Paul Melvin

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Curriculum Vitae

Department of Mathematics
Bryn Mawr College
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Research Interests

Geometric and Quantum Topology

Education

Degrees

Ph.D. in Mathematics, University of California, Berkeley, May 1977
Thesis: *Blowing up and down in 4-manifolds* Advisor: Robion Kirby
B.A. in Mathematics, Haverford College, May 1971

Fellowships

Woodrow Wilson 1971-72 (honorary graduate fellowship)
National Science Foundation 1971-74 (graduate fellowship)

Employment

Bryn Mawr College	Professor	1992–present
	On the Hale Chair	2000–08
	Department Chair	2011–14, 2005–06, 1998–99, 1993–96
	Associate Professor	1987–92
	Assistant Professor	1981–87
U.C. Santa Barbara	Visiting Assistant Professor	1979–81
U.W. Madison	Assistant Professor	1977–79

Visiting Positions

Stanford University (Palo Alto)	Visiting Professor	2020 (Fall–remote)
Institute for Advanced Study (Princeton)	Visitor	2016 (Fall)
Math. Sci. Research Institute (Berkeley)	Member	2009-10
Institute for Advanced Study (Princeton)	Member	2002–03
Math. Sci. Research Institute (Berkeley)	Research Professor	1996–97

Newton Institute (Cambridge, England)	SERC Fellow	1992 (Fall)
U.C. Berkeley	Research Associate	1989 (Spring)
Stanford University (Palo Alto)	Visiting Assoc. Professor/Scholar	1988–89/1994 (Summer)
University of Pennsylvania	Visiting Scholar	1985–86

Grants

American Institute of Mathematics

SQuaRE Grants:

Trisections, Knotted Surfaces, and Symplectic 4-Manifolds (2018-23)
Stabilization in 4-dimensional topology (2014–17)
Augmentations, rulings, and generating families (2008–13)

Mellon Foundation

Trico Faculty Forum Seed Grant (2017–18)
PACT Seminar Seed Grants (2014–17)
Faculty-Student Seminar in Topology (2005–06)
Tri-College Contact Seminar (2004–05)

National Science Foundation

Research Grants:

Topological invariants of 3 and 4-manifolds (FRG: 2003–06)
Quantum invariants of 3-manifolds (1992–95)
3-manifold invariants from quantum theory (1991–92)
Transformation groups on 3 and 4-manifolds (1981–83)
4-manifolds and bordism of diffeomorphisms (1978–79)

Conference Grants:

Oxtoby Centennial Conference (at Bryn Mawr, October 2010)
Low-dimensional topology (at MSRI, June 1998)

Bryn Mawr College

Sabbatical Leaves:

Enhanced Sabbatical (1996-97)
Junior Faculty Research Leave (1985–86)

Faculty Research:

Research and Equipment Grants (1996–97, 1992–93, 1990–91)

Professional Service

PCMI (Park City Mathematics Institute) Steering Committee (2018–present)

Publications

1. *Slice knots and property R* (with R. Kirby), Invent. Math. **45** (1978), 57–59.
2. *Bordism of Diffeomorphisms*, Topology **18** (1979), 173–175.
3. *On* 4*-manifolds with singular torus actions*, Math. Ann. **256** (1981), 255–276.
4. *Tori in the diffeomorphism groups of simply connected* 4*-manifolds*, Math. Proc. Camb. Phil. Soc. **91** (1982), 305–314.
5. *Algebraic knots are algebraically dependent* (with C. Livingston), Proc. Amer. Math. Soc. **87** (1983), 179–180.
6. 2*-sphere bundles over compact surfaces*, Proc. Amer. Math. Soc. **92** (1984), 567–572.
7. 4*-dimensional oriented bordism*, Contemp. Math. **35** (1984), 399–405.
8. *Abelian invariants of satellite knots* (with C. Livingston), in "Geometry and Topology" (Maryland 1984), Springer Lecture Notes **1167** (1985), 217–227.
9. *The Smale invariant of a knot* (with J. Hughes), Comment. Math. Helv. **60** (1985), 615–627.
10. 4*-manifolds with large symmetry groups* (with J. Parker), Topology **25** (1986), 71–83.
11. *Fibred knots of genus* 2 *formed by plumbing Hopf bands* (with H. R. Morton), J. London Math. Soc. **34** (1986), 159–168.
12. 3*-dimensional bordism* (with W. Kazez), Mich. Math. J. **36** (1989), 251–260.
13. *Evaluations of the* 3*-manifold invariants of Witten and Reshetikhin-Turaev for sl*(2,$\mathbb{C}$) (with R. Kirby), London Math. Soc. Lecture Notes **151** (1990), 101–114.
14. *The* 3*-manifold invariants of Witten and Reshetikhin-Turaev for sl*(2,$\mathbb{C}$) (with R. Kirby), Invent. Math. **105** (1991), 473–545.
15. *Templates and framed braids* (with N. Tufillaro), Phys. Rev. A **44** (1991), 3419–3422.
16. *Quantum invariants of lens spaces and a Dehn surgery formula* (with R. Kirby), Abstracts Amer. Math. Soc. **12** (1991), 435.
17. *Relative Rotation Rate Package* (with A. Lorentz and N. Tufillaro), Appendix G in "An Experimental Approach to Nonlinear Dynamics and Chaos" by N. Tufillaro, T. Abbott and J. Reilly, Addison-Wesley (1992), 314–322.
18. *Quantum invariants at the sixth root of unity* (with R. Kirby and X. Zhang), Commun. Math. Phys. **151** (1993), 607–617.
19. *Dedekind sums,* μ*-invariants and the signature cocycle* (with R. Kirby), Math. Ann. **299** (1994), 231–267.
20. *The coloured Jones function* (with H. R. Morton), Commun. Math. Phys. **169** (1995), 501–520.
21. *Perturbative invariants* (with R. Kirby), k-slice 2-knots (with T. Cochran), and other contributions to Problems in low-dimensional topology, in "Geometric Topology", Vol. **2**, W.H. Kazez (ed.), Amer. Math. Soc. and International Press (1997), pp. 127–8, 258, 276, 347–351.
22. *Canonical framings for* 3*-manifolds* (with R. Kirby), Turk. J. of Math. **23** (1999), 89-115, (arXiv:9903056); also in: Proc. Gokova Geometry-Topology Conf. 1998.

23. *The E_8-manifold, singular fibers and handlebody decompositions* (with R. Kirby), Proceedings of the Kirby Fest, Geometry & Topology Monographs **2** (1999), 233–258 (arXiv:9911253).

24. *Finite type invariants of* 3*-manifolds* (with T. Cochran), Invent. Math. **140** (2000), 45–100 (arXiv:9805026).

25. *Quantum cyclotomic orders of* 3*-manifolds* (with T. Cochran), Topology 40 (2001), 95–125, (arXiv:9809129).

26. *A geometric interpretation of Milnor's triple linking numbers* (with B. Mellor), Algebraic & Geometric Topology **3** (2003), 557–568 (arXiv:0110001).

27. *Local surgery formulas for quantum invariants and the Arf invariant* (with R. Kirby), Proceedings of the Casson Fest, Geometry & Topology Monographs **7** (2004), 213–233 (arXiv:0410358).

28. *The nonuniqueness of Chekanov polynomials of Legendrian knots* (with S. Shrestha '07 BMC), Geometry & Topology **9** (2005), 1221–1252 (arXiv:0411206).

29. *A topological menagerie*, Amer. Math. Monthly **113** (2006), 348–351 (arXiv:0412486).

30. *A non-smoothable four-manifolds with infinite cyclic fundamental group* (with S. Friedl, I. Hambleton and P. Teichner), Int. Math. Res. Not. 2007 (rnm31) (arXiv:0611077).

31. *Triple linking numbers, ambiguous Hopf invariants and integral formulas for three-component links* (with D. DeTurck, H. Gluck, R. Komendarczyk, C. Shonkwiler and S. Vela-Vick), Matematica Comtemporanea (DoCarmo Festshrift) **34** (2009), 251–283 (arXiv:0901.1612).

32. *The Milnor degree of a* 3*-manifold* (with T. Cochran), Journal of Topology **3** (2010), 405–423 (arXiv:0902.1731).

33. *Cohomotopy Sets of* 4*-manifolds* (with R. Kirby and P. Teichner), Proceedings of the Freedman Fest, Geometry & Topology Monographs **18** (2012), 161–190 (arXiv:1203.1608).

34. *Generalized Gauss maps and integrals for three-component links: Toward higher helicities for magnetic fields and fluid flows* (with D. DeTurck, H. Gluck, R. Komendarczyk, C. Shonkwiler and S. Vela-Vick), J. Math. Phys. **54**, 013515 (2013), 48 pages (arXiv:1101.3374).

35. *Generalized Gauss maps and integrals for three-component links: Toward higher helicities for magnetic fields and fluid flows, Part II* (with D. DeTurck, H. Gluck, R. Komendarczyk, H. Nuchi, C. Shonkwiler and S. Vela-Vick), Algebraic & Geometric Topology **13** (2013) 2897–2923 (arXiv:1207.1793).

36. *Stable isotopy in four dimensions* (with D. Auckly, H-J. Kim and D. Ruberman), J. London Math. Soc. **91** (2) (2015) 439-463 (arXiv:1406.4937).

37. *Equivariant corks* (with D. Auckly, H-J. Kim and D. Ruberman), Algebraic & Geometric Topology **17** (2017) 1771–1783 (arXiv:1602.07650).

38. *Isotopy of surfaces in* 4*-manifolds after a single stabilization* (with D. Auckly, H-J. Kim, D. Ruberman and H. Schwartz), Advances in Mathematics **341** (2019) 609–615 (arXiv:1708.03208).

39. *Higher order corks* (with H. Schwartz), Invent. Math. **224** (2021) 291–313, on line version (2020) doi.org/10.1007/s00222-020-01009-x (arXiv:1902.02840).

Submitted or in preparation

40. *Equivariant hyperbolization of* 3*-manifolds via homology cobordisms* (with D. Auckly, H-J. Kim and D. Ruberman), arXiv:1804.03777, submitted

41. *Ample* 4*-manifolds* (with D. Auckly, H-J. Kim and D. Ruberman), in preparation.

Invited Lectures (2000–present)

Colloquia and Seminars:

Georgia–Georgia Tech Topology Seminar (October 2019) "Smooth 4-manifolds and higher order corks"
Philadelphia PACT Seminar (September 2019, three talks) "Higher Order Corks"
Philadelphia PACT Seminar (Nov–Dec 2018, two talks) "Exotic 4-dimensional snapshots"
University of Pennsylvania (February 2018) "Isotopy in 4-manifolds after stabilization"
University of Texas (Austin) (November 2017) "One is enough"
Triangle Topology Seminar at Duke University (October 2017) "One is enough"
Princeton University Topology Seminar (November 2016) "Higher Order Corks"
Kansas State University Colloquium (September 2016) "4-Dimensional Exoticity"
Kansas State University Topology Seminar (September 2016) "Embeddings of the Mazur Cork"
Univ. of Penn. Geometry Seminar (April 2015) "Exotic dissolution in simply-connected 4-manifolds"
Indiana University Topology Seminar (April 2014) "Stable isotopy in 4-manifolds"
Philadelphia PACT Seminar (Feb-April 2014, four talks) "Dissolution of 4-dimensional exoticity"
Tetrahedral Geometry/Topology Seminar (Feb 2014) "Dissolution of 4-dimensional exoticity"
University of Virginia Topology Seminar (November 2013) "Exotic 2-spheres in 4-manifolds"
University of Georgia Topology Seminar (October 2013) "Exotic 2-spheres in 4-manifolds"
Mathily Workshop (July 2013) "Linking"
Columbia University Geometric Topology Seminar (May 2013) "Spherical projections of 4-manifolds"
Knots in Washington XXXV (Dec 2012, Opening Colloquium) "A Knotty Bucket List"
Philadelphia PACT Seminar (Fall 2012, five talks) "Cohomotopy Theory"
Tetrahedral Geometry/Topology Seminar (Oct 2011) "Degree formulas for higher order linking"
Temple University Colloquium (Oct 2011) "Asteroids, triple linking and bicycles"
University of Pennsylvania (Feb 2011, 2 talks) "Cohomotopy Theory of 4-manifolds"
Philadelphia PACT Seminar (2010-11) "Link concordance" (Fall 2010); "Cerf Theory" (Spring 2011)
Tulane University Colloquium (Apr 2010) "Asteroids, triple linking and bicycles"
Mathematical Sciences Research Institute PlayGround (Feb 2010) "Amphicheiral links"
Berkeley Math Circle (Feb 2010) "Enhanced linking"
Rice University Colloquium (Dec 2009) "From asteroids to bicycles"
San Francisco State University Colloquium (Nov 2009) "From asteroids to bicycles"
Claremont Colleges Topology Seminar (Nov 2009) "Degree formulas for higher order linking"
Joint Caltech/UCLA/USC Topology Seminar (Nov 2009) "Degree formulas for higher order linking"
University of California, Berkeley (Oct 2009) "Degree formulas for higher order linking"
University of Pennsylvania (Apr 2009) "Applications of quantum topology to classical topology"
Philadelphia PACT Seminar "3-dimensional surgery and 4-dimensional handlebodies" (Jan–Feb 2009, two talks); "Topological 4-manifolds with infinite cyclic fundamental group" (Oct 2008)
University of Pennsylvania (Apr 2008) "Higher order linking invariants"
Philadelphia PACT Seminar (Feb–Mar 2008, series of four talks) "On the Milnor degree"

University of Pennsylvania (Feb 2008) "Topological 4-manifolds"

Kansas State University: *William J. Spencer Lecture* (May 2007) "Topological 4-manifolds and slice knots"; Topology Seminar (May 2007) "What does quantum topology tell us about classical topology"

Philadelphia PACT Seminar (Oct-Nov/2006, series of four talks) "Smooth 4-manifolds"

University of Pennsylvania (Mar 2006) "Fertile Legendrian knots"

Philadelphia PACT Seminar (Nov 2005) "Ng's bound for the Thurston-Bennequin number from Khovanov homology"

University of California, Santa Barbara (Dec 2004) "Contact Homology of Legendrian knots"

University of California, Berkeley (Dec 2004) "Contact Homology of Legendrian knots"

University of Texas, Austin (Oct 2004) "Contact Homology of Legendrian knots"

Tri-College Contact Seminar (Sep 2004) "Poincare-Chekanov polynomials for Legendrian knots"

University of California, Berkeley (Jul 2004) "The Nonuniqueness of Chekanov polynomials of Legendrian knots"

Tri-College Contact Seminar (Apr 2004, series of 4 lectures) "Heegaard Floer homology"

University of Pennsylvania (Jan 2004) "Combinatorial aspects of Ozsvath-Szabo theory"

Bryn Mawr/Haverford Colloquium (Sep 2003) "Enhancing the Alexander polynomial: an introduction to Ozsvath-Szabo theory"

Elizabethtown College (May 2003) "Enhancing the Alexander polynomial"

Columbia University (Apr 2003) "The Milnor degree and quantum orders of 3-manifolds"

University of California, Berkeley (Apr 2003) "The Milnor degree and quantum orders of 3-manifolds"

Princeton University (Apr 2003) "The Milnor degree and quantum orders of 3-manifolds"

Rice University Colloquium (Mar 2003) "Holomorphic disks and topology: on the work of Peter Ozsvath and Zoltan Szabo"

CUNY Graduate Center, Einstein Chair Seminar (Mar 2001, series of 3 talks) "Finite type invariants in low-dimensional topology"

Microsoft Corporation (Dec 2000, 2 talks) "Analyticity of quantum invariants"

Haverford College Colloquium (Oct 2000) "Who wants to be a millionaire: The Poincaré Conjecture"

University of Pennsylvania (Apr 2000) "The topology of complex surfaces"

Conference Talks:

(Virtual) Tech Topology Summer School (July 2021) "Ample 4-manifolds"

(Virtual) Summer Trisectors Workshop (June 2021) "Stabilizations of trisections of 4-manifolds"

Park City Mathematics Institute Undergraduate Faculty Program Lecturer, July 2019 "Bordism, Cerf Theory, and the Kirby Calculus" (12 lectures)

American Institute of Mathematics SQuaRE Meetings, March 2019 "Gluck twists and algebraic curves in complex projective space" and July 2017 "Equivariant hyperbolization of 3-manifolds"

American Institute of Mathematics Trisections Workshop, March 2017 "Smooth 4-Manifolds and their Knotted Surfaces"

University of Georgia (Topology Conference, May 2016) "Mazur Magic"

Gokova, Turkey (Geometry/Topology, May 2013) "Spherical projections of 4-manifolds"

George Washington University (Knots in Washington XXXV, Dec 2012) "A Knotty Bucket List"

Wesleyan University (AMS Sectional Meeting Oct 2008) "Topological 4-manifolds with infinite cyclic fundamental group"

Gokova, Turkey, FRG Workshops: (June 2005) "Contact Homology of Legendrian knots", (June 2004, several lectures) "Khovanov cohomology and the Milnor conjecture", (June 2003, several lectures) "Knot Floer homology"

Banff, Canada (BIRS: Knots and their manifold stories May 2004) "Knot Floer homology: Enhancing the Alexander polynomial", (BIRS: Floer Homology Nov 2003) "The Maslov index"

Conference Organization:

Park City Mathematics Institute Virtual Program July-August 2021

Park City Mathematics Institute, "Quantum Field Theory and Manifold Invariants" July 2019

American Institute of Mathematics, SQuaRE Meetings

"Trisections, knotted surfaces, and symplectic 4-manifolds" March 2019, and subsequently virtual
"Stabilization in 4-Dimensional Topology" Summers 2015–17 (organizer)
"Augmentations, Rulings, and Generating Families" Summers 2009–13 (coorganizer)

Fields Institute of Mathematics, "Flavours of Gauge Theory: Rubermania" May 2016 (coorganizer)

Bryn Mawr College (coorganizer) MAA–EPaDel Regional Conference November 2011

Bryn Mawr College (coorganizer) "Oxtoby Centennial Conference" October 2010

Gokova, Turkey "FRG Workshops on Ozsvath-Szabo Theory" June 2003/04/05

Microsoft "Topological Aspects of Gauge Theory" (January 2003)

Additional Invited Conference/Workshop Participation:

(Virtual) Winter Trisectors Workshop December 2020

UC Berkeley "Kirby-Scharlemann-Thompson 80-70-60 Birthday Conference" June 2018

Oaxaca, Mexico "Gauge Theory and 4-Manifolds" August 2017

Rice University "Topology in Dimension 3.5" June 2016

Gokova, Turkey "Geometry and Topology" May 2014/13/05/04/03, 1998

Banff IRS Workshop "Parametrized Morse Theory in Low-Dimensional and Symplectic Topology",

March 2014 (Cochaired TQFT Problem Session)

Max Planck Institute "4-Manifolds Workshop", June 2013

Mathematical Sciences Research Institute

"Homology Theories of Knots and Links", Jan 2010
"Symplectic and Contact Geometry and Topology", Aug 2009
"Low Dimensional Topology" Aug 2008

American Institute of Mathematics in Palo Alto, California Workshop "Legendrian and Transverse Knots" Sep, 2008

Park City Mathematics Institute "Low Dimensional Topology" June–July, 2006

Clay Institute Workshop in Budapest "Floer homology, gauge theory and low-dimensional topology" June, 2004

Warwick Mathematics Institute "Workshop on Geometry and Topology" July 2002/00

UC San Diego "The Influence of Physics on Topology" Aug 2000

Refereeing

Grants: National Science Foundation; Israeli Science Foundation; Binational Science Foundation.

Research Papers: Annals of Mathematics; Journal of the American Mathematical Society; Journal of the European Mathematical Society; Proceedings of the National Academy of Sciences; Inventiones Mathematicae; Journal of Mathematical Physics; Mathematische Annalen; American Mathematical Society Proceedings and Transactions; Geometry& Topology; Topology; Math Proceedings of the Cambridge Philosophical Society; Pacific Journal of Math; Communications in Analysis and Geometry; American Mathematical Monthly; Mathematics Magazine; Journal of Knot Theory and its Ramifications; Georgia International Conference Proceedings.

Ph.D. Students

Isaac Sundberg	current
Hannah Schwartz	2019
Kathryn Bryant	2016
Jennifer Hom	2011
Jonah Swann	2010
Gowri Meda	1997

Collaborators

Dave Auckly
Tim Cochran
Dennis DeTurck
Stefan Friedl
Herman Gluck
Ian Hambleton
John Hughes
Will Kazez
Hee Jung Kim
Rob Kirby
Rafael Komendarczyk
Blake Mellor
Hugh Morton
Haggai Nguchi
Jeff Parker
Danny Ruberman
Hannah Schwartz
Clay Shonkwiler
Sumana Shrestha
Peter Teichner
Nick Tufillaro
Shea Vela Vick
Xingru Zhang