zhao Scholar of Hebei Province, 2 recipients of the Hebei Provincial Outstanding Youth Fund, 2 young and middle-aged experts with outstanding contributions in Hebei Province, 1 Teaching Master of Hebei Province, and 1 Outstanding Returned Overseas Scholar of Hebei Province. The school has appointed 9 foreign visiting professors, including 2 foreign academicians. The "Mathematics and Data Science Faculty Team" was selected for the fourth batch of the "National University Huang Danian-style Teacher Teams" program list.

Applied Research

While achieving fruitful results in basic research, the discipline has also made breakthroughs in applied research. Relying on the Mathematics discipline, the school has established the School of Software 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, Hebei Province's first collaborative innovation center focused on educational technology –the"Hebei Province Collaborative Innovation Center for Digital Education" was approved. 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 school is undertaking the development of the "Beitai Tianyuan" 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, 并在第五轮学科评估中取得新突破, 实现提档升级. 2024 年, 数学学科入选 “河北省优势特色学科”. 2025 年, 数学学科入选河北省 “十五五” 时期 “双一流” 建设后备学科. 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, 目前拥有国家数学天元中部中心河北基地等两个国家级平台, 以及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、控制论与运筹学等特色研究团队, 近五年主持国家级项目 58 项, 其中包括国家自然科学基金重点项目、国际（地区）重点合作项目和优秀青年基金项目各 1 项. 承担省部级项目 50 项, 获首届基础科学前沿科学奖 1 项、河北省燕赵友谊奖 2 项、河北省科学技术合作奖 1 项、河北省自然科学二等奖 1 项、三等奖 2 项; 举办高水平国际和全国性学术会议 46 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 510 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 20 余人、硕士研究生 100 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. 中国科学院院士、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百余人.

师资力量

数学学科师资力量雄厚, 现有专任教师 91 人, 其中正高职称教师 29 人, 副高职称教师 36 人, 全职外籍教师 3 人, 具有海外经历教师 37 人. 教师团队中有有 ICM 45 分钟报告人 1 人、国家级人才 4 人、国务院特殊津贴专家 2 人、中国数学会副理事长 1 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. 聘请外籍客座教授 9 人, 其中外籍院士 2 人. “数学与数据科学教师团队” 入选第四批 “全国高校黄大年式教师团队” 创建示范活动入围名单.

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, 独立研发 4 个行业工具箱并正式对外发布, 成为首家独立完成工具箱研发并取得自主知识产权的联合研发单位, 为解决基础软件 “卡脖子” 问题做出了贡献.