

## 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] Zekeriya Arvasi, Alper Odabaş, and Christopher D. Wensley. Computing 3-Dimensional Groups : Crossed Squares and  $\text{Cat}^2$ -Groups. *arXiv e-prints*, page arXiv:1911.12799, Nov 2019.
- [4] Anh Tuan B and Anh Thi N. A brief introduction to the Quillen conjecture. *Sci. Tech. Dev. J.*, 22(2):235–238, 2019.
- [5] J.S. Bailes. *Cohen-Lenstra Heuristics and the Cohomology of the Braid Group*. PhD thesis, University of Melbourne. University of Melbourne, 2011.
- [6] Mohamed Barakat. The homomorphism theorem and effective computations. *Habilitationsschrift, Aachen* <http://www.mathb.rwth-aachen.de/~barakat/habil/habil.pdf>, 2018.
- [7] Ethan Berkove and Alexander D. Rahm. The mod 2 cohomology rings of  $\text{SL}_2$  of the imaginary quadratic integers. *J. Pure Appl. Algebra*, 220(3):944–975, 2016. With an appendix by Aurel Page.
- [8] 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.
- [9] L.R. Bosko. *Schur Multipliers of Nilpotent Lie Algebras*. BiblioBazaar, 2012.
- [10] 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.
- [11] A. T. Bui and Graham Ellis. Computing bredon homology of groups. *Journal of Homotopy and Related Structures*, 11(4):715–734, 2016.
- [12] A.T. Bui, A. Rahm, and M. Wendt. The Farrell-Tate and Bredon homology for  $\text{PSL}_4(\mathbb{Z})$  and other arithmetic groups. *ArXiv e-prints*, November 2016.

- [13] 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.
- [14] Erin Wolf Chambers and Mikael Vejdemo-Johansson. Computing minimum area homologies. *Computer Graphics Forum*, 34(6):13–21, 2015.
- [15] Maura Clancy and Graham Ellis. Homology of some Artin and twisted Artin groups. *J. K-Theory*, 6(1):171–196, 2010.
- [16] I.S. Costa. Presentation complexes with the fixed point property. *Geometry and Topology*, 21:1275–1283, 2017.
- [17] I.S. Costa. Puntos fijos de acciones y funciones en 2complejos. *PhD thesis, Universidad de Buenos Aires*, 2019.
- [18] Paul de Lange. The physics & mathematics of microstates in string theory and a monstrous farey tail. *PhD thesis, Univ. van Amsterdam*, 2016.
- [19] 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.
- [20] Mathieu Dutour Sikirić and Graham Ellis. Wythoff polytopes and low-dimensional homology of Mathieu groups. *J. Algebra*, 322(11):4143–4150, 2009.
- [21] Mathieu Dutour Sikirić, Graham Ellis, and Achill Schürmann. On the integral homology of  $\mathrm{PSL}_4(\mathbb{Z})$  and other arithmetic groups. *J. Number Theory*, 131(12):2368–2375, 2011.
- [22] 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.
- [23] Graham Ellis. Cohomological periodicities of crystallographic groups. *J. Algebra*, 445:537–544, 2016.
- [24] Graham Ellis and Fintan Hegarty. Computational homotopy of finite regular CW-spaces. *J. Homotopy Relat. Struct.*, 9(1):25–54, 2014.
- [25] Graham Ellis and Simon King. Persistent homology of groups. *J. Group Theory*, 14(4):575–587, 2011.
- [26] Graham Ellis and Luyen Van Le. Homotopy 2-types of low order. *Exp. Math.*, 23(4):383–389, 2014.
- [27] Graham Ellis and Le Van Luyen. Computational homology of  $n$ -types. *J. Symbolic Comput.*, 47(11):1309–1317, 2012.

- [28] Graham Ellis and Roman Mikhailov. A colimit of classifying spaces. *Adv. Math.*, 223(6):2097–2113, 2010.
- [29] 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.
- [30] Graham Ellis and Emil Sköldbberg. The  $K(\pi, 1)$  conjecture for a class of Artin groups. *Comment. Math. Helv.*, 85(2):409–415, 2010.
- [31] Graham Ellis and Paul Smith. Computing group cohomology rings from the Lyndon-Hochschild-Serre spectral sequence. *J. Symbolic Comput.*, 46(4):360–370, 2011.
- [32] Dominic Else and Ryan Thorngren. Topological theory of lieb-schultz-mattis theorems in quantum spin systems. *arXiv:1907.08204*, 2019.
- [33] 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.
- [34] Matthias R. Gaberdiel, Daniel Persson, Henrik Ronellenfitsch, and Roberto Volpato. Generalized Mathieu Moonshine. *Commun. Number Theory Phys.*, 7(1):145–223, 2013.
- [35] Terry Gannon and Corey Jones. Vanishing of categorical obstructions for permutation orbifolds. *arXiv:1804.08343*, 2018.
- [36] Angus Gruen. Computing modular data for drinfeld centers of pointed fusion categories. *Bachelor thesis, The Mathematical Sciences Institute, Australian National University*, 2017.
- [37] S. Hatui. A characterization of finite  $p$ -groups by their schur multiplier. *arXiv:1608.06322*, 2016.
- [38] Sumana Hatui. Finite  $p$ -groups having Schur multiplier of maximum order. *J. Algebra*, 492:490–497, 2017.
- [39] Sumana Hatui, Vipul Kakkar, and Manoj Yadav. The schur multipliers of  $p$ -groups of order  $p^5$ . *arXiv:1804.11308*, 2018.
- [40] Sumana Hatui, Vipul Kakkar, and Manoj K. Yadav. The Schur multiplier of groups of order  $p^5$ . *J. Group Theory*, 22(4):647–687, 2019.
- [41] F. Hegarty. *Computational Homology of Cubical and Permutahedral Complexes*. PhD thesis, National University of Ireland Galway. National University of Ireland Galway, 2012.

- [42] Jnathan Heras, Vico Pascual, and Julio Rubio. A system for computing and reasoning in algebraic topology. In JamesH. Davenport, WilliamM. 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.
- [43] A. Holzinger. On topological data mining. *Lecture Notes in Computer Science*, 8401:331–356, 2014.
- [44] 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.
- [45] A. Hoshi, M.-c. Kang, and A. Yamasaki. Multiplicative invariant fields of dimension  $\leq 6$ . *arXiv.org*, *arXiv:1609.04142*, pages 1–105, 2016.
- [46] 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.
- [47] Akinari Hoshi and Aiichi Yamasaki. Rationality problem for algebraic tori. *Mem. American Math. Soc. (to appear)*, pages 1–146, 2016.
- [48] U. Jezernik. *Universal Commutator Relations*. PhD thesis, University of Ljubljana. University of Ljubljana, 2016.
- [49] Urban Jezernik and Primož Moravec. Bogomolov multipliers of groups of order 128. *Exp. Math.*, 23(2):174–180, 2014.
- [50] T. Johnson-Freyd. The moonshine anomaly. *arXiv:1707.08388*, pages 1–15, 2017.
- [51] T. Johnson-Freyd and D. Treumann.  $H^4(C_{00}; \mathbb{Z}) = \mathbb{Z}_{24}$ . *arXiv:1707.07587v1*, pages 1–14, 2017.
- [52] T. Johnson-Freyd and D. Treumann. Third homology of some sporadic finite groups. *arXiv:arXiv:1810.00463v1*, pages 1–29, 2018.
- [53] A. Joshi. *MATHIEU MOONSHINE: From  $M_{24}$  to  $M_{12}$* . MSc thesis, IIT Madras. Indian Institute of Technology Madras, 2016.
- [54] 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.
- [55] Tomasz Kaczynski and Marian Mrozek. The cubical cohomology ring: an algorithmic approach. *Found. Comput. Math.*, 13(5):789–818, 2013.

- [56] Anton Kapustin and Ryan Thorngren. Anomalous discrete symmetries in three dimensions and group cohomology. *Phys. Rev. Lett.*, 112:231602, Jun 2014.
- [57] 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.
- [58] Larry A. Lambe. An algebraic study of the Klein bottle. *J. Homotopy Relat. Struct.*, 11(4):885–891, 2016.
- [59] Rafał Lutowski and Bartosz Putrycz. Spin structures on flat manifolds. *J. Algebra*, 436:277–291, 2015.
- [60] 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://conf.uni-ruse.bg/bg/docs/cp15/6.1/6.1-3.pdf>, pages 24–27, 2015.
- [61] Pascal Michel. Homology of groups and third busy beaver function. *Internat. J. Algebra Comput.*, 20(6):769–791, 2010.
- [62] M. Mignard and P. Schauenburg. Morita equivalence of pointed fusion categories of small rank. *HAL Id: hal-01573708*, pages 1–46, 2017.
- [63] Roman Mikhailov and Jie Wu. On homotopy groups of the suspended classifying spaces. *Algebr. Geom. Topol.*, 10(1):565–625, 2010.
- [64] Yasushi Mizusawa. On certain 2-extensions of  $\mathbb{Q}$  unramified at 2 and  $\infty$ . *Osaka J. Math.*, 53(4):1063–1088, 10 2016.
- [65] 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.
- [66] 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.
- [67] D. Müllner. *Orientation Reversal of Manifolds*. Bonner mathematische Schriften. D. Müllner, 2008.
- [68] Neha Nanda, Mahender Singh, and Manpreet Singh. Knot invariants from derivations of quandles. *arXiv:1804.01113*, 2018.
- [69] P. Niroomand and R. Rezaei. On the exterior degree of finite groups. *Comm. Algebra*, 39(1):335–343, 2011.

- [70] Peyman Niroomand and Rashid Rezaei. The exterior degree of a pair of finite groups. *Mediterr. J. Math.*, 10(3):1195–1206, 2013.
- [71] A. Odabaş, E.Ö. Uslu, and E. Ilgaz. Isoclinism of crossed modules. *J. Symbolic Comput.*, 74:408–424, 2016.
- [72] Nansen Petrosyan and Bartosz Putrycz. On cohomology of crystallographic groups with cyclic holonomy of split type. *J. Algebra*, 367:237–246, 2012.
- [73] Alexander D. Rahm. The homological torsion of  $\mathrm{PSL}_2$  of the imaginary quadratic integers. *Trans. Amer. Math. Soc.*, 365(3):1603–1635, 2013.
- [74] Alexander D. Rahm. Accessing the cohomology of discrete groups above their virtual cohomological dimension. *J. Algebra*, 404:152–175, 2014.
- [75] Alexander D. Rahm. The subgroup measuring the defect of the abelianization of  $\mathrm{SL}_2(\mathbb{Z}[i])$ . *J. Homotopy Relat. Struct.*, 9(2):257–262, 2014.
- [76] Pradeep K. Rai and Manoj K. Yadav. On Sh-rigidity of groups of order  $p^6$ . *J. Algebra*, 428:26–42, 2015.
- [77] J. Roberts. *ALGORITHMS FOR UPPER BOUNDS OF LOW DIMENSIONAL GROUP HOMOLOGY*. PhD thesis, University of Kentucky. University of Kentucky, 2010.
- [78] Joshua Roberts. An algorithm for low dimensional group homology. *Homology, Homotopy Appl.*, 12(1):27–37, 2010.
- [79] 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.
- [80] 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.
- [81] Ana Romero and Julio Rubio. Computing the homology of groups: the geometric way. *J. Symbolic Comput.*, 47(7):752–770, 2012.
- [82] Ana Romero and Julio Rubio. Homotopy groups of suspended classifying spaces: an experimental approach. *Math. Comp.*, 82(284):2237–2244, 2013.
- [83] S. Schönnenbeck. Homologiegruppen von Einheitengruppen von Ordnungen. *Masterarbeit, RWTH Aachen*, September 2013.
- [84] S. Schönnenbeck. Resolutions for unit groups of orders. *ArXiv e-prints*, September 2016.

- [85] Markus Szymik. The third Milgram–Priddy class lifts. *arxiv.org/pdf/1909.05064.pdf*, pages 1–6, 2019.
- [86] Bui Anh Tuan and Graham Ellis. The homology of  $SL_2(\mathbb{Z}[1/m])$  for small  $m$ . *J. Algebra*, 408:102–108, 2014.
- [87] Lukas Vokřínek. Algorithmic aspects of topological problems. *Habilitation thesis, Brno University*, 2017.
- [88] 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.
- [89] V. Ivaréz, 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.