



HCMNEWS 2/25

HCM to be financed for another seven years

Funding for the HCM is secured for another seven years. In the nationwide Excellence Competition, all six existing clusters of excellence at the University of Bonn were selected for further funding. In addition, both newly proposed Bonn cluster initiatives will receive support from the federal and state governments. This means that Bonn will be represented by a total of eight clusters in

the coming period — more than any other university in Germany. The two other mathematical clusters of excellence in Münster and Berlin will also continue to receive funding. Many thanks to our team for making this possible! And a very special thank you from the HCM goes to Valentin Blomer and Magdalena Balcerak Jackson for their great personal commitment!



New Collaborative Research Center

The German Research Foundation (Deutsche Forschungsgemeinschaft; DFG) approved a new Collaborative Research Center (Sonderforschungsbereich; SFB) at the University of Bonn. A team of 19 principal investigators and their working groups will study the mathematical structures underlying complex phenomena in areas of criticality. The spokesperson of the CRC is Leibniz Prize winner Professor Angkana Rüland of the Hausdorff Center for Mathematics. The Collaborative Research Center will receive nearly four years of DFG funding of approximately seven million euros.

How can simple rules give rise to surprisingly complex patterns, as observed in crystal growth, tissue structure and in the properties of modern materials? In many cases, the answer lies in a special condition known as 'criticality'. This is a state in which systems react extremely sensitively, and even the slightest influences trigger major changes.

The mathematicians involved in the new Collaborative Research Center CRC 1720, 'Analysis of Criticality: from Complex Phenomena to Models and Estimates', are working to gain a better understanding of the mathematical structures underlying states of criticality, thereby paving the way for more accurate simulations and for new applications in engineering and the natural sciences.

"Criticality often occurs in systems in which several processes occur simultaneously and on a variety of different scales – and influence each other," explains Angkana Rüland from the Institute of Applied Mathematics at the University of Bonn. "This complexity leads to singular structures, strong interactions and intriguing phase transitions between different states.



Classical mathematical methods often reach their limits at states of criticality."

To move forward, the researchers at the CRC are pursuing an approach that combines different mathematical perspectives and sub-disciplines. The research team is investigating models in which strong interactions across many different scales lead to complex patterns, such as those found in biological or physical systems. Another area of interest is identifying key properties that define critical systems and filtering them out from a multitude of competing effects. As many questions in this field are difficult to mathematically grasp, new tools are being developed to enable the systematic analysis of so-called 'ill-posed problems'.

Three speakers at ICM 2026 from Bonn Mathematics



With Dennis Gaitsgory, Jessica Fintzen and Valentin Blomer, three mathematicians from Bonn have received an invitation to the next International Congress of Mathematics (ICM), which will take place in Philadelphia, Pennsylvania, from July 23 to 26, 2026. Dennis Gaitsgory, Director at the Max Planck Institute for Mathematics in Bonn, who was recently awarded the Breakthrough Prize, will give one of the particularly renowned plenary lectures. The ICM is the most influential conference in the field of mathematics. During the opening ceremony of the congress, many prestigious awards such as the Fields Medal will be presented.

Minkowski Medal of the German Mathematical Society for Markus Hausmann

The Minkowski Medal of the German Mathematical Society (DMV) for 2025 goes to Markus Hausmann, Professor at the Mathematical Institute of the University of Bonn. Markus Hausmann conducts research in the field of topology. In particular, his contributions to equivariant homotopy theory, which he published in the *Annals of Mathematics* in 2022, are of fundamental importance.

"I am delighted that we are able to honor Markus Hausmann, such a deserving young scientist, and I congratulate him most sincerely. May this award further his career!" says Jürg Kramer, President of the DMV.

The DMV awards the Minkowski Medal to young mathematicians who have already gained international recognition for their outstanding work but whose careers are still largely ahead of them. The DMV Presidium selects the winners based on the assessments of an external commission.

Markus Hausmann, born in 1988, has been Professor of Topology at the University of Bonn since 2023. He was previously a "University Lecturer" at Stockholm University (2021 to 2023). Before that, he held postdoctoral positions at the Universities of Copenhagen, Denmark, and Bonn. He completed his mathematics studies at the University of Bonn with a stay abroad at MIT, USA. With his ERC Starting Grant "Bordism of symmetries: From global groups to derived

orbifolds" (BorSym), he is conducting basic research in mathematics. He uses algebraic methods to investigate the symmetry of spaces. The ERC is funding BorSym for the next five years.

The DMV created the Hermann Minkowski Medal in the year of its 130th anniversary (2020) for special mathematical research achievements by young mathematicians.

It presents the award every two years. The bronze medal is endowed with 2000 euros and will be presented on September 1, 2025 at a ceremony at the DMV annual conference, which will take place this year together with the Austrian Mathematical Society (OMG) at the Johannes Kepler University in Linz, Austria.



Frontiers of Science Award for Christian Brennecke

For his scientific work "Bogoliubov Theory in the Gross-Pitaevskii Limit", Christian Brennecke, Bonn Junior Fellow at the HCM and Professor at the Institute for Applied Mathematics, University of Bonn, received the Frontiers of Science Award 2025, together with three co-authors. The prize was awarded on July 13 at the International Congress of Basic Science in Beijing. This award recognizes cutting-edge research with a focus on achievements over the past ten years.

Together with his co-authors Chiara Boccato (University of Pisa), Serena Cenatiempo (GSSI L'Aquila), Benjamin Schlein (University of Zurich), Christian Brennecke was honored for the paper "Bogoliubov Theory in the Gross-Pitaevskii Limit". The laudation says: "This work establishes Bogoliubov Theory for dilute Bose gases in the Gross-Pitaevskii limit, a key step in understanding Bose-Einstein condensation and superfluidity. The authors contribute to the mathematical foundation of many-body quantum physics by introducing rigorous tools to derive macroscopic properties from microscopic equations."

Christian Brennecke studied physics and mathematics in Aachen, Berlin and Zurich. He received his doctorate in mathematics from the University of Zurich in 2018. He was then a Benjamin Peirce Fellow at Harvard University for three years. Since October 2021, Christian Brennecke has been a Junior Fellow at the Hausdorff Center for Mathematics and Professor at the Institute for Applied Mathematics. His research area lies at the interface of analysis, mathematical physics and probability theory.



Skolem Award for Floris van Doorn

Together with four other scientists, Floris van Doorn receives the Thoralf Skolem Award 2025. This prize rewards a paper, published in the International Conference on Automated Deduction (CADE) proceedings ten years ago, that has passed the test of time by proving to be the most influential paper in the field of automated deduction in that year. The award will be presented at CADE-30 in July 2025.

The paper "The Lean theorem prover (system description)", published in the CADE-25 proceedings in 2015, is recognized for "being the first description of the Lean theorem prover, which meanwhile has made spectacular progress and has a tremendous impact in interactive and automated reasoning, with numerous applications, in particular to formalized mathematics and software verification", as can be read in the official laudation. The paper describes the (then) new proof assistant Lean, that over the last 10 years has grown to become the most prominent proof assistant for formalized mathematics, and which has made the possibility of formalization more widely known among mathematicians. Notable formalization projects that have been formalized in Lean since then are the Liquid Tensor Experiment and the Sphere Eversion project, and there are ongoing projects including the Carleson project and the Fermat's Last Theorem project.

The authors of the paper are Leonardo de Moura, Soonho Kong, Jeremy Avigad, Floris van Doorn, and Jakob von Raumer, which at that time were the only developers and users of Lean. Since then, Lean has been developed much further from a prototype to a performant proof assistant and

programming language with 20 developers, and includes a large mathematical library with over 500 contributors.

Floris van Doorn received his PhD in 2018 at Carnegie Mellon University under the supervision of Jeremy Avigad and Steve Awodey. He then worked as a postdoc at the mathematics department of the University of Pittsburgh with Tom Hales and at the mathematics department of the University of Paris-Saclay with Patrick Massot. Since 2023, he has been a professor at the Mathematical Institute of the University of Bonn and research leader of the new Interdisciplinary Research Unit (IRU) "Formalized mathematics and computer-assisted proofs". This IRU wants to formalize brand-new research results, develop new computational tools and contribute to libraries for the rigorous formalization of mathematics and will serve as a bridge between the departments of mathematics and computer science.



Teaching Awards for Jan Schröer, Lorenzo Portinale, and Thoralf Räsch

The University of Bonn has honored 14 lecturers for their outstanding commitment with teaching awards, including Jan Schröer from the Institute of Mathematics. The award winners were selected by the students themselves. The ceremonial presentation of the certificates by Klaus Sandmann, Vice Rector for Studies, Teaching, and University Development,

took place during the Bonn University Festival in front of over 7,000 participants on the Hofgartenwiese in Bonn.

During the academic ceremony, further teaching awards from the Faculty of Mathe-

matics and Natural Sciences were presented by Vice Dean Barbara Kirchner. Among the eight award winners in 2025 are Lorenzo Portinale from the Institute of Applied Mathematics and Thoralf Räsch from the Mathematical Institute.



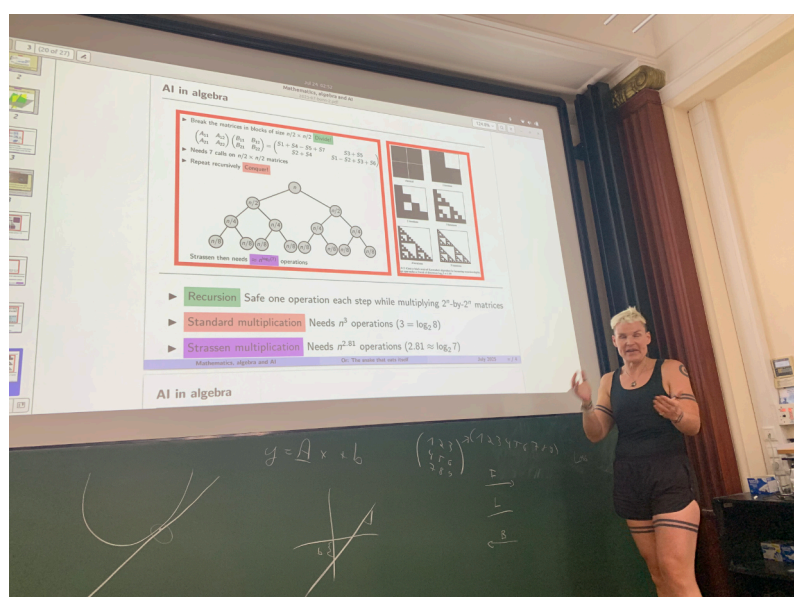
HAUSDORFF EVENTS

Queer and Trans Mathematicians in Algebra and Representation Theory (QTMART)

In July, we hosted a workshop entitled “Queer and Trans Mathematicians in Algebra and Representation Theory” (QTMART), which aimed to raise the profile of this underrepresented group in mathematics and provide a valuable opportunity for exchange. The workshop was organized by Alice Dell’Arciprete (University of York), Dinushi Munasinghe (University of Toronto), and two postdoctoral researchers from our HSM, Alexis Langlois-Rémillard and David Schwein. Parallel to the workshop, an exploratory program on the topic of “Queer Mathematics and Inclusion” took place. The program’s activities focused on exploring what it means to be a queer or transgender mathematician and whether there is such a thing as “queer mathematics” at all. The question of how to make the science culture and atmosphere more welcoming and diverse was also addressed, and concrete measures were initiated.

As part of this program, Dani Tubbenhauer (University of Sydney, former postdoctoral fellow at HCM) gave a public lecture entitled “Mathematics, Algebra, and AI.” At the beginning, the basic idea of machine learning was explained, which involves relatively elementary mathematics from linear and non-linear algebra. He then explained the potential and limitations of using AI in mathematical research. As an example, Dani presented the performance of Deepmind’s Alpha Tensor, which optimized matrix multiplication with reinforcement learning for arbitrary matrices in 2022. The AI followed an old idea from Strassen and refined it. AI is also very good at recognizing possible subgroups in Latin squares and patterns in general. When it comes to truly groundbreaking scientific discoveries, humans still seem to have the upper hand, but they can use AI in a very targeted and specialized way.

After the presentation, there was a lively fishbowl discussion on how to increase diversity at international conferences and what can be done in places that are hostile to diversity. A fishbowl format is a discussion technique in which a small group (the “fishbowl”) holds a conversation in front of a larger audience. The audience observes and participates by rotating in and out of the inner circle. This format promotes active listening and allows for a more intimate and focused dialogue within the inner circle, while at the same time involving the larger group. Many participants felt safe enough to enter the inner circle and talk about their personal experiences. We were very impressed by the wonderful and open atmosphere! The conversations continued late into the night – even during the closing barbecue.



Mathematical Salon with Lillian Pierce

“What we talk about when we talk about mathematics” was the title of Lillian Pierce’s lecture at the Mathematical Salon, which took place at the end of May. In a journey through history, she used many impressive and vivid examples to explain what mathematics is all about and what goes on in the minds of mathematicians. She explained when abstraction is advantageous and when it is better to use examples. Lillian also described the internal representations that mathematicians develop. Her illustrations were particularly impressive – each slide was a work of art! The exciting lecture was framed by two fantastic string quartets by Haydn and Beethoven, performed by four young musicians from

the Gürzenich Orchestra Cologne. A great evening for our audience of 90 guests!

For the first time, the salon took place in the Lipschitzsaal to accommodate the increased interest. This will also be an option from time to time in the future.



May 12 Initiative

This year, we participated in the May 12 Initiative and celebrated women in mathematics. This initiative brings together local and virtual events that celebrate women in mathematics and take place between May 1 and June 15. It is a wonderful opportunity for the mathematical community to celebrate successful female mathematicians. The celebration takes place every year around the world. The goal of this day is to inspire women to showcase their achievements in mathematics and to promote an open, welcoming, and inclusive work environment for all. During our event, two Bonn Research Chairs — Masha Gordina and Lillian Pierce — gave public lectures on their research areas. Lillian also provided authentic insights into the research process itself, spanning several decades, from analysis to number theory and back again. In the subsequent panel discussion, moderated by Magdalena Balcerak Jackson, both

spoke about their personal (many bad, but also some quite encouraging) experiences as women in mathematics and discussed what we actually want to achieve in the future. Is it more about increasing the numbers? Or is it more about creating a welcoming and inclusive environment for everyone, with an increase in the proportion of female mathematicians as a possible side effect?



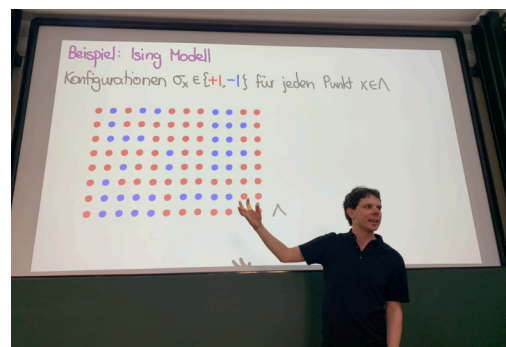
Mathematics of Quantum Field Theory – public lecture by Roland Bauerschmidt

As part of the trimester program “Probabilistic Methods in Quantum Field Theory,” Roland Bauer-schmidt gave a public lecture (in German) at HIM on the mathematics of quantum field theory (QFT). He began by describing QFT as a mixture of quantum mechanics and classical field theory, quoting Nathan Seiberg: “QFT is modern infinitesimal calculus,” as well as his prediction that a mathematically recognized description of QFT will certainly take another 200 years. The crucial question is: Are quantum mechanics, relativity theory, and interaction mathematically compatible? Another perspective is to view QFT (or at least a large part of it) as a question of classical statistical physics, whereby one must also see the differences (for example, QFT: theory of small scales, statistical physics: theory of large scales). According to Marc Kac (“Be wise, discretize”), the problem is addressed with the help of discrete models, the Ising model, which Roland Bauerschmidt presented in detail. The Ising model is perhaps the most realistic model for phase transitions, and he explained what this has to do with QFT and what the general advantages and disadvantages of such an approach with discrete models

are, where convergence is very difficult to prove.

Mathematical research on the Ising model has led to the awarding of several Fields Medals (Werner (2006), Smirnov (2010), Hairer (2014), Duminil-Copin

(2022)), and it is now possible to describe some physical intuitions quite well mathematically (keyword: Feynman-Kac path integrals), but there is still a long way to go to prove the Yang-Mills conjecture. The Yang-Mills conjecture is an unsolved problem in mathematical physics – one of the Millennium Problems – that is closely related to quantum field theory, in particular Yang-Mills theory. Roland Bauerschmidt outlined the necessary and difficult steps that could lead to a possible solution.



BIGS Poster session

Our BIGS poster session took place during the first week of July. Ninety-three doctoral students participated in the poster exhibition. Florine Hartwig won the poster prize for his poster entitled “Bending to Slither – Optimal Motion from Shape Change.” Her prize was the English-language biography of Felix Hausdorff, written by Walter Purkert.



HAUSDORFF MIXED

The Bonn Math Club in Baku

For the second time since 2023, we participated in the international final round of the Fizmat Elementary Math Olympiad (FEMO). Eight children from the Bonn Math Club, from grades 2 to 5, flew with their parents to Baku, Azerbaijan, where this year's largest math festival for elementary school students worldwide took place, with over 430 participants from around the world. Our children from the Bonn Math Club won several medals:

- Silver: Linus Jender (grade 3)
- Silver: Olivia Ritz Buranbaeva (grade 4)
- Bronze: Linus Mispelbaum (grade 4)
- Bronze: Oliver Roubal (grade 4)



HIM in Quanta Magazine

The HIM offers an excellent environment for making decisive progress in mathematics in a quiet and peaceful atmosphere of cooperation, as was reported a few months ago in Quanta Magazine:

Gee secured the team a room in the basement of the Hausdorff Research Institute, where they were unlikely to be disturbed by itinerant mathematicians. There, they spent an entire week working on Pan's theorem, one 12-hour day after the next, only coming up to ground level occasionally for caffeine. "After a coffee, we would always joke that we had to go back to the mine," Pilloni said.

The group proved the modularity for ordinary abelian surfaces during the trimester program "The Arithmetic of the Langlands Program."

"Mathemacher" of the DMV

Stefan Hartmann, who is responsible for outreach and science communication at the HCM, has been named "Mathematician of the Month for July and August" by the German Mathematical Society (DMV). Stefan Hartmann has been involved in promoting gifted students for more than 25 years. He has been employed at the Hausdorff Center for Mathematics (HCM) since 2017, where he is responsible for numerous school projects, such as the Bonn Math Club and the Bonn Math Tournament, which he organizes and runs together with a large team of students.



Bonn once again ranked second best university at the IMC

At this year's International Mathematics Competition for University Students (IMC) in Blagoevgrad (Bulgaria), the Bonn team came in second place in the unofficial team rankings and was thus – as last year – the second most successful university in the competition worldwide, behind Saint Petersburg State University. The University of Bonn team, consisting of Samuel Meyer, Henrik Jasper Schlüter, Juri Kaganskiy, Lennart Christian Gräbber, Boldizsár Mann, Christian Kraftsik, Paul Jakob Schmidt, and Ruth Plümer, also achieved outstanding results in the individual rankings: Samuel Meyer, Henrik Jasper Schlüter, and Juri Kaganskiy received a coveted Grand First Prize and finished among the top ten participants, while the other Bonn team members were also awarded prizes and honorable mentions.



News from the Bonn Mathematical Society

„Tangente trifft Tresen“ – The Great Math Pub Quiz



In June, the Bonn Mathematical Society, in collaboration with the Student Services Association and the HCM, organized a math pub quiz in the Poppelsdorf cafeteria. Around 250 participants took part in teams of three to six people and were able to demonstrate their mathematical knowledge in numerous disciplines, including: picture puzzles, trivia, mathematical puzzles, recognizing mathematical theorems that had previously been run through Google Translate x times, recognizing formulas based on a small excerpt from their visual proofs, recognizing numbers in songs, and estimation



questions, for example, about the number of professors in Bonn mathematics. The evening was moderated by Thoralf Räscher. A large team from the Bonn Mathematical Society, including many students, ensured that everything ran smoothly. Michael Kaiser provided musical accompaniment on his guitar, including a song about the circle number π , and Uli Brauner performed mathematical magic tricks. In the end, the “Bonnsai” team won the pub quiz in a tiebreaker against the team from the NRW Summer Academy (Mathematics Olympiad).

Awarding of bachelor's degrees

As part of the Math Pub Quiz, BMG Chairman Rainer Kaenders also presented this year's BMG Awards for outstanding bachelor's theses in mathematics. Students who have completed their bachelor's degree by September 30 of the respective year are eligible for the award.

Two to three prizes are awarded to graduates of a bachelor's degree program in mathematics and one prize is awarded to a graduate of a bachelor's degree program in mathematics education. The prize consists of a certificate and a cash prize.

The following students were awarded a bachelor's degree prize by the BMG for outstanding achievements in the 2023/24 academic year:

- Leo Diederich, "Contributing to the Formalization of Carleson's Theorem" (advisor: Floris van Doorn)
- Veran Stojanovic, "Starke Approximation in algebraischen Gruppen" (advisor: Valentin Blomer)
- Jimena Lozano Simón, "Uncertainty Quantification of Eigenvalues with the Contour Integral Method" (advisor: Jürgen Dölz)
- Kiana Mertin, "Die Mathematik von Sudokus" (advisor: Antje Kiesel)

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