Peter A. Brooksbank

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Education

University of Oregon 1995–2001 Ph.D.
Dissertation: *Constructive recognition of the finite simple classical groups* (Advisor: W.M. Kantor)

University of Sheffield 1990–1992 M.Phil.

University of Sheffield 1987–1990 B.Sc.

Academic Positions

Bucknell University	Presidential Professor	2024–present
Bucknell University	Professor	2015–present
Bucknell University	Associate Professor	2010–2015
Bucknell University	Assistant Professor	2004–2010
The Ohio State University	Zassenhaus Assistant Professor	2001–2004
Universite Libres de Bruxelles	Visiting Scholar	2025
University of Auckland	Visiting Scholar	2006/7; '11; '14; '17; '19
Hausdorff Institute	Visiting Scholar	2018

Research Areas

Computational Algebra • Group Theory • Multilinear Algebra • Discrete Geometry

External Funding

Rapid Structure Recovery and Outlier Detection in High-Dimensional Data $114,416
Collaboration Grant, National Science Foundation, 2023–2025. DMS #2319372

New Methods For Group Isomorphism $78,058
Collaboration Grant, National Science Foundation, 2016–2021. DMS #1620362

Classical Groups And Their Geometries $35,000
Collaboration Grant, Simons Foundation, 2013–2018.

Computing With Matrix Groups $30,000
Young Investigators Grant, National Security Agency, 2011–2013.

Bucknell Awards

Scholarly Development Grant	2006, 2009, 2020
Research Travel Grant	2007, 2017, 2023
75% Sabbatical Funding	2010/11, 2018/19
Interdisciplinary Collaborations Initiative Grant	2022

Publications

(coauthors in *blue* were Bucknell undergraduates when the article was written)

(29) *Tensor isomorphism by conjugacy of Lie algebras*, Journal of Algebra 604, 790–807, 2022. (with J. Maglione and J.B. Wilson)

(28) *On the ranks of string C-group representations for symplectic and orthogonal groups*, Contemporary Mathematics 764, American Mathematical Society, 31–41, 2021.

(27) *Improved algorithms for alternating matrix space isometry: from theory to practice*, European Symposium on Algorithms, Art. 26, 15pp, 2020. (with Y. Li, Y. Qiao, J.B. Wilson)

(26) *Orthogonal groups in characteristic 2 acting on polytopes of high rank*, Discrete & Computational Geometry 63, no. 3, 656–669, 2020. (with *J.T. Ferrara* and D. Leemans)

(25) *Exact sequences of inner automorphisms of tensors*, Journal of Algebra 545, 43–63, 2020. (with J. Maglione and J.B. Wilson)

(24) *Rank reduction of string C-group representations*, Proceedings of the American Mathematical Society 147. no. 12, 5421–5426, 2019. (with D. Leemans)

(23) *Testing isomorphism of graded algebras*, Transactions of the American Mathematical Society 372, 8067–8090, 2019. (with E.A. O'Brien and J.B. Wilson)

(22) *A fast isomorphism test for p-groups whose Lie algebra has genus 2*, Journal of Algebra 473, 545–590, 2017. (with J. Maglione and J.B. Wilson)

(21) *Polytopes of large rank for* PSL$(4, q)$, J. Algebra 452, 390–400, 2016. (with D. Leemans)

(20) *The module isomorphism problem reconsidered*, Journal of Algebra 421, 541–559, 2015. (with J.B. Wilson)

(19) *Groups acting on tensor products*, J. Pure App. Alg. 218, 405–416, 2014. (with J.B. Wilson)

(18) *On groups with a class-preserving outer automorphism*, Involve 7, no. 2, 171–179, 2014. (with *M.S. Mizuhara*)

(17) *Intersecting two classical groups*, J. Algebra 353, no. 1, 286–297, 2012. (with J.B. Wilson)

(16) *On the derived length of Coxeter groups*, Communications in Algebra 40, no. 3, 1142–1150, 2012. (with A. Piggott)

(15) *Computing isometry groups of bilinear maps*, Transactions of the American Mathematical Society 364, 1975–1996, 2012. (with J.B. Wilson)

(14) *Three-dimensional classical groups acting on polytopes*, Discrete & Computational Geometry 44, no. 3, 654–659, 2010. (with *D.A. Vicinsky*)

(13) *Testing isomorphism of modules*, J. Algebra 320, no. 11, 4020–4029, 2008. (with E.M. Luks)

(12) *Fast constructive recognition of black box symplectic groups*, J. Algebra 320, 885–909, 2008.

Publications, continued

(11) *On intersections of classical groups*, Journal of Group Theory 11, no. 4, 465–478, 2008. (with E.A. O'Brien)

(10) *Constructing the group preserving a system of forms*, International Journal of Algebra & Computation 18, no. 2, 227–241, 2008. (with E.A. O'Brien)

(9) *Fast constructive recognition of black box orthogonal groups*, Journal of Algebra 300, no.1, 256–288, 2006. (with W.M. Kantor)

(8) *A reduction algorithm for matrix groups with extraspecial normal subgroup*, pp. 1–16 in: Finite Geometries, Groups & Computation, 2006. (with A.C. Niemeyer and Á. Seress)

(7) *On Dowling geometries of infinite groups*, Journal of Combinatorial Theory, Ser. A, 108/1, 155–158, 2004. (with H. Qin, E. Robertson and Á. Seress)

(6) *Fast constructive recognition of black box unitary groups*, London Mathematical Society Journal of Mathematics & Computation, 162–197, 2003.

(5) *Constructive recognition of classical groups in their natural representation*, Journal of Symbolic Comput., 35, 195–239, 2003.

(4) *A constructive recognition algorithm for the matrix group* $\Omega(d, q)$, pp. 79–93 in: Groups and Computation III (W. M. Kantor and Á. Seress eds), 2001.

(3) *On constructive recognition of a black box* $PSL(d, q)$, pp. 95–111 in: Groups and Computation III, 2001. (with W.M. Kantor)

(2) *Transversal greedoids*, European Journal of Combinatorics, 18, 137–141, 1997.

(1) *Greedy algorithm compatibility and heavy-set structures*, European Journal of Combinatorics, 13, 81–86, 1992. (with V.W. Bryant)

Preprints

(A) Article: *Isomorphism invariant metrics*, under revision. (16 pages) (with J. Maglione, E.A. O'Brien, J.B. Wilson). arXiv:2304.00465

(B) Article: *Detecting null patterns in tensor data*, submitted. (17 pages) (with M. Kassabov, J.B. Wilson). arXiv:2408.17425

(C) Article: *Categorification of characteristic structures*, submitted. (48 pages) (with H. Dietrich, J. Maglione, E.A. O'Brien, J.B. Wilson). arXiv:2502.01138

Works in Progress

(C) Book: *Tools to Tame Tensors*, ∼100 pages complete (with J. Maglione, J.B. Wilson)

(D) Article: *Intersecting classical groups in polynomial time*, in preparation. (with M. Kassabov, J.B. Wilson)

Conference Organizing

Groups, Actions & Computation (co-organizer)
University of Auckland, New Zealand, December 9–13, 2024.
Special Session at Joint Meeting of the American, Australian, and New Zealand Mathematical Societies

Tensors: Algebra, Computation, Applications (co-organizer)
University of Colorado, Boulder & Colorado State University, June 3–14, 2019.
Funding: • National Security Agency • University of Colorado • Colorado State University

Groups, Computation & Geometry (co-organizer)
Pingree Park (Colorado State), June 9–13, 2014.
Funding: • National Science Foundation • National Security Agency • Colorado State University

A Mathematical Celebration (co-organizer)
Bucknell University, May 13 & 14, 2013.
Funding: • Department of Mathematics • Dean of Arts & Sciences (Bucknell) • Simons Foundation

Selected Conferences (∼ 10 years)

2025	*Computational Group Theory*	Math. Forsch. Oberwolfach
	Representations of Finite and Algebraic Groups	University of Denver
2024	*Groups, Actions & Computation*	University of Auckland
	New Perspectives in Computational Group Theory	University of Warwick
	Groups, Nilpotence, and Tensors II	University of Denver
	Tensors: Algebra, Geometry, Applications	Colorado State University
2023	*Algorithms for Threat Detection*	George Mason University
	Groups, Nilpotence, and Tensors	Colorado State University
2022	*Pfaffians, Tensors, and Applications*	Max Planck Institute, Leipzig
	Groups in Galway	University of Galway
2021	*Computational Group Theory* (remote)	Math. Forsch. Oberwolfach
2019	*Tensors: Algebra, Computation, Applications*	Pingree Park, Colorado
2018	*Discrete and Combinatorial Geometry*	CMS, Vancouver
	Logic and Algorithms in Groups (1 month residency)	Hausdorff Institute, Bonn
	Polytopes and Discrete Geometry	JMM Sectional, Boston
2017	*Symmetries of Discrete Structures in Geometry*	Casa Matematica, Oaxaca
2016	*Computational Group Theory*	Math. Forsch. Oberwolfach
2015	*Geometry and Combinatorics of Polytopes*	JMM Sectional, New Brunswick
2014	*Algorithms for Linear Groups*	Banff International Research Station
	Groups, Computation, and Geometry	Pingree Park, Colorado

Selected Invited Lectures ($\sim$ 10 years)

2025	*Detecting structure in tensors using algebraic invariants*	Math. Forsch. Oberwolfach
2024	*Linear methods for tensors* (short course)	Colorado State University
	Characteristic structure: a categorical perspective	University of Denver
2023	*Computing intersections of classical groups*	Colorado State University
2022	*You're going to need a bigger boat* (student talk)	Bucknell University
	Computing intersections of classical groups	University of Galway
	Taming tensors	Humboldt State University
2021	*Dimension reduction strategies for tensor isomorphism*	Universität Bielefeld (remote)
2019	*Algebraic methods for tensor equivalence* (short course)	University of Colorado, Boulder
	Isomorphism testing in groups, algebras, and modules	SUNY Albany
	Rank reduction of string C-groups	University of Auckland
2018	*Existence of high rank regular polytopes for* PSp$(4, q)$	Vancouver
	A multilinear approach to isomorphism testing	RWTH Aachen University
	Geometric properties of involutions in classical groups	Northeastern University
2017	*Orthogonal groups acting on polytopes*	Casa Matematica Oaxaca
	Testing isomorphism of graded algebras	Colorado State & Auckland
	What do you mean it's hard? (student talk)	Allegheny College & Bucknell
2015	*Polytopes of high rank for linear groups*	Rutgers University
2014	*Testing isomorphism of p-groups of genus 2*	Banff International Research Station
	Testing isomorphism of finite groups, a new approach	University of Auckland
2012	*Linear methods in computational algebra* (short course)	University of Galway
	Testing isomorphism of nilpotent groups	University of Arizona

Software

- Develop software distributed with the *Magma* computer algebra system.
- Maintain *Magma* repositories on *GitHub* available through website The Tensor Space

TensorSpace	data structures for computing with tensors
StarAlge	algorithms for algebras with involution
TameGenus	fast isomorphism tests for groups and algebras of tame genus
Auto-Sandbox	experimental algorithms for automorphism groups
MatrixAlgebras	algorithms for associative and Lie algebras of matrices

- Maintain *Julia* repository for computation with tensors on *GitHub*

OpenDleto	rapid structure recovery in high-dimensional data

- Maintain *Magma* repository (String Groups Generated by Involutions) on *GitHub*

SGGI	computations with group-based discrete geometric structures

Academic Service

University Service, Bucknell University:

- Co-Director, Residential Colleges (June 2023—present)
- Faculty Fellow, Dominguez Center for Data Science (Jan 2023—present)
- Provost Search Committee (Oct 2023—Feb 2024)
- Faculty Mentor (Aug 2022—present)
- Faculty Council (2020—2023)
- Vice Chair, Department of Mathematics (2019–2020)
- University Review Committee (2015–2018; co-Chair, 2016–2018)
- Committee on Athletics (2014–2015)
- Residential College Steering Committee (2013–2015)
- Faculty Colloquium Committee (2013–present)
- Committee on Planning & Budget (2011–2014; Chair, 2013–2014)
- Faculty Representative to the Board of Trustees Finance Committee (2011–2014)
- Marshall Fellowship Advisor (2009–2016)
- Faculty Advisor, Men's Soccer (2007–2018)
- Faculty Advisor, Women's Soccer (2008–2015)
- Honors Council (2008–2010)
- Library Committee (2005–2006)

External Professional Service:

- Magma developer (2006–present)
- Referee for GAP (Groups, Algorithms, and Programming)
- Referee for various academic journals
- External examiner for PhD and Masters theses
- Grant proposal reviewer
  - NSF Division of Mathematical Sciences, Panelist
  - Marsden Fund of New Zealand
- *Mathematical Reviews*, Reviewer (Aug 2004–present); completed 55 reviews
- *Mathematical Reviews*, Panelist/Consultant (2015–16)