

Marek Kaluba

Curriculum vitae

Geibelstraße 2A
76185 Karlsruhe
Germany

✉ kalmar@mailbox.org

Past and Current Positions

- 2021-2024 **Independent Researcher**, *Karlsruher Institut für Technologie*, Karlsruhe, Germany
Priority Programme 2026 GEOMETRY AT INFINITY, project: *Property (T)*
- 2022 **Replacement Professor**, *Heidelberg Universität*, Heidelberg, Germany
- 2019-2021 **PostDoc**, *Technische Universität*, Berlin, Germany
MATH+ program *Approximate Convex Hulls With Bounded Complexity*
- 2018 **Visiting Professor**, *Tokyo University of Science*, Tokyo, Japan
- 2015-2017 **Assistant Professor**, *IMPAN*, Warsaw, Poland
- 2014-2021 **Assistant Professor**, *Adam Mickiewicz University in Poznań*, Poznań, Poland
- 2010-2014 **Graduate student**, *Adam Mickiewicz University in Poznań*, Poznań, Poland

Research Visits

- 2024 *KU Leuven*, Leuven, Belgium
- 2023 *University of Oxford*, Oxford, UK
- 2022 *IMPAN*, Warsaw, Poland
- 2022 *KU Leuven*, Leuven, Belgium
- 2021 *University of Oxford*, Oxford, UK
- 2018 *Tokyo University of Science*, Tokyo, Japan
- 2015 *Max Planck Institute for Intelligent Systems*, Tübingen, Germany

Education

- 2010-2014 **Graduate Studies**, *Adam Mickiewicz University*
PhD thesis title: *Constructions of Smooth Exotic Actions on Homotopy Complex Projective Spaces and Products of Manifolds*,
prepared under the supervision of prof. Krzysztof Pawłowski
- 2005-2010 **Undergraduate Studies in Mathematics**, *Adam Mickiewicz University*
specialisation: *pure mathematics*

Awards

- 2023 *Frontiers of Science 2018-2023* prize received at the International Congress for Basic Science, Beijing.
Awarded for the results of *On Kazhdan's property (T) for $\text{Aut}(F_n)$ and $\text{SL}_n(\mathbb{Z})$* , which bridges applied optimization and pure mathematics to solve problems open for more than 50 years.

Research Software

- *SymbolicWedderburn.jl* (Amazing package to compute Wedderburn decomposition for endomorphisms of finite groups modules)
- *StarAlgebras.jl* (A package for computation in $*$ -algebras with basis)
- *RamanujanGraphs.jl* (Rigorous computations of spectral gaps for Ramanujan graphs for $\mathrm{PSL}(2, \mathbb{F}_q)$)
- *ArbLib.jl* (thin, efficient julia wrapper around F.Johannsons Arb library)
- *Polymake.jl* (a julia interface to polymake software for computational convex geometry)
- *GroupsCore.jl* (An interface definition for abstract groups)
- *Groups.jl* (Computations in finitely presented groups, especially the automorphism groups of free groups)
- *KnuthBendix.jl* (Pure julia implementation of the Knuth-Bendix completion)
- *PropertyT.jl* (Sum of squares formulation of positivity problems in group rings)

Datasets

- 2023 Marek Kaluba and Dawid Kielak,
Replication software for 2306.12358. Zenodo doi:10.5281/zenodo.8094797
- 2021 Pierre-Emmanuel Caprace, Marston Conder, Marek Kaluba and Stefan Witzel,
kalmarek/SmallHyperbolic: v2.0. Zenodo doi:10.5281/zenodo.5517417
- 2020 Marek Kaluba, Dawid Kielak, and Piotr W. Nowak,
Approximate sum of squares decompositions for $\mathrm{Adj}_5 + k \cdot \mathrm{Op}_5 - \lambda \Delta_5 \in \mathrm{ISAut}(F_5)$ (Version 2.0). Zenodo. doi:10.5281/zenodo.1958995
- 2018 Kaluba, Marek, Nowak, Piotr W., and Ozawa, Narutaka,
An approximation of the spectral gap for the Laplace operator on $\mathrm{SAut}(F_5)$ (Version 1.3). Zenodo. doi:10.5281/zenodo.1133440

Supervision of Students

- 2019-2022 Łukasz P. Michalak, co-advising doctoral thesis *On Reeb graphs and related objects*
- 2018-2021 Piotr Mizerka, co-advising doctoral thesis *Excluding and constructing of exotic group actions on spheres*
- 2017-2018 Tomasz Sternal, bachelor thesis *Persistence Weighted Gaussian Kernels in Topological Data Analysis*

Publications

- 2022 (with P.W. Nowak and P. Mizerka) Spectral gap for the cohomological Laplacian of $\mathrm{SL}_3(\mathbb{Z})$ *Experimental Mathematics*, 2024 arXiv:2207.02783
- 2022 (with Z. Błaszczuk) Constructions of exotic actions on product manifolds with an asymmetric factor, *Kyoto Journal of Mathematics*, 2022, vol. 62, no. 3, 1-10, arXiv:1603.04888

- 2021 (with P-E. Caprace, M. Conder and S. Witzel) Hyperbolic generalized triangle groups, property (T) and finite simple quotients, accepted to *Journal of London Mathematical Society* arXiv:2011.09276
- 2021 (with D. Kielak and P.W. Nowak) On Kazhdan's property (T) for $\text{Aut}(F_n)$ and $\text{SL}_n(\mathbb{Z})$ *Annals of Mathematics*, **193** No. 2 (2021), 539-562, arXiv:1812.03456
- 2020 (with B. Lorenz and S. Timme) Polymake.jl: A New Interface to **polymake** *Mathematical Software - ICMS 2020*, **12097** (2020), 377 - 385, arXiv:2003.11381
- 2019 (with P.W. Nowak and N.Ozawa) $\text{Aut}(F_5)$ has Kazhdan's property (T) *Mathematische Annalen*, **375** (2019), 1169-1191, arXiv:1712.07167
- 2018 (with P.W. Nowak) Certifying numerical estimates of spectral gaps *Groups Complexity Cryptology*, **10** No. 1 (2018), 33-41, arXiv:1703.09680
- 2018 (with Z. Błaszczyk) Effective topological complexity of spaces with symmetries *Publicacions Matemàtiques*, **62** No. 1 (2018), 55-74, arXiv:1510.08724
- 2017 (with Z. Błaszczyk) On equivariant and invariant topological complexity of smooth \mathbb{Z}/p -spheres *Proceedings of American Mathematical Society*, **145** No. 9 (2017), 4075-4086, arXiv:1501.07724
- 2015 (with W. Marzantowicz and N. Silva) On Representation of the Reeb Graph as a Sub-Complex of Manifold *Topological Methods in Non-linear Analysis*, **45** No 1 (2015) 287-307, arXiv:1405.4579
- 2014 (with K. Pawłowski) Group actions on complex projective spaces via group actions on disks and spheres *The Topology and the Algebraic Structures of Transformation Groups*, Proceedings of RIMS - Kokyuroku No. 1922 (2014), 147-153
- 2012 (with W. Politarczyk) Non-symplectic actions on complex projective spaces *Journal of Symplectic Geometry*, **10** No. 1 (2012), 17-26, arXiv:1004.2737
- In preparation
- 2022 (with D. Kielak) Kazhdan constants for Chevalley groups over the integers submitted arXiv:2306.12358

Conferences Organized

- 2021 kpa70, *online conference organized at AMU, Poznań*, the main organizer
- 2018 Glances@Manifolds 2018, *Kraków*, member of the Organizational committee
- 2016 Glances@Manifolds, *Kraków*, member of the Organizational committee
- 2012-2015 Seminar of the Topology and Geometry group at AMU, Poznań
- 2015-2017 Young Reserchers Colloquium at IMPAN, Warsaw

Language skills (CEFR)

- English C2 (proficiency)
- German B2 (intermediate)
- Polish C2 (proficiency, first language)