MOHAMED BARAKAT
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(https://mohamed-barakat.github.io/)
(May 2023)

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| **Personal:** | |
| Birthday: | 21 December 1973 |
| Place of birth: | Cairo, Egypt |
| Nationality: | German (since February 2013) |
| Marital status: | married, two sons and one daughter |
| **School education:** | |
| 1979 – 1983 | Orouba language School in Cairo |
| 1983 – 1992 | Deutsche Evangelische Oberschule in Cairo |
| May 1992 | German Abitur |
| **Higher education:** | |
| 1992 – 1997 | Study of mathematics with minor physics at the RWTH Aachen University |
| 1995 | Vordiplom in mathematics with the total degree *"very good"* |
| October 1997 | Diploma in mathematics at the RWTH Aachen University with the total degree *"excellent"* |
| January 2002 | Ph.D. in mathematics at the RWTH Aachen University *"summa cum laude"* |
| March 2010 | Habilitation in mathematics at the RWTH Aachen University |
| **Academia:** | |
| 1993 – 1994 | Teaching assistant at the Institut für Statistik und Wirtschaftsmathematik |
| 2000 – 2002 | Research assistant at the Lehrstuhl B für Mathematik, RWTH Aachen University |
| 2002 – 2008 | Scientific assistant at the Lehrstuhl B für Mathematik, RWTH Aachen University |
| 2008 – 2009 | Research assistant at the Saarland University |
| since October 2009 | Lecturer at the University of Kaiserslautern |
| summer semester 2014 | Deputy professor of Algebra at the Catholic University Eichstätt-Ingolstadt |
| summer & winter semester 2015 | Deputy professor of Algebra at the RWTH Aachen University |
| since February 2016 | Full professor of pure mathematics at the University of Siegen |

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| **Grants & prizes:** | |
| Nov. 1997 – Nov. 2000 | Ph.D. grant from the graduate school<br>“Analyse und Konstruktion in der Mathematik” |
| October 2002 | Borchers-Medal of the RWTH Aachen University |
| October 2002 | Friedrich-Wilhelm Prize of the RWTH Aachen University |
| **Research visits:** | |
| Winter 2002/03<br>(4 month) | Guest of the mathematical institute<br>of the Utrecht University |
| November 2007<br>(1 week) | Guest at INRIA – Sophia Antipolis, Nice<br>as member of the Procope program<br>*Computational Methods in Mathematical Systems Theory* |
| May 2008<br>(1 week) | Guest at the Departamento de Álgebra<br>of the Universidad de Sevilla |
| March 2012<br>(2 weeks) | Guest at the Departamento de Álgebra<br>of the Universidad de Sevilla |
| June 2012<br>(1 week) | Guest at INRIA – Saclay, Paris<br>as member of the Procope program<br>*Constructive Algebra for Systems Theory* |
| December 2012<br>(1 week) | Guest at INRIA – Saclay, Paris<br>as member of the Procope program<br>*Constructive Algebra for Systems Theory* |
| February 2015<br>(1 week) | Guest at the Departamento de Álgebra<br>of the Universidad de Sevilla |
| **Further research activities:** | |
| Since December 2013<br>2 years | Foreign member of the<br>Proyecto de Investigación de excelencia,<br>Junta de Andalucía – Singularidades,<br>geometría algebraica aritmética<br>y teoría de representaciones:<br>estructuras y métodos diferenciales, cohomológicos,<br>combinatorios y computacionales. |

**Acquired research funding:**

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| July 2013<br>3 years | PhD position (126225 €) + 9000 € travel fund<br>for a winning proposal in the DFG priority program<br>"Algorithmic and Experimental Methods<br>in Algebra, Geometry, and Number Theory",<br>Project: *Constructive derived equivalences<br>and equivariant vector bundles* |
| January 2017<br>4 years | Postdoc position (266400 €) + 4000 € travel fund<br>for a winning proposal in the DFG<br>Collaborative Research Centre TRR 195<br>"Symbolic Tools in Mathematics and their Application",<br>Project: *Central software project:<br>Interaction, high-performance and support* |
| January 2017<br>4 years | Postdoc position (266400 €) + 16000 € travel fund<br>+ 31816 € Research assistant<br>for a winning proposal in the DFG<br>Collaborative Research Centre TRR 195<br>"Symbolic Tools in Mathematics and their Application",<br>Project: *Derived categories of equivariant coherent sheaves* |
| January 2022<br>3 years | PhD/Postdoc position (201000 €)<br>"Qompiler – Standardisierter Quanten Software Stack ",<br>Project: *Implementierung einer kategoriellen Zwischenebene* |

## Preprints
## (inverse chronological)

[1] H. Chau Nguyen, Sébastien Designolle, Mohamed Barakat and Otfried Gühne, *Symmetries between measurements in quantum mechanics*. (arXiv:2003.12553).

## Refereed publications
## (inverse chronological)

[2] Mohamed Barakat, Robin Brüser, Claus Fieker, Tobias Huber and Jan Piclum, *Feynman integral reduction using Gröbner bases*. Accepted for publication in JHEP (2023). (arXiv:2210.05347).

[3] Mohamed Barakat and Lukas Kühne, *Computing the nonfree locus of the moduli space of arrangements and Terao's freeness conjecture*. Math. Comp. 92 (2023), 1431-1452. (arXiv:2112.13065).

[4] Mohamed Barakat and Markus Lange-Hegermann, *An algorithmic approach to Chevalley's Theorem on images of rational morphisms between affine varieties*. Math. Comp., 91(333), (2022), 451–490. (arXiv:1911.10411).

[5] Mohamed Barakat and Reimer Behrends and Christopher Jefferson and Lukas Kühne and Martin Leuner, *On the generation of rank 3 simple matroids with an application to Terao's freeness conjecture*. SIAM J. Discrete Math., 35(2), (2021), 1201–1223. (arXiv:1907.01073).

[6] Mohamed Barakat and Markus Lange-Hegermann, *A constructive approach to the module of twisted global sections on relative projective spaces*. Algorithmic and Experimental Methods in Algebra, Geometry, and Number Theory, (Springer), (2017), 23–49, (arXiv:1409.6100).

[7] Takuro Abe, Mohamed Barakat, Michael Cuntz, Torsten Hoge, and Hiroaki Terao, *The freeness of ideal subarrangements of Weyl arrangements*. J. Eur. Math. Soc. **18** (2016), no. 6, 1339–1348, (arXiv:1304.8033).

[8] Mohamed Barakat, *On subdirect factors of a projective module and applications to system theory*. Multidim. Syst. Sign. Process. **26** (2015), 339–348, (arXiv:1305.0058).

[9] Mohamed Barakat and Markus Lange-Hegermann, *On the* $\mathrm{Ext}$*-computability of* SERRE *quotient categories*. Journal of Algebra **420** (2014), 333–349, (arXiv:1212.4068).

[10] Mohamed Barakat and Markus Lange-Hegermann, *Characterizing Serre quotients with no section functor and applications to coherent sheaves*. Appl. Categor. Struct. **22** (2014), no. 3, 457–466, (arXiv:1210.1425).

[11] Mohamed Barakat and Markus Lange-Hegermann, *On monads of exact reflective localizations of Abelian categories*. Homology, Homotopy and Application **15**, (2013), no. 2, 145–151, (arXiv:1202.3337).

[12] Mohamed Barakat and Michael Cuntz, *Coxeter and crystallographic arrangements are inductively free*. Advances in Mathematics **229** (2012), no. 1, 691–709, (arXiv:1011.4228).

[13] Mohamed Barakat and Markus Lange-Hegermann, *An axiomatic setup for algorithmic homological algebra and an alternative approach to localization*. J. Algebra Appl. **10** (2011), no. 2, 269–293, (arXiv:1003.1943).

[14] Mohamed Barakat and Simon Görtzen, *Simplicial cohomology of smooth orbifolds in* GAP. Proceedings of the third International Congress on Mathematical Software - ICMS 2010 (Kobe, Japan) (K. Fukuda et al., ed.), Lecture Notes in Computer Science, vol. 6327, Springer, 13–17 September 2010, pp. 46–49, (https://algebra.mathematik.uni-siegen.de/barakat/ICMS10/SCO.pdf).

[15] Mohamed Barakat and Stanislaus Maier-Paape, *Conley index theory*. Proceedings of the 19th International Symposium on Mathematical Theory of Networks and Systems - MTNS 2010 (Budapest, Hungary) (András Edelmayer, ed.), 5–9 July 2010, pp. 1645–1651 (http://www.conferences.hu/mtns2010/proceedings/Papers/286_472.pdf).

[16] Mohamed Barakat, *Purity filtration and the fine structure of autonomy*. Proceedings of the 19th International Symposium on Mathematical Theory of Networks and Systems - MTNS 2010 (Budapest, Hungary) (András Edelmayer, ed.), 5–9 July 2010, pp. 1657–1661 (http://www.conferences.hu/mtns2010/proceedings/Papers/288_451.pdf).

[17] Mohamed Barakat and Stanislaus Maier-Paape, *Computation of connection matrices using the software package* conley. Internat. J. Bifur. Chaos Appl. Sci. Engrg. **19** (2009), no. 9, 3033–3056.

[18] Mohamed Barakat and Daniel Robertz, conley*: Computing connection matrices in* Maple. J. Symbolic Comput. **44** (2009), no. 5, 540–557, (arXiv:math.DS/0701173).

[19] Mohamed Barakat and Daniel Robertz, homalg *– A meta-package for homological algebra*. J. Algebra Appl. **7** (2008), no. 3, 299–317, (arXiv:math.AC/0701146).

[20] Mohamed Barakat and Daniel Robertz, *Computing invariants of multidimensional linear systems on an abstract homological level*. Proceedings of the 17th International Symposium on Mathematical Theory of Networks and Systems - MTNS 2006 (Kyoto, Japan), 2006, pp. 542–559, (https://algebra.mathematik.uni-siegen.de/barakat/mtns/homalg_mtns06.pdf).

[21] Mohamed Barakat and Daniel Robertz, homalg*: First steps to an abstract package for homological algebra*. Proceedings of the X meeting on computational algebra and its applications - EACA 2006 (Sevilla, Spain), 2006, pp. 29–32, (https://algebra.mathematik.uni-siegen.de/barakat/eaca/homalg_eaca06.pdf).

[22] Mohamed Barakat, *The existence of Cartan connections and geometrizable principal bundles*. Arch. Math. (Basel) **83** (2004), no. 2, 159–163, (arXiv:math.DG/0206136).

[23] Mohamed Barakat, `jets`. *A MAPLE-package for formal differential geometry*. Computer algebra in scientific computing (Konstanz, 2001), Springer, Berlin, 2001, pp. 1–12, (`https://algebra.mathematik.uni-siegen.de/barakat/casc/casc.pdf`).

[24] Mohamed Barakat and Martin Oberlack, *Reduction and long time behaviour of homogeneous turbulence under spatially constant mean-velocity gradient*. Advances in turbulence VIII: Proc. of the Eights European Turbulence Conference (Barcelona, Spain) (C. Dopazo, ed.), CIMNE, June 27-30 2000, pp. 865–868.

## Non-refereed publications (inverse chronological)

[25] Mohamed Barakat, Robin Brüser, Tobias Huber and Jan Piclum, *Feynman integral reduction using Gröbner bases*. PoS 416 - Loops and Legs in Quantum Field Theory (LL2022), (`arXiv:2207.09275`).

[26] Mohamed Barakat and Markus Lange-Hegermann and Sebastian Posur, *Elimination via saturation*. (`arXiv:1707.00925`).

[27] Mohamed Barakat and Markus Lange-Hegermann, *Gabriel morphisms and the computability of Serre quotients with applications to coherent sheaves*. (`arXiv:1409.2028`).

[28] Mohamed Barakat, Max Horn, Frank Lübeck, Oleksandr Motsak, Max Neunhöffer, Hans Schönemann, *The GAP package* `SingularInterface`. Computeralgebra-Rundbrief, **55**, 29–33, October 2014, (`http://www.fachgruppe-computeralgebra.de/data/CA-Rundbrief/car55.pdf`).

[29] Mohamed Barakat, *Computations of unitary groups in characteristic* 2. (for J.-P. Serre), 2013, (`https://algebra.mathematik.uni-siegen.de/barakat/forJPSerre/UnitaryGroup.pdf`).

[30] Mohamed Barakat and Markus Lange-Hegermann, *Computing Ext in Serre quotient categories*. Mini-Workshop: Constructive Homological Algebra with Applications to Coherent Sheaves and Control Theory, no. 25, MFO, Oberwolfach, 2013, pp. 14–17.

[31] Mohamed Barakat and Markus Lange-Hegermann, *The* `homalg` *project*. Computeralgebra-Rundbrief, **51**, 6–9, October 2012, (`http://www.fachgruppe-computeralgebra.de/data/CA-Rundbrief/car51.pdf`).

[32] Mohamed Barakat, *Jet groupoids and the invariance of geometric structures*. Mini-Workshop: Algebraic and Analytic Techniques for Polynomial Vector Fields, no. 57, MFO, Oberwolfach, 2010, pp. 19–21.

[33] Mohamed Barakat, *Spectral sequences and effective computations*. Mini-Workshop: Formal Methods in Commutative Algebra: A View Toward Constructive Homological Algebra, no. 50, MFO, Oberwolfach, 2009, pp. 7–12.

[34] Mohamed Barakat, *Spectral filtrations via generalized morphisms*. (arXiv:0904.0240).

[35] Mohamed Barakat and Barbara Bremer, *Higher extension modules and the Yoneda product*. (arXiv:0802.3179).

## Theses

[36] *Pro-Nilpotente Lie-Algebren*. Diploma thesis, Lehrstuhl B für Mathematik, RWTH Aachen University, October 1997.

[37] *Functional spaces. A direct approach*. PhD thesis, RWTH Aachen University, January 2002.

[38] *The homomorphism theorem and effective computations*. Habilitation thesis, RWTH Aachen University, April 2009.

## Software projects

[39] *The* homalg *project.* 2003–current. (https://homalg-project.github.io).

[40] jets *package.* 2000–2007. (https://algebra.mathematik.uni-siegen.de/barakat/jets/).

## Editorial activity

[41] Associate Editor, *The Journal of Software for Algebra and Geometry*.

## Organized (since 2010)

[42] PLESKEN*'s 60th birthday colloquium*. RWTH Aachen University, 7 May, 2010. (co-organizer)

[43] *The second* SINGULAR-GAP *developers meeting*. University of Kaiserslautern, 14–18 November 2011. (organizer)

[44] *The third* SINGULAR-polymake-GAP *developers meeting*. University of St Andrews, 27–31 August 2012. (organizer)

[45] *The fourth* SINGULAR-GAP *developers meeting*. RWTH Aachen University, 7–11 January 2013. (organizer)

[46] OBERWOLFACH MINI-WORKSHOP: *Constructive Homological Algebra with Applications to Coherent Sheaves and Control Theory*. Mathematisches Forschungsinstitut Oberwolfach, 12–18 May 2013. (co-organizer)

[47] *The fifth* SINGULAR-GAP *developers meeting*. RWTH Aachen University, 6–10 January 2014. (co-organizer)

[48] *First* GAP *Days*. RWTH Aachen University, 25–29 August 2014. (co-organizer)

[49] *Seventh de Brún Workshop on Homological Perturbation Theory*. National University of Ireland, Galway, 1–5 December 2014. (co-organizer)

[50] *Second* GAP *Days*. RWTH Aachen University, 16–20 March 2015. (co-organizer)

[51] *Third* GAP *Days*. NTNU Trondheim, 14–23 September 2015. (co-organizer)

[52] *Minisymposium der DMV Jahrestagung: Computer Algebra and Applications*. Hamburg, 21–25 September 2015. (co-organizer)

[53] *Session on computational aspects of homological algebra, group, and representation theory at ICMS 2016*. ZIB Berlin, 11–14 July 2016. (co-organizer)

[54] GAP *Days Fall 2017*. University of Siegen, Workshop: 30 August – 1 September, Code sprint: 4–8 September, 2017. (co-organizer)

[55] GAP *Days Fall 2018*, University of Siegen, 17–21 September, 2018. (co-organizer)

[56] *The Mathematics of Quantum Information, 2019*, University of Siegen, 18–21 March, 2019. (co-organizer)

[57] *Functor Categories, Model Theory, and Constructive Category Theory*, University of Tartu, Pärnu, Estonia, 15–17 July, 2019. (co-organizer)

[58] *Mathematical Structures in Feynman Integrals*, University of Siegen, 13–16 February, 2023. (co-organizer)

[59] *Functor Categories, Model Theory, and Constructive Category Theory*, University of Málaga, 3–7 July, 2023. (co-organizer)

## Advised PhD theses

[60] SEBASTIAN POSUR: *Constructive category theory and applications to equivariant sheaves*, PhD thesis, University of Siegen, June 2017.

[61] SEBASTIAN GUTSCHE: *Constructive category theory with applications to algebraic geometry*, PhD thesis, University of Siegen, August 2017.

[62] MARTIN BIES: *Cohomologies of coherent sheaves and massless spectra in F-theory*, PhD thesis, Institut für theoretische Physik, University of Heidelberg, February 2018 (coadvisor).

[63] SERGIO SICCHA: *Normalizers of primitive groups with non-regular socles in polynomial time*, PhD thesis, RWTH Aachen University, July 2020 (coadvisor).

[64] KAMAL SALEH: *Constructive category theory and tilting equivalences via strong exceptional sequences*, PhD thesis, University of Siegen, May 2022.

[65] FABIAN ZICKGRAF: *CompilerForCAP – A category theory compiler*, PhD thesis, University of Siegen (**in preparation**).