

CURRICULUM VITAE

DR. RER. NAT. MARTIN BIES

PERSONAL DETAILS

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Nationality: German

Date of birth: 15/12/1987



SUMMARY

Education	PhD in Physics (Heidelberg university – defended on 01/02/2018)
Past research	Physics: <ul style="list-style-type: none">• Phenomenological aspects of standard models in string theory.• In particular computation of massless spectra of string vacua. Mathematics: <ul style="list-style-type: none">• Algorithms for cohomologies of coherent sheaves.• Constructive approaches to Freyd categories.• Brill-Noether theory and root bundles. Software development via github since December 2015: <ul style="list-style-type: none">• Github-metric:<ul style="list-style-type: none">– More than 2500 contributions.– More than 500.000 lines of code added.– More than 480.000 lines of code modified/deleted.• Contributions to homalg_project, CAP_project, each consisting of more than 200.000 lines of code.• Other contributions include ToricVarieties_project, oscar-system.• Experience in gap, python, julia, C++, git.
Teaching experience	Instructor (2021): <i>Computational Linear Algebra</i> , University of Pennsylvania Senior Tutor in 2016 and 2018 (Heidelberg University) Tutor for 8 lecture courses (Oct. 2012 – Oct. 2018, Heidelberg University)
Language skills	German – mother tongue English – fluent (Imperial College International Diploma) French – (CEFR level B1)
Scholarships	Simons Postdoctoral Fellow (since Sept. 2020) FWA – Foundation Wiener-Anspach (Oct. 2018 – Sept. 2020) Studienstiftung des deutschen Volkes (Jan. 2010 – Feb. 2018)

PROFESSIONAL EXPERIENCE

Since Sept. 2021	Simons Postdoctoral Fellow Department of Physics and Astronomy, University of Pennsylvania
Sept. 2020 - Aug. 2021	Simons Postdoctoral Fellow Department of Mathematics, University of Pennsylvania
Oct. 2019 – Sept. 2020	Long term visitor Mathematical institute, University of Oxford
Oct. 2018 – Sept. 2019	Postdoctoral Researcher Physique Théorique et Mathématique, Université Libre de Bruxelles
Feb. 2018 – Sept. 2018	Postdoctoral Researcher Institut für theoretische Physik, Ruprecht-Karls-Universität Heidelberg

EDUCATION

Mar. 2014 – Feb. 2018	PhD studies in physics (Heidelberg university) on the subject <i>Cohomologies of coherent sheaves and massless spectra in F-theory</i> Supervisor physics: Prof. Dr. Timo Weigand (Uni. Heidelberg) Supervisor mathematics: Prof. Dr. Mohamed Barakat (Uni. Siegen) Result: Magna cum laude (very good)
Sept. 2012 – Feb. 2014	Master studies in physics (Heidelberg university) on the subject <i>Cohomologies of holomorphic line bundles in smooth and compact normal toric varieties</i> Supervisor: Prof. Dr. Timo Weigand Result: 1.0
Oct. 2008 – Aug. 2012	Bachelor studies in physics (Heidelberg university) on the subject <i>Intersecting D6-brane models on $T^2 \times T^2 \times T^2/(\sigma \times \Omega)$ and $T^2 \times T^2 \times T^2/(\mathbb{Z}_2 \times \mathbb{Z}_2 \times \sigma \times \Omega)$ orientifolds</i> Supervisor: Prof. Dr. Timo Weigand Result: 1.1
Oct. 2010 – June 2011	Studies abroad at Imperial College (London, United Kingdom)

SOFTWARE DEVELOPMENT

I develop open-source software on **github**. My interest rests on tools which help to investigate geometries relevant to string theory. This includes *toric geometry*, for which I have written a collection of packages https://github.com/homalg-project/ToricVarieties_project. This includes the *gap-4* package *QSMExplorer*, which is currently under heavy development to reflect and extend recent insights into a class of string theory solutions known as the **Quadrillion Standard Models**. I have also contributed to https://github.com/homalg-project/CAP_project and <https://github.com/oscar-system/Oscar.jl>. My programming experience includes the languages **gap**, **python**, **julia**, **C++**. For more details please visit my **GitHub-profile** <https://github.com/HereAround> or my **website** <https://martinbies.github.io/>.

SCIENTIFIC PUBLICATIONS

- *Statistics of Root Bundles Relevant for Exact Matter Spectra of F-theory MSSMs*
Journal: *Physical Review D*
DOI: 10.1103/PhysRevD.104.L061903
Collaborators: M. Cvetič, M. Liu
- *Root Bundles and Towards Exact Matter Spectra of F-theory MSSMs*
Journal: *Journal of High Energy Physics*
DOI: 10.1007/JHEP09(2021)076
Collaborators: M. Cvetič, R. Donagi, M. Liu, M. Ong
- *Tensor products of finitely presented functors*
Journal: *Journal of Algebra and Its Applications*
DOI: 10.1142/s0219498822501869
Collaborator: Sebastian Posur
- *Machine Learning and Algebraic Approaches towards Complete Matter Spectra in 4d F-theory*
Journal: *Journal of High Energy Physics*
DOI: 10.1007/JHEP01(2021)196
Collaborators: M. Cvetič, R. Donagi, L. Ling, M. Liu, F. Ruehle
- *Cohomologies of coherent sheaves and massless spectra in F-theory*
Journal: Heidelberg University Library
DOI: 10.11588/HEIDOK.00024045
- *Algebraic Cycles and Local Anomalies in F-theory*
Journal: *Journal of High Energy Physics*
DOI: 10.1007/jhep11(2017)100
Collaborators: Christoph Mayrhofer and Timo Weigand
- *Gauge Backgrounds and Zero-Mode Counting in F-theory*
Journal: *Journal of High Energy Physics*
DOI: 10.1007/jhep11(2017)081
Collaborators: Christoph Mayrhofer and Timo Weigand
- *Chow groups, Deligne cohomology and massless matter in F-theory*
Preprint: <https://arxiv.org/abs/1402.5144>
Collaborators: Christoph Mayrhofer, Christian Pehle and Timo Weigand

CONFERENCES AND TALKS

- Sept 2021 **Talk** at Summer series on string phenomenology
Title: *Root Bundles and Towards Exact Matter Spectra of F-theory MSSMs*
- July 2021 String Pheno 2021 (virtual conference)
- June 2021 Strings 2021 (virtual conference)
- June 2021 String Math 2021 (virtual conference)
- Dec. 2020 **Talk** at String Data 2020 (virtual conference)
Title: *Vector-like spectra in F-theory* (joined with M. Liu)
- Oct. 2020 **Talk** in Philadelphia, Pennsylvania
Title: *Machine Learning and Algebraic Approaches towards Complete Matter Spectra in 4d F-theory*
- June 2020 **Talk** at Summer series on string phenomenology
Title: *On stratification diagrams, algorithmic spectrum estimates and vector-like pairs in F-theory*
- June 2020 String Pheno 2020 (virtual conference)
- Dec. 2019 **Talk** in Philadelphia, Pennsylvania
Title: *From F-theory Standard Models to Freyd Categories and back*
- Sept. 2019 Poster at Strings and Geometry (Oxford, United Kingdom)
Title: *Tensor products of finitely presented functors*
- Aug. 2019 **Talk** at gap singular meeting and school (Lambrecht, Germany)
Title: *Monoidal structures in Freyd categories*
- July 2019 Strings (Brussels, Belgium)
- Oct. 2018 **Talk** in Brussels, Belgium
Title: *Counting massless matter in F-theory with CAP*
- Aug. 2018 **Talk** at CAP_days 2018 (Siegen, Germany)
Title: *CAP, machine learning and string theory*
- May 2018 **Talk** in seminar on *Holography and Large-N duality* in Heidelberg, Germany
Title: *Conformal invariants; Fefferman–Graham expansion; Graham–Lee theorem* (joined with Menelaos Zikidis)
- Mar. 2018 String Data 2018 (Munich, Germany)
- Jul. 2017 **Talk** at String Pheno 2017 (Virginia, USA)
Title: *Zero Mode Counting in F-Theory via CAP*
- Dec. 2015 String Math (Sanya, China)
- Sept. 2015 Third GAP Days (Trondheim, Norway)
- Mar. 2015 Second GAP Days (Aachen, Germany)
- Feb. 2015 Physics and Geometry of F-theory (Munich, Germany)
- Dec. 2014 Homological Perturbation Theory (Galway, Ireland)
- Aug. 2014 **Talk** at GAP Days (Aachen, Germany)
Title: *String theory, sheaf cohomology and the homalg package*
- July 2014 **Talk** in Aachen, Germany
Title: *The Standard Model From String Theory*
- May 2014 **Talk** at seminar series *What is?* in Heidelberg, Germany
Title: *What is a fermion/boson (in quantum mechanics)?*
- Feb. 2014 Geometry and Physics of String Compactifications (Heidelberg, Germany)
- Feb. 2014 **Talk** in Heidelberg, Germany
Title: *Cohomology Of Holomorphic Pullback Line Bundles On Smooth And Compact Normal Toric Varieties*
- May 2012 **Talk** in Heidelberg, Germany
Title: *Intersecting D6-Brane Models*

TEACHING EXPERIENCE

Jan. 2021 – May. 2021	Instructor	Computational linear algebra
Apr. 2018 – Oct. 2018	Senior tutor	Methods of mathematical physics 1
Oct. 2016 – Mar. 2017	Tutor	Theoretical physics I
Apr. 2016 – Sept. 2016	Senior tutor	General relativity
Apr. 2015 – Sept. 2015	Tutor	Theoretical physics IV
Oct. 2014 – Mar. 2015	Tutor	Quantum field theory
Oct. 2013 – Mar. 2014	Tutor	Theoretical physics III
Apr. 2013 – Sept. 2013	Tutor	Theoretical physics II
Oct. 2012 – Mar. 2013	Tutor	Theoretical physics I

ENGAGEMENT AT *Studienstiftung des deutschen Volkes*

June 2018	Member of the admission board <i>Heidelberg</i>
Dec. 2017	Member of the admission board <i>Ellwangen III</i>
May 2017	Training for admission board members – successfully completed
Nov. 2016	Member of the admission board <i>Heidelberg</i>

OTHER SEMINARS/CONFERENCES

May 2018	Kontaktseminar – Schwerpunkt Banken und Beratung (Bonn, Germany)
May 2018	Physiker im Beruf (Bad Honnef, Germany)