Berlin Mathematics Research Center
MATH+

Honoring Jürg Kramer

MATH+ takes this opportunity to wish Jürg Kramer all the best for a happy 65th birthday! His outstanding commitment to Berlin mathematics and to young mathematicians within MATHEON, the Berlin Mathematical School (BMS), and MATH+ make him one of our most highly valued members.

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Born in Switzerland on 3 June 1956, he started his mathematical career at the University of Basel, where he he got his diploma in mathematics with minors in physics and astronomy in 1980, and received his doctorate under Martin Eichler in 1985. Postdoc positions took him to the Max Planck Institute for Mathematics in Bonn, to Harvard University, the MSRI, Universität Wuppertal and to ETH Zurich, where he completed his habilitation in 1993. In 1994, he accepted the offer of a professorship at Humboldt-Universität zu Berlin (HU Berlin).

After his arrival in Berlin, Jürg Kramer soon took on essential leadership roles. He was deputy director and director of the Institute of Mathematics at HU Berlin from 1998 to 2008. A member of the DFG Research Center MATHEON since its founding in 2002, he served on the MATHEON Executive Board from 2007 to 2014. He was also one of the founding fathers of the Berlin Mathematical School (BMS) and has served as chair or co-chair since 2006. In 2013, he was one of the initiators of the Einstein Center for Mathematics ECMath, where he also served on the Executive Board.

From 2013 to 2014, Jürg Kramer served as President of the German Mathematical Society (DMV). He is a member of European Mathematical Society, the Academia Europea, Acatech, and INNOMATH – a European initiative to support highly gifted high school students.

Throughout his career Jürg Kramer has been devoted not only to mathematics itself but also to the education and training of mathematics teachers and the advancement of mathematically talented and interested school pupils, students, and teachers – from elementary schools to doctoral researchers. Moreover, his research group aims to make current mathematical developments accessible to the public at large.

Jürg Kramer, Emre Sertöz, Gregor Botero, Ana Botero
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This commitment is expressed in his engagement in the Berlin network of STEM schools at HU Berlin (*Berliner Netzwerk mathematisch naturwissenschaftlicher Schulen*) as well as his support for the “Mathematical Kangaroo” (*Känguru der Mathematik*), the largest international mathematics competition for school children, which is based at the Institute of Mathematics at Humboldt-Universität zu Berlin.

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In 2010, a group of experts convened by the Deutsche Telekom Foundation (DTS) proposed a national advanced training center for mathematics as an important building block in its recommendations on *Mathematik entlang der Bildungskette* ("Mathematics along the educational chain"). As a result, the DTS issued a call for applications providing funding for five years to establish such a center. Based on his project *Mathematik anders machen* ("Doing Mathematics Differently") Jürg Kramer organized a consortium of universities, which submitted the winning proposal. Thus, the *Deutsches Zentrum für Lehrerbildung Mathematik* was founded in October 2011. Jürg Kramer has been the Director of DZLM since the beginning and saw the DZLM find a permanent home as part of a new department *Fachbezogener Erkenntnistransfer* ("Subject-Specific Transfer of Knowledge") of the Leibniz Institute for Science and Mathematics Education (IPN) Kiel in 2020. He is now director of the department.

The success story of DZLM would have been impossible without Jürg Kramer's experience in large collaborative projects like MATHEON, BMS, ECMath, and MATH+, his strong commitment, his excellent networking and communication skills and not least at all his personality and respectful attitude to other people.

In addition to his numerous engagements, Jürg Kramer is also an outstanding researcher, with interests in number theory, automorphic forms, and arithmetic geometry. He chaired two DFG Research Training Groups *Arithmetic and Geometry* (2004-2009) and *Moduli and Automorphic Forms* (2012-2016). Anna von Pippich elaborates on Jürg Kramer's research below.

Last but not least, Jürg Kramer is a key member of the Berlin Mathematics Research Center MATH+, and contributed an important part to the successful application for MATH+ in the framework of the German Excellence Strategy. With all his energy and commitments, Jürg Kramer has significantly contributed to the shape of the mathematical landscape in Berlin and has helped to make it an internationally attractive destination for study and research. Due to his efforts, there are many mathematicians around the world who owe their education to Berlin mathematics!

Dear Jürg, MATH+ wishes you a happy birthday and we look forward to working together on many more activities!

Together with

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Anna von Pippich on Jürg Kramer's Research

"There are five basic operations of arithmetic: addition, subtraction, multiplication, division, and modular forms." This is a quote by Martin Eichler (1912-1992), Jürg Kramer's PhD advisor at the University of Basel, who introduced him to the magic power of modular forms in number theory. A famous example for this power is the crucial role of modular forms in Andrew Wiles's proof of Fermat's Last Theorem in 1994, which states that there are no non-zero integral solutions x, y, z to the equation $x^n + y^n = z^n$ as soon as $n \geq 3$.

The theory of modular forms or, more generally, the theory of automorphic form is one main field of Jürg Kramer's research activity. While trigonometric functions are periodic functions on the real line, modular forms are periodic functions on the hyperbolic plane or on higher dimensional analogs. One main result obtained by Jürg Kramer, jointly with Jay Jorgenson, concerns the fundamental question of understanding bounds for automorphic forms. In particular, their work establishes optimal sup-norm bounds for the average value of any orthonormal basis of weight two automorphic forms. Strikingly, to achieve these arithmetic results, Jorgenson-Kramer combined methods from the underlying hyperbolic geometry of modular curves with heat kernel analysis. The second main field of Jürg Kramer's research activities is Arakelov theory, which has its origins in the pioneering work on arithmetic surfaces by Suren Arakelov in the 80s. In the early 90s, Gillet-Soulé extended Arakelov's work to higher dimensional arithmetic varieties. One important application of Arakelov theory is that the height of a point or of a higher dimensional cycle, a measure for the arithmetic complexity of that point or cycle, can be computed by means of arithmetic intersection theory. In joint work with José Burgos Gil and Ulf Kühn, Jürg Kramer was able to generalize the Arakelov theory of Gillet-Soulé to a certain logarithmically singular setting. This foundational work is crucial for future arithmetic applications, in particular, it allows the treatment of modular curves.

Another direction of research aims at establishing bounds for Arakelov invariants, such as the Faltings's delta function, that was introduced by Faltings as a measure for the distance to the boundary of the moduli space, for a complex Riemann surface. In an important work, Jorgenson-Kramer proved a bound for this function in terms of geometric data, such as the lengths of closed geodesics or the smallest eigenvalue of the hyperbolic Laplacian. The key idea of their proof consists in a translation from Arakelov geometry to hyperbolic geometry, and then uses several methods available for the latter. a strategy turns out to be fruitful for many other research problems.

Besides his remarkable research results at the interplay between the theory of modular forms and Arakelov theory, Jürg Kramer is known to be an inspiring lecturer and a great teacher. His lectures and his discussions have provided students, colleagues, and collaborators with much inspiration and deep insights.

Jürg Kramer, Michael Joswig, Anna von Pippich

Anna von Pippich got her doctorate under the supervision of Jürg Kramer from HU Berlin in 2010. She is currently a principal investigator in the LOEWE research unit "Uniformized Structures in Arithmetic and Geometry" at TU Darmstadt and GU Frankfurt.