Kathryn Hess Bellwald

Curriculum Vitae

Education

1989 **PhD in mathematics**, *Massachusetts Institute of Technology*.

1985 BSc with honors in mathematics, The University of Wisconsin-Madison.

Research interests

- Homotopy theory, category theory
- Applications of algebraic topology in the life sciences (in particular in neuroscience and cancer biology) and in chemical engineering.

Academic positions held

- 2015–present Associate professor, EPFL.
 - 2014 **Research professor in the algebraic topology program (one semester)**, *Mathematical Sciences Research Institute.*
 - 1999–2014 Adjunct professor, EPFL.
 - 1999–2000 Visiting professor, University of Stockholm, fellowship from the Swedish NSF.
 - 1998–1999 Scientific collaborator, EPFL.
 - 1994 Visiting researcher (one month), Université de Louvain-la-Neuve.
 - 1993 Visiting researcher (one month), Mittag-Leffler Institute.
 - 1993–1999 Lecturer (Chargée de cours), EPFL.
 - 1992–1998 First assistant (position "relève académique"), EPFL.
 - 1991–1992 Assistant, EPFL.
 - 1991 Visiting professor (one semester), University of Toronto.
 - 1990 Visiting researcher (one semester), University of Nice.
 - 1989–1990 Visiting researcher (one year), University of Stockholm, fellowship from the Swedish NSF.
 - 1989, 1992 Visiting researcher (one month), University of Lille.
 - 1985–1989 Teaching and research assistant, MIT.

Honors and awards

- 2016 Individual member of the Swiss Academy of Engineering Sciences
- 2013 "Polysphère d'Or" (Agépoly prize for best teacher at the EPFL)
- 2012 Crédit Suisse prize for best EPFL teacher
- 2005 Agépoly prize for best teacher in the Faculty of Basic Sciences

Conference and seminar presentations (since 2011)

2016

Invited lecture, Workshop on Algebraic and Topological Methods for Biological Networks, Warren Center, University of Pennsylvania, USA

Online seminar, Applied Algebraic Topology Research Network

Mini-course lecturer, Conference on Triangulated Categories in Algebra, Geometry, and Topology, Stuttgart, Germany

Colloquium, Mathematics in Science and Society, University of Illinois-Urbana, USA

Topology seminar, University of Illinois-Urbana, USA

Invited lecture, Minisymposium on Applied and Computational Topology, British Applied Mathematics Colloquium, Oxford, England

Topology seminar, University of Paris-Nord, France

Keynote speaker, Cascade Topology Seminar, Banff, Canada

Topology seminar, University of Regensburg, Germany

Colloquium, University of Osnabrück, Germany

Keynote speaker, Conference on Algebraic Topology: Computation, Methods, and Science, Turin, Italy

2015

Invited lecture, AWM workshop in homotopy theory at the Joint Mathematics Meeetings, USA Plenary lecture, 13th Graduate Student Topology Geometry Conference, University of Illinois-Urbana, USA Plenary lecturer and mentor, The 2015 MIT Talbot Workshop, USA 5th Annual Meeting of the NCCR Synapsy, Switzerland Invited lecture, Minisymposium on Algebraic Topology in Neuroscience, SIAM Conference on Applications of Dynamical Systems, USA Invited lecture, Lehigh University Geometry and Topology Conference, USA CNP Seminar, Centre de neurosciences psychiatriques, CHUV, Switzerland Plenary lecture, 17th general meeting of the association of European Women in Mathematics, Italy Invited lecture, Clay research workshop on algebraic toplogy, Oxford, England Topology seminar, University of Stockholm, Sweden

Colloquium, Stockholms Mathematikcentrum, Sweden

Symposium on data science and neuroscience, HKUST, Hong Kong

2014

Mini-course lecturer, Workshop "Connections for Women: Algebraic Topology", MSRI, USA

 $\mathsf{MSRI}/\mathsf{Evans}\ \mathsf{Lecture,}\ \mathsf{Berkeley,}\ \mathsf{USA}$

Seminar, Stanford University, USA

Open Problems Seminar, MSRI, Berkeley, USA

Seminar, University of Oregon, USA

Plenary lecture, Conference "Manifolds, K-theory and Related Topics," Dubrovnik, Croatia

Mini-course lecturer, Conference "Loop spaces in Geometry and Topology," Nantes, France

Invited lecture, Conference "Algèbre homotopique, Opérades et Groupes de Grothendieck-Teichmüller," Nice, France

2013

Invited lecture, Introductory workshop on Grothendieck-Teichmüller Groups, Deformations and Operads, Newton Institute, England

Invited lecture, Conference "Higher Structures 2012," Newton Institute, England

Minicourse on free loop spaces, University of Münster, Germany

Seminar, University of Copenhagen, Denmark

Invited lecture, 26th Nordic and 1st European-Nordic Congress of Mathematicians, Lund, Sweden Invited lecture, Conference on Algebraic and Geometric Topology, Chern Institute, Tianjin, China Mini-course lecturer, Summer school "Category Theory and Algebraic Topology," Louvain-Ia-Neuve, Belgium Invited leture, 5^e Symposium Genevois "Cancer du Sein Précoce," Geneva, Switzerland

Plenary lecture, Union College Mathematics Conference, Union College, USA 2012 Invited lecture, Sheffield Homotopy Meeting, University of Sheffield, England Seminar, Northwestern University, USA Seminar, University of Chicago, USA Seminar, University of Geneva, Switzerland Invited lecture, Conference on Rational Homotopy Theory and its Applications, Ottawa, Canada Invited lecture, Conference on Homotopy Algebra and its Applications, CIRM, France Contributed lecture, Stanford Symposium on Algebraic Topology, USA Oberwolfach (Topology workshop), Germany Seminar, University of Nice, France

2011

Seminar, Université de Paris-Nord, France Invited lecture, Workshop on Functor Calculus and Operads, Banff, Canada Invited lecture, Conference in honor of Ross Street, Louvain-la-Neuve, Belgium Mini-course lecturer, Summer school on Algebra and Topology (lecturer), Nordfjordeid, Norway Invited lecture, Conference on Structured Ring Spectra, Hamburg, Germany Oberwolfach (Homotopy theory workshop), Germany Seminar, Université de Lille, France

Published articles and preprints

1. K. Hess, A proof of Ganea's conjecture for rational spaces, Topology 30 (1991), 205-214.

2. K. Hess, Twisted tensor products of DGA's and the Adams-Hilton model for the total space of a fibration, London Mathematical Society Lecture Notes **175** (1992) 29-51.

3. K. Hess, Mild and tame homotopy theory, J. Pure and Applied Algebra 84 (1993) 277-310.

4. K. Hess and J.-M. Lemaire, *Generalizing LS-category to model categories*, J. Pure and Applied Algebra **91** (1994) 165-182.

5. N. Dupont and K. Hess, *Twisted tensor models of fibrations*, J. Pure and Applied Algebra **91** (1994) 109-120.

6. K. Hess and J.-M. Lemaire, *Nice and lazy cell attachments*, J. Pure and Applied Algebra **112** (1996) 29-39.

7. K. Hess, Perturbation and transfer of generic algebraic structure, Contemporary Math. **227** (1999) 103-144.

8. K. Hess, A history of rational homotopy theory, History of Topology, ed. I.M. James, Elsevier Science B.V., 1999, pp. 757-796.

9. N. Dupont and K. Hess, Noncommutative algebraic models for fiber squares, Math. Annalen **314** (1999) 449-467.

10. N. Dupont and K. Hess, *How to model the free loop space algebraically*, Math. Annalen **314** (1999), 469-490.

11. N. Dupont and K. Hess, *Hochschild cohomology is topological*, J. Pure and Applied Algebra **165** (2001) 1-6.

12. K. Hess, Model categories in algebraic topology, Applied Categorical Structures 10 (2002) 195-220.

13. N. Dupont and K. Hess, An algebraic model for homotopy fibers, Homology Homotopy Appl. **4** (2002) 117-139.

14. K. Hess and P.-E. Parent, Emergence of the Witt group in the cellular lattice of rational spaces, Trans. Amer. Math. Soc. **354** (2002) 4571-4583.

15. K. Hess, Review of "Rational Homotopy Theory" by Felix, Halperin and Thomas, Bull. of the London Math. Soc. **34** (2002) 624-626.

16. N. Dupont and K. Hess, Commutative free loop space models at large primes, Math. Z. 244 (2003) 1-34.

17. G. Adagio (S. Blanc, R. Guerraoui, K. Hess, P. Kouznetsov, P.-E. Parent, B. Pochon and O. Sauvageot), Using the topological characterization of synchronous models, Electronic Notes in Theoretical Computer

Science 81 (2003) 12 p.

18. K. Hess, P.-E. Parent, A. Tonks and K. Worytkiewicz, *Simulations as homotopies*, Electronic Notes in Theoretical Computer Science **100** (2004) 65-93.

19. K. Hess, P.-E. Parent, J. Scott, A. Tonks, A canonical enriched Adams-Hilton model for simplicial sets, Adv. in Math. **207** (2006), 847-875.

20. K. Hess, An algebraic model for mod 2 topological cyclic homology, in String Topology and Cyclic Homology, Advanced Courses in Mathematics CRM Barcelona, Birkhäuser, 2006, pp. 97-163.

21. K. Hess, P.-E. Parent, A. Tonks and K. Worytkiewicz, A model structure la Thomason on 2-CAT, J. Pure and Applied Algebra **208** (2007) 205-236.

22. K. Hess, P.-E. Parent and J. Scott, A chain coalgebra model for the James map, Homology Homotopy Appl. 9 (2007) 209-231.

23. K. Hess, Rational homotopy theory: a brief introduction, Contemporary Math. 436 (2007) 175-202

24. K. Hess, R. Levi, An algebraic model for the loop space homology of a homotopy fiber, Alg. Geom. Top. 7 (2007) 1699-1765.

25. K. Hess, P.-E. Parent and J. Scott, *CoHochschild homology of chain coalgebras*, J. Pure Applied Algebra **213** (2009) 536-556.

26. K. Hess, *Homotopic Hopf-Galois extensions: Foundations and examples*, Geometry and Topology Monographs **16** (2009) 79-132.

27. K. Hess and A. Tonks, *The loop group and the cobar construction*, Proc. Amer. Math. Soc. **138** (2010) 1861-1876.

28. E. D. Farjoun and K. Hess, Normal and conormal maps in homotopy theory, Homology Homotopy Appl. 14 (2012) 79-112.

29. K. Hess, *Multiplicative structure in equivariant cohomology*, J. Pure Applied Algebra **216** (2012) 1680-1699.

30. W. Dwyer and K. Hess, Long knots and maps between operads, Geometry and Topology 16 (2012) 919-955.

31. J.P.C. Greenlees, K. Hess and S. Shamir, *Complete intersections in rational homotopy theory*, J. Pure Applied Algebra **217** (2013) 636-663.

32. J. E. Harper and K. Hess, *Homotopy completion and topological Quillen homology of structured ring spectra*, Geometry and Topology **17** (2013) 1325-1416.

33. K. Hess and B. Shipley, *The homotopy theory of coalgebras over a comonad*, Proc. London Math. Soc **108** (2014) 484-516.

34. W. Dwyer and K. Hess, *The Boardman-Vogt tensor product of operadic bimodules*, Contemporary Mathematics **620** (2014) 71-98.

35. M. Bayeh, K. Hess, V. Karpova, M. Kedziorek, E. Riehl and B. Shipley, *Left-induced model category structures and diagram categories*, Contemporary Mathematics **641** (2015) 49-81.

36. C. Brisken, K. Hess, and R. Jeitziner, *Progesterone and overlooked endocrine pathways in breast cancer pathogenesis*, Endocrinology **156** (2015) 3442-3450.

37. K. Hess, The Hochschild complex of a twisting cochain, J. Algebra 451 (2016) 302-356.

38. K. Hess and B. Shipley, Waldhausen K-theory of spaces via comodules, Adv. in Math. **290** (2016) 1079-1137.

39. K. Hess, A general framework for homotopic descent and codescent, arXiv:1001.1556v3, 68 pages.

40. A. Berglund and K. Hess, *Homotopical Morita theory for corings*, arXiv:1411.6517v2, 46 pages.

41. A. Berglund and K. Hess, *Homotopic Hopf-Galois extensions revisited*, arXiv:1412.7072v2, 38 pages.
42. K. Hess, M. Kedziorek, E. Riehl and B. Shipley, *A necessary and sufficient condition for induced model structure*, arXiv:1509.08154, 49 pages.

43. P. Dłotko, K. Hess, R. Levi, M. Nolte, M. Reimann, M. Scolamiero, K. Turner, E. Muller, and H. Markram, *Topological analysis of the connectome of digital reconstructions of neural microcircuits*, arXiv:1601.01580, 28 pages.

44. L. Kanari, P. Dłotko, M. Scolamiero, R. Levi, J. C. Shillcock, K. Hess, and H. Markram, *Quantifying topological invariants of neuronal morphologies*, arXiv:1603.08432, 10 pages.

Teaching and supervision

Courses taught

 1^{st} year Linear algebra (for engineers and for mathematicians and physicists)

 2^{nd} year Analysis (University of Toronto), general topology, abstract algebra

- Upper level Knot theory, Lie algebras, algebraic topology, homological algebra, algebraic K-theory
 - Doctoral Game theory, symmetric spectra, homotopy theory (University of Stockholm), cyclic homology, homotopical algebra, topological data analysis, various working groups in algebraic topology

Projects supervised

- Over 70 semester projects at the EPFL personally directed since 1991, on topics including homotopy theory, knot theory, topological groups, homological algebra, Galois theory, category theory, K-theory, the Atiyah-Singer index theorem, mathematical physics, C^* algebras, algebraic genetics and topological data analysis.
- Over 40 masters or diploma projects at the EPFL personally directed since 1993, on topics including category theory, homological algebra, homotopy theory, K-theory, knot theory (including applications to polymer science and dynamical sytems), algebraic geometry, cryptography, mathematical physics (quantum gauge theory and quantum gravity) and topological data analysis.

Doctoral students

- Rachel Jeitziner, "Topological data analysis applied to breast cancer biology," joint supervision with Cathrin Brisken (EPFL-SV), started Spring 2014.
- Dimitri Zaganidis, "Homotopic Galois theory," sponsored by FN grant 200020-144399, started Spring 2013.
- Sophie Raynor, "Neurotopology," joint supervision with Ran Levi (Aberdeen), sponsored by the Blue Brain lab, started Fall 2012.
- Martina Rovelli, "Homotopy normality and conormality," sponsored by FN grant 200020-144399, started Fall 2012.
- Marc Stephan, "Kan spectra, group spectra and twisting structures," thesis defended November 2014 (currently SNF postdoc at the University of Chicago).
- Varvara Karpova, "Homotopic Hopf-Galois theory of commutative differential graded algebras," sponsored by FN grant 200020-132379, thesis defended February 2014 (currently employed in risk management at Ernst and Young).
- Patrick Müller, "Homotopic descent over monoidal model categories," sponsored by FN grants 200020-121864 and 200020-132379, thesis defended September 2011 (currently gymnasium math professor in St Gallen).
- Nicolas Michel, "Categorical foundations of K-theory," thesis defended September 2010, sponsored by FN grant 200020-121864 (currently studying theology at Regent University).
- Ilias Amrani, "Catégories simpliciales et K-théorie de Waldhausen," thesis defended September 2010, sponsored by FN grants 200020-113707 and 200020-121864 (currently postdoc at Academic University of St. Petersburg).
- Théophile Naïto, "Alexander-Whitney coalgebras: an algebraic model for topological spaces," thesis defended May 2009, sponsored by FN grant 200020-113707 (currently teacher for the Ecole Steiner).

- Jan Brunner, "The link between the infinite mapping class group of the disk and the braid group on infinitely many strands," thesis defended June 2008, sponsored by FN grant 200020-105383 (currently math professor at the HES Bienne).
- Sylvestre Blanc, "Modèles tordus d'espaces de lacets libres et fonctionnels," thesis defended September 2004, sponsored by FN grant 2000-068137.02 (currently IT quant at Grammont Finance S.A).
- Orin Sauvageot, "Stabilisation de complexes croisés," thesis defended November 2002, sponsored by FN grant 21-061707.00 (currently Chief Operating Officer at Tetral SA).
- Chantal Oberson, "Etude des relations structure-propriété des polymères par des méthodes topologiques," thesis defended June 1999, sponsored by FN grant 21-43404.95 (currently postdoc at Paris 6).
- Fabio Simoncini, "Autour de quelques invariants d'homotopie rationnelle," thesis defended October 1998, sponsored by FN grant 21-43406.95 (currently portfolio manager on Swiss Fixed Income at Banque Cantonale Vaudoise).

Postdocs supervised

- Jean Verrette (Hawaii, 2016): March 2016-present
- Gard Spreemann (NTNU, 2015): February 2016-present
- Senja Barthel (Imperial College, 2015): September 2015-present
- Katharine Turner (Chicago, 2015): September 2015-present
- Martina Scolamiero (KTH, 2015): July 2015-present
- Magdalena Kędziorek (Sheffield, 2014): February 2015-present
- Justin Young (Indiana, 2012): September 2012–August 2014 (currently lecturer at Ohio State University-Newark)
- Eric Finster (Virginia, 2010): August 2010-August 2012 (currently postdoc at Paris VII)
- Gavin Seal (VU Brussels, 2000): January 2009–December 2012 (currently employed by the Euler course and student at the HEP-Lausanne)
- John E. Harper (Notre Dame, 2008): August 2008–July 2010 (currently assistant professor at Ohio State University-Newark)
- Samuel Wüthrich (Bern, 2004): September 2006–July 2008 (currently employed by the CFF)
- Christine Vespa (Paris XIII, 2006): September 2006–August 2007 (currently maître de conférence at the University of Strasbourg)
- Sverre Lunøe-Nielsen (Oslo, 2005): September 2005–August 2006 (unknown employment status)
- Jonathan Scott (Toronto, 2000): September 2004–July 2006 (currently associate professor at Cleveland State University)
- Peter Bubenik (Toronto, 2003): September 2003–July 2005 (currently associate professor at the University of Florida)
- Paul-Eugène Parent (Louvain-la-Neuve, 2001): September 2001–August 2003 (currently associate professor at the University of Ottawa)

Professional service

Assessments

2016 Member of the Review Panel for the Mathematical Institute at Oxford

2015-present Member of the Association for Women in Mathematics Noether Lecture selection committee

- 2013–2014, Member of the selection committee for the Heidelberg Laureate Forum 2016
- 2012–2015 Chair of the committee evaluating undergraduate mathematics education in all Swedish universities
 - 2012 Member of the mathematics panel of the international commission evaluating KTH in its Research Assessment Exercise
- 2004–present Member of the selection committee for choosing a new professor for the mathematics departments of the Universities of Aalborg (2005, 2009, 2015), Bergen (2004), Copenhagen (2015), ETHZ (2014), Göteborg (2015), Lille (2012), Nijmegen (2012, 2014), Osnabrück (2012), Paris XIII (2015), Stockholm (2014), and Trondheim (2006, 2012, 2013), and for promotion to professor at KTH (2010) and Copenhagen (2012, 2014). Reviewer for creation of Junior Research Group at FU Berlin (2013)
 - 2001 Member of the international commission evaluating the mathematics departments of all Swedish universities
- 2000–present Reviewer of grant applications for the U.S. National Science Foundation, the Norwegian Research Council, the Academy of Finland, the US-Israel Binational Science Foundation, the Netherlands Organisation for Scientific Research, the European Research Commission (EURYI prize), France's National Research Agency, Canada's National Science and Engineering Research Council, Georgia's Shota Rustaveli National Science Foundation, and the Research Foundation-Flanders.
- 1992-present Member of thesis and habilitation juries in Aalborg (3), Aberdeen, Copenhagen (2), Lausanne (5), Lille (4), Louvain-Ia-Neuve (2), Nantes, Nice, Nijmegen, Oslo, Paris, Singapore, Stockholm (3), Trondheim (2), and Utrecht (2). Reporter for theses in Angers and Paris

Service internal to EPFL

- 2014-present Vice-president of the EPFL-WISH Foundation (for the promotion of women in science)
- 2012–2015 Director of the Doctoral program in mathematics
- 2010-2012 Member of the committee selecting the laureat of the EPFL doctoral prize
- 2010-present Member of the Bureau of the EPFL-WISH Foundation
- 2008–2015 Member of the Research Commission (chair of the mathematics and computer science panel starting in 2013)
- 2008–2012 Vice-director of the Doctoral school in mathematics
- 2006–2012 Member of the Teaching committee of the section of mathematics
- 2006–2012 Exchange coordinator for the section of mathematics
- 2004–2008 Member of the Evaluating Committee of the FSB (responsible for evaluating applications for internal promotion)
- 1995-present Numerous presentations to visiting high school and elementary school students (Journée des gymnasiennes, Journée des gymnasiens, Journée des classes)

Conferences co-organized

- 2017 Women in Topology Workshop (MSRI)
- 2017 Conference in applied algebraic topology (Sapporo, Japan)
- 2017 Program "Applied and Computational Algebraic Topology" (Hausdorff Research Institute for Mathematics, Bonn)
- 2015 Workshop in category theory and algebraic topology (Louvain)
- 2014 Introductory Workshop, Emphasis semester in algebraic topology (MSRI)

- 2013, 2014 Summer schools in algebraic topology and category theory (Université Catholique de Louvain/EPFL)
- 2013, 2016 Women in Topology Workshop (Banff International Research Station)
 - 2011 André Memorial Conference (EPFL)
 - 2010 Workshop on Tannakian Categories (EPFL)
- 2007-present Young Topologists Meetings (held annually in Switzerland or Denmark since 2007)
 2006 Alpine Operad Workshop (Villars)
 - 2006 Emphasis semester in algebraic topology (Mittag-Leffler Institute)
- 1999-present Arolla Conferences on Algebraic Topology (1999, 2004, 2008, 2012, 2016)
 - 2002 GDRE meeting (Lille)

Editorial work

- Co-editor of the Proceedings of the 2013 and 2016 Women in Topology workshops, in the *Contemporary Mathematics* series of the AMS and in *Topology and its Applications*
- Co-editor of the Proceedings of the 1999, 2004, 2008, 2012, and 2016 Arolla Conferences on Algebraic Topology, in the *Contemporary Mathematics* series of the AMS
- Member of the editorial board of Algebraic and Geometric Topology (2001-present, chief editor from 2012), Publicacions Matematiques (2007-present), and Theory and Applications of Categories (2011-present)

Referee work

- Regular contributor to Mathematical Reviews (89 reviews since 1995)
- Referee for numerous journals, including Advances in Mathematics, Algebraic and Geometric Topology, Annals of Mathematics, Bulletin de la Socit Mathmatique de France, Commentarii Mathematici Helvetici, Compositio Mathematicae, Documenta Mathematicae, Expositiones Mathematicae, Homology, Homotopy and Applications, Israel Journal of Mathematics, Journal of Algebra, Journal of K-theory, Journal of Pure and Applied Algebra, Journal of Topology, Journal of Topology and Analysis, K-Theory, manuscripta mathematica, Mathematica Scandinavica, Mathematische Zeitschrift, Pure and Applied Mathematics Quarterly, Proceedings of the American Mathematical Society, Topology, Topology and its Applications, Transactions of the American Mathematical Society and journals of the London Mathematical Society
- Manuscript reviewer for Springer Verlag, University of Chicago Press, and the American Mathematical Society

Outreach

- 2013 Invited speaker at "Women Inspire Innovation", Swiss Embassy, Washington D.C.
- 2011–2013 Speeches given to sections of the Rotary Club, the Business and Professional Women's Club, the Lions Club, Kiwanis and the Equal Opportunity Office of the Canton of Valais
- 2010, 2011 EPFL coordinator of the Lausanne semi-final and the Swiss final of the Championnat de jeux mathématiques et logiques
- 2009–2013 Regular (bimonthly) mathematical columnist in Le Temps (Swiss newspaper)
- 2007-present Founder of the Cours Euler, a fast-paced mathematics course for young students with very high potential in mathematics (http://euler.epfl.ch)
 - 2007-2012 Talks at "Maths en Jeu" graduation ceremonies
 - 2001 Translated (from Swedish to French), staged, and acted in a play about mathematical history for the EPFL open house "Science et Cité"

2000–2006 Acted (in Swedish) in plays about mathematical history, while on leave at the University of Stockholm and on various visits to Sweden

Languages

English	Native speaker
French	Fluent
Swedish	Fluent
Norwegian	Excellent oral and written comprehension
German	Very good oral and written comprehension

Miscellaneous

- Radio interview (in French) available at

 $http://www.rsr.ch/\#/la-1ere/programmes/impatience/?date=\!24\text{-}04\text{-}2010$