References

- [1] V. Alvarez, J.A. Armario, M.D. Frau, and P. Real. Calculating cocyclic hadamard matrices in mathematica: Exhaustive and heuristic searches. In Andres Iglesias and Nobuki Takayama, editors, *Mathematical Software ICMS 2006*, volume 4151 of *Lecture Notes in Computer Science*, pages 419–422. Springer Berlin Heidelberg, 2006.
- [2] N. Andruskiewitsch, C. Galindo, and M. Müller. Examples of finite-dimensional Hopf algebras with the dual Chevalley property. *ArXiv* e-prints, September 2015.
- [3] J.S. Bailes. Cohen-Lenstra Heuristics and the Cohomology of the Braid Group. PhD thesis, University of Melbourne. University of Melbourne, 2011.
- [4] Mohamed Barakat. The homomorphism theorem and effective computations. Habilitationsschrift, Aachen http://www.mathb.rwth-aachen.de/~barakat/habil/habil.pdf, 2018.
- [5] Ethan Berkove and Alexander D. Rahm. The mod 2 cohomology rings of SL₂ of the imaginary quadratic integers. *J. Pure Appl. Algebra*, 220(3):944–975, 2016. With an appendix by Aurel Page.
- [6] Anna M. Bigatti and E. Sáenz-de Cabezón. Computation of the (n-1)-st Koszul homology of monomial ideals and related algorithms. In ISSAC 2009—Proceedings of the 2009 International Symposium on Symbolic and Algebraic Computation, pages 31–37. ACM, New York, 2009.
- [7] L.R. Bosko. Schur Multipliers of Nilpotent Lie Algebras. BiblioBazaar, 2012.
- [8] Piotr Brendel, Pawel Dlotko, Graham Ellis, Mateusz Juda, and Marian Mrozek. Computing fundamental groups from point clouds. *Applicable Algebra in Engineering, Communication and Computing*, 26(1-2):27–48, 2015.
- [9] A. T. Bui and Graham Ellis. Computing bredon homology of groups. Journal of Homotopy and Related Structures, 11(4):715–734, 2016.
- [10] A.T. Bui, A. Rahm, and M. Wendt. The Farrell-Tate and Bredon homology for $PSL_4(\mathbb{Z})$ and other arithmetic groups. ArXiv e-prints, November 2016.
- [11] Martin Čadek, Marek Krčál, Jiří Matoušek, Lukáš Vokřínek, and Uli Wagner. Polynomial-time computation of homotopy groups and Postnikov systems in fixed dimension. SIAM J. Comput., 43(5):1728–1780, 2014.
- [12] Erin Wolf Chambers and Mikael Vejdemo-Johansson. Computing minimum area homologies. *Computer Graphics Forum*, 34(6):13–21, 2015.
- [13] Maura Clancy and Graham Ellis. Homology of some Artin and twisted Artin groups. J. K-Theory, 6(1):171–196, 2010.

- [14] I.S. Costa. Presentation complexes with the fixed point property. *Geometry and Topology*, 21:1275–1283, 2017.
- [15] Paul de Lange. The physics & mathematics of microstates in string theory and a monstrous farey tail. *PhD thesis, Univ. van Amsterdam*, 2016.
- [16] Heiko Dietrich, Bettina Eick, and Dörte Feichtenschlager. Investigating p-groups by coclass with GAP. In *Computational group theory and the theory of groups*, volume 470 of *Contemp. Math.*, pages 45–61. Amer. Math. Soc., Providence, RI, 2008.
- [17] Mathieu Dutour Sikirić and Graham Ellis. Wythoff polytopes and low-dimensional homology of Mathieu groups. *J. Algebra*, 322(11):4143–4150, 2009.
- [18] Mathieu Dutour Sikirić, Graham Ellis, and Achill Schürmann. On the integral homology of $PSL_4(\mathbb{Z})$ and other arithmetic groups. *J. Number Theory*, 131(12):2368–2375, 2011.
- [19] Graham Ellis. Homological algebra programming. In *Computational group theory and the theory of groups*, volume 470 of *Contemp. Math.*, pages 63–74. Amer. Math. Soc., Providence, RI, 2008.
- [20] Graham Ellis. Cohomological periodicities of crystallographic groups. *J. Algebra*, 445:537–544, 2016.
- [21] Graham Ellis and Fintan Hegarty. Computational homotopy of finite regular CW-spaces. J. Homotopy Relat. Struct., 9(1):25–54, 2014.
- [22] Graham Ellis and Simon King. Persistent homology of groups. *J. Group Theory*, 14(4):575–587, 2011.
- [23] Graham Ellis and Luyen Van Le. Homotopy 2-types of low order. Exp. Math., 23(4):383–389, 2014.
- [24] Graham Ellis and Le Van Luyen. Computational homology of *n*-types. *J. Symbolic Comput.*, 47(11):1309–1317, 2012.
- [25] Graham Ellis and Roman Mikhailov. A colimit of classifying spaces. Adv. Math., 223(6):2097–2113, 2010.
- [26] Graham Ellis, Hamid Mohammadzadeh, and Hamid Tavallaee. Computing covers of Lie algebras. In Computational group theory and the theory of groups, II, volume 511 of Contemp. Math., pages 25–31. Amer. Math. Soc., Providence, RI, 2010.
- [27] Graham Ellis and Emil Sköldberg. The $K(\pi, 1)$ conjecture for a class of Artin groups. Comment. Math. Helv., 85(2):409–415, 2010.

- [28] Graham Ellis and Paul Smith. Computing group cohomology rings from the Lyndon-Hochschild-Serre spectral sequence. *J. Symbolic Comput.*, 46(4):360–370, 2011.
- [29] Dominic Else and Ryan Thomgren. Topological theory of lieb-schultz-mattis theorems in quantum spin systems. arXiv:1907.08204, 2019.
- [30] P. Fernández Ascariz. Módulos cruzados de álgebras conmutativas, homología y HAP. Teses de doutoramento da Universidade de Santiago de Compostela. Universidad de Santiago de Compostela, Servizo de Publicacións e Intercambio Científico, 2007.
- [31] Matthias R. Gaberdiel, Daniel Persson, Henrik Ronellenfitsch, and Roberto Volpato. Generalized Mathieu Moonshine. *Commun. Number Theory Phys.*, 7(1):145–223, 2013.
- [32] Terry Gannon and Corey Jones. Vanishing of categorical obstructions for permutation orbifolds. arXiv:1804.08343, 2018.
- [33] Angus Gruen. Computing modular data for drinfeld centers of pointed fusion categories. Bachelor thesis, The Mathematical Sciences Institute, Australian National University, 2017.
- [34] S. Hatui. A characterization of finite p-groups by their schur multiplier. arXiv:1608.06322, 2016.
- [35] Sumana Hatui. Finite p-groups having Schur multiplier of maximum order. J. Alqebra, 492:490–497, 2017.
- [36] Sumana Hatui, Vipul Kakkar, and Manoj Yadav. The schur multipliers of p-groups of order p^5 . arXiv:1804.11308, 2018.
- [37] F. Hegarty. Computational Homology of Cubical and Permutahedral Complexes. PhD thesis, National University of Ireland Galway. National University of Ireland Galway, 2012.
- [38] Jnathan Heras, Vico Pascual, and Julio Rubio. A system for computing and reasoning in algebraic topology. In James H. Davenport, William M. Farmer, Josef Urban, and Florian Rabe, editors, *Intelligent Computer Mathematics*, volume 6824 of *Lecture Notes in Computer Science*, pages 295–297. Springer Berlin Heidelberg, 2011.
- [39] A. Holzinger. On topological data mining. Lecture Notes in Computer Science, 8401:331–356, 2014.
- [40] Andreas Holzinger and Igor Jurisica. Knowledge discovery and data mining in biomedical informatics: The future is in integrative, interactive machine learning solutions. In *Interactive Knowledge Discovery and Data Mining in Biomedical Informatics State-of-the-Art and Future Challenges*, pages 1–18. 2014.

- [41] A. Hoshi, M.-c. Kang, and A. Yamasaki. Multiplicative invariant fields of dimension ≤ 6. arXiv.org, arXiv:1609.04142, pages 1–105, 2016.
- [42] A. Hoshi, M.-c. Kang, and A. Yamasaki. Degree three unramified groups and noether's problem for groups of order 243. arXiv.org, arXiv:1710.01958, pages 1–61, 2017.
- [43] Akinari Hoshi and Aiichi Yamasaki. Rationality problem for algebraic tori. Mem. American Math. Soc. (to appear), pages 1–146, 2016.
- [44] U. Jezernik. *Universal Commutator Relations*. PhD thesis, University of Ljubljana. University of Ljubljana, 2016.
- [45] Urban Jezernik and Primož Moravec. Bogomolov multipliers of groups of order 128. Exp. Math., 23(2):174–180, 2014.
- [46] T. Johnson-Freyd. The moonshine anomaly. arXiv:1707.08388, pages 1–15, 2017.
- [47] T. Johnson-Freyd and D. Treumann. $H^4(Co_0; Z) = Z_{24}$. arXiv:1707.07587v1, pages 1–14, 2017.
- [48] T. Johnson-Freyd and D. Treumann. Third homology of some sporadic finite groups. arXiv:rXiv:1810.00463v1, pages 1–29, 2018.
- [49] A. Joshi. *MATHIEU MOONSHINE: From* M_{24} to M_{12} . MSc thesis, IIT Madras. Indian Institute of Technology Madras, 2016.
- [50] David Joyner. A primer on computational group homology and cohomology using GAP and SAGE. In *Aspects of infinite groups*, volume 1 of *Algebra Discrete Math.*, pages 159–191. World Sci. Publ., Hackensack, NJ, 2008.
- [51] Tomasz Kaczynski and Marian Mrozek. The cubical cohomology ring: an algorithmic approach. Found. Comput. Math., 13(5):789–818, 2013.
- [52] Anton Kapustin and Ryan Thorngren. Anomalous discrete symmetries in three dimensions and group cohomology. Phys. Rev. Lett., 112:231602, Jun 2014.
- [53] V. Kurlin. Computing invariants of knotted graphs given by sequences of points in 3-dimensional space. Topological methods in data analysis and visualization IV: theory, algorithms, and applications. Mathematics and visualization. (Springer), 2017.
- [54] Larry A. Lambe. An algebraic study of the Klein bottle. *J. Homotopy Relat. Struct.*, 11(4):885–891, 2016.
- [55] Rafał Lutowski and Bartosz Putrycz. Spin structures on flat manifolds. J. Algebra, 436:277–291, 2015.

- [56] I. Michailov, I. Ivanov, and N. Ziapkov. Algorithmic generation of isoclinism classes for 4-generator groups of nilpotency class 2. Proceedings of the University of Ruse Conference, 2015. http://ori.uni-ruse.bg/bg/docs/cp15/6.1/6.1-3.pdf, pages 24-27, 2015.
- [57] Pascal Michel. Homology of groups and third busy beaver function. *Internat. J. Algebra Comput.*, 20(6):769–791, 2010.
- [58] M. Mignard and P. Schauenburg. Morita equivalence of pointed fusion categories of small rank. *HAL Id: hal-01573708*, pages 1–46, 2017.
- [59] Roman Mikhailov and Jie Wu. On homotopy groups of the suspended classifying spaces. *Algebr. Geom. Topol.*, 10(1):565–625, 2010.
- [60] Yasushi Mizusawa. On certain 2-extensions of \mathbb{Q} unramified at 2 and ∞ . Osaka J. Math., 53(4):1063–1088, 10 2016.
- [61] Mohammad Reza R. Moghaddam and Peyman Niroomand. Some properties of certain subgroups of tensor squares of p-groups. Comm. Algebra, 40(3):1188–1193, 2012.
- [62] M. Muller Lopes Rocha. Ejemplos de lgebras de Hopf semisimples y de algebras de Hopf con la propiedad de Chevalley dual. PhD thesis, Universidad National de Cordoba. University Universidad National de Cordoba, 2016.
- [63] D. Müllner. Orientation Reversal of Manifolds. Bonner mathematische Schriften. D. Müllner, 2008.
- [64] Neha Nanda, Mahender Singh, and Manpreet Singh. Knot invariants from derivations of quandles. *arXiv:1804.01113*, 2018.
- [65] P. Niroomand and R. Rezaei. On the exterior degree of finite groups. Comm. Algebra, 39(1):335–343, 2011.
- [66] Peyman Niroomand and Rashid Rezaei. The exterior degree of a pair of finite groups. *Mediterr. J. Math.*, 10(3):1195–1206, 2013.
- [67] A. Odabaş, E.Ö. Uslu, and E. Ilgaz. Isoclinism of crossed modules. *J. Symbolic Comput.*, 74:408–424, 2016.
- [68] Nansen Petrosyan and Bartosz Putrycz. On cohomology of crystallographic groups with cyclic holonomy of split type. *J. Algebra*, 367:237–246, 2012.
- [69] Alexander D. Rahm. The homological torsion of PSL₂ of the imaginary quadratic integers. *Trans. Amer. Math. Soc.*, 365(3):1603–1635, 2013.
- [70] Alexander D. Rahm. Accessing the cohomology of discrete groups above their virtual cohomological dimension. *J. Algebra*, 404:152–175, 2014.

- [71] Alexander D. Rahm. The subgroup measuring the defect of the abelianization of $SL_2(\mathbb{Z}[i])$. J. Homotopy Relat. Struct., 9(2):257–262, 2014.
- [72] Pradeep K. Rai and Manoj K. Yadav. On Sh-rigidity of groups of order p^6 . J. Algebra, 428:26–42, 2015.
- [73] J. Roberts. ALGORITHMS FOR UPPER BOUNDS OF LOW DIMEN-SIONAL GROUP HOMOLOGY. PhD thesis, University of Kentucky. University of Kentucky, 2010.
- [74] Joshua Roberts. An algorithm for low dimensional group homology. *Homology, Homotopy Appl.*, 12(1):27–37, 2010.
- [75] Marc Röder. Geometric algorithms for resolutions for Bieberbach groups. In Computational group theory and the theory of groups, II, volume 511 of Contemp. Math., pages 167–178. Amer. Math. Soc., Providence, RI, 2010.
- [76] Ana Romero, Graham Ellis, and Julio Rubio. Interoperating between computer algebra systems: Computing homology of groups with kenzo and gap. In *Proceedings of the 2009 International Symposium on Symbolic and Algebraic Computation*, ISSAC '09, pages 303–310, New York, NY, USA, 2009. ACM.
- [77] Ana Romero and Julio Rubio. Computing the homology of groups: the geometric way. J. Symbolic Comput., 47(7):752–770, 2012.
- [78] Ana Romero and Julio Rubio. Homotopy groups of suspended classifying spaces: an experimental approach. *Math. Comp.*, 82(284):2237–2244, 2013.
- [79] S. Schönnenbeck. Homologiegruppen von Einheitengruppen von Ordnungen. *Masterarbeit, RWTH Aachen*, September 2013.
- [80] S. Schönnenbeck. Resolutions for unit groups of orders. ArXiv e-prints, September 2016.
- [81] Bui Anh Tuan and Graham Ellis. The homology of $SL_2(\mathbb{Z}[1/m])$ for small $m.\ J.\ Algebra,\ 408:102-108,\ 2014.$
- [82] Lukas Vokrínek. Algorithmic aspects of topological problems. *Habilitation thesis, Brno University*, 2017.
- [83] Wayne Zheng, Jia-Wei Mei, and Yang Qi. Classification and monte carlo study of symmetric Z_2 spin liquids on the triangular lattice. arXiv:1505.05351, 2015.
- [84] V. Ivarez, J.A. Armario, M.D. Frau, and P. Real. A mathematica notebook for computing the homology of iterated products of groups. In Andres Iglesias and Nobuki Takayama, editors, *Mathematical Software - ICMS* 2006, volume 4151 of *Lecture Notes in Computer Science*, pages 47–57. Springer Berlin Heidelberg, 2006.