

John C. Baez

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CITIZENSHIP	USA	
EDUCATION	Ph.D., Mathematics, Massachusetts Institute of Technology , 1986. Thesis: <i>Conformally Invariant Quantum Fields</i> . Advisor: Irving Segal. <ul style="list-style-type: none">• National Science Foundation Fellowship, 1982-1985. B.A., Mathematics, Princeton University , 1982. Thesis: <i>Recursivity in Quantum Mechanics</i> . Advisor: John Burgess.	
EMPLOYMENT	University of California at Riverside , Department of Mathematics. <ul style="list-style-type: none">• On leave, visiting the Centre for Quantum Technologies, 2010-2012.• Full Professor, 1995-2012.• Associate Professor, 1991-1995.• On leave, visiting Wellesley College, 1990-1992.• Assistant Professor, 1988-1991. Yale University , Department of Mathematics, Gibbs Instructor, 1986-1988.	
COURSES TAUGHT	Applications of Mathematics without Calculus, First Year Calculus, Vector Calculus, Differential Equations, Linear Algebra, Number Theory, Advanced Calculus, Foundations of Mathematics, Methods of Theoretical Physics, Mathematical Physics, Graduate Real Analysis, Graduate Complex Analysis, Graduate Algebraic Topology, Quantum Theory and Analysis, Symbolic Computation, Low-Dimensional Topology and Physics, Knots and Quantum Gravity, Quantum Gravity Seminar, Geometric Representation Theory Seminar.	
SERVICE	Served as Ph.D. advisor for 12 students. Served on Executive Committee, Committee on Preparatory Education, Library Committee, faculty hiring committees in mathematics and physics, and other committees.	
GRANTS	PI for ‘Feynman Diagrams and the Semantics of Quantum Computation’, NSF program on Quantum Information and Revolutionary Computing, \$148,938, August 2007 – August 2010. PI for ‘Categorifying Fundamental Physics’, Foundational Questions Institute, \$131,865, August 2008 – August 2010.	

CONFERENCES
ORGANIZED

- Knots and Quantum Gravity workshop, U. C. Riverside, May 14–16, 1993.
- Knots and Quantum Gravity session of the Seventh Marcel Grossmann Meeting on General Relativity, Stanford, July 26, 1994.
- Low-dimensional Topology and Quantum Gravity session of Workshop on Canonical and Quantum Gravity II, Stephan Banach Institute, Warsaw, May 26 – June 6, 1997.
- Low-dimensional Topology and Quantum Gravity session of Joint Mathematics Meetings, Baltimore, January 7–8, 1998.
- n -Categories: Foundations and Applications, workshop at Institute for Mathematics and its Applications, Minnesota, June 7–18, 2004.
- Higher Categories and Their Applications, workshop as part of the Thematic Program on Geometric Applications of Homotopy Theory, Fields Institute, Toronto, January 9–13, 2007.

BOOKS

- An Introduction to Algebraic and Constructive Quantum Field Theory*, with Irving Segal and Zhengfang Zhou, Princeton University Press, 1992.
- Knots and Quantum Gravity*, editor, Oxford University Press, 1994.
- Gauge Fields, Knots, and Gravity*, with Javier Muniain, World Scientific Press, 1994.
- Infinite-Dimensional Representations of 2-Groups*, with Aristide Baratin, Laurent Freidel and Derek Wise. To appear in *Memoirs Amer. Math. Soc.*.

PAPERS

1. Recursivity in quantum mechanics, *Trans. Amer. Math. Soc.* **280** (1983), 339–350.
2. Bell’s inequality for C^* -algebras, *Lett. Math. Phys.* **13** (1987), 135–136.
3. Is life improbable?, *Found. Phys.* **19** (1989), 91–95.
4. The global Goursat problem on $R \times S^1$, with Zhengfang Zhou, *Jour. Funct. Analysis* **83** (1989), 364–382.
5. Scattering and the geometry of the solution manifold of $\square f + \lambda f^3 = 0$, *Jour. Funct. Analysis* **83** (1989), 317–332.
6. Analyticity of scattering for the ϕ^4 theory, with Zhengfang Zhou, *Comm. Math. Phys.* **124** (1989), 9–21.
7. Scattering for the Yang-Mills equations, *Trans. Amer. Math. Soc.* **315** (1989), 823–832.
8. Wick products of the free Bose field, *Jour. Funct. Analysis* **86** (1989), 211–225.
9. Scattering and complete integrability in conformally invariant nonlinear theories, *Jour. Math. Phys.* **31** (1990), 757–762.
10. The global Goursat problem and scattering for nonlinear wave equations, with Irving Segal and Zhengfang Zhou, *Jour. Funct. Analysis* **93** (1990), 239–269.
11. Conserved quantities for the Yang-Mills equations, *Adv. Math.* **82** (1990), 126–131.
12. Scattering and complete integrability in the massive ϕ^4 theory, with Zhengfang Zhou, *Jour. Funct. Analysis* **94** (1990), 397–414.

13. Topological lower bound on the energy of a twisted rod, with Rossen Dandoloff, *Phys. Lett. A* **155** (1991), 145–147.
14. The vacuum and lightcone quantization of interaction Hamiltonians, *Lett. Math. Phys.* **21** (1991), 117–121.
15. Differential calculi on quantum vector spaces with Hecke-type relations, *Lett. Math. Phys.* **23** (1991), 133–141.
16. Renormalized oscillator Hamiltonians, with Zhengfang Zhou, *Adv. Math.* **92** (1992), 106–127.
17. On quantum fields satisfying a given wave equation, with Zhengfang Zhou, *Jour. Funct. Analysis* **106** (1992), 439–453.
18. On the Hopf term in a 2-dimensional sigma model for antiferromagnets, with Alan Bishop and Rossen Dandoloff, *Mod. Phys. Lett. B* **5** (1991), 2003–2005.
19. R-commutative geometry and quantization of Poisson algebras, *Adv. Math.* **95** (1992), 61–91.
20. Scattering and complete integrability in four dimensions, in *Mathematical Aspects of Classical Field Theory*, eds. Mark Gotay, Jerrold Marsden and Vincent Moncrief, *Contemp. Math.* **132**, American Mathematical Society, Providence, Rhode Island, 1992, pp. 99–116.
21. Link invariants of finite type and perturbation theory, *Lett. Math. Phys.* **26** (1992), 43–51.
22. Quantum gravity and the algebra of tangles, *Class. Quantum Grav.* **10** (1993), 673–694.
23. An algebraic approach to discrete mechanics, with James Gilliam, *Lett. Math. Phys.* **31** (1994), 205–212.
24. Generalized measures in gauge theory, *Lett. Math. Phys.* **31** (1994), 213–223.
25. Diffeomorphism-invariant generalized measures on the space of connections modulo gauge transformations, in *Proceedings of the Conference on Quantum Topology*, ed. David N. Yetter, World Scientific Press, Singapore, 1994, pp. 21–43.
26. Strings, loops, knots and gauge fields, in *Knots and Quantum Gravity*, ed. J. Baez, Oxford U. Press, Oxford, 1994, pp. 133–168.
27. Hochschild homology in a braided tensor category, *Trans. Amer. Math. Soc.* **344** (1994), 885–906.
28. Strings and two-dimensional QCD for finite N , with Washington Taylor IV, *Nucl. Phys. B* **426** (1994), 53–70.
29. Link invariants, holonomy algebras and functional integration, *Jour. Funct. Analysis* **127** (1995), 108–131.
30. Topological aspects of spin and statistics of solitons in nonlinear sigma-models, with Michael Ody and William Richter, *Jour. Math. Phys.* **36** (1995), 108–131.
31. Higher-dimensional algebra and topological quantum field theory, with James Dolan, *Jour. Math. Phys.* **36** (1995), 6073–6105.
32. Quantum gravity hamiltonian for manifolds with boundary, with Javier P. Muniain and Dardo Piriz, *Phys. Rev. D* **52** (1995), 6840–6845.

33. Spin networks in gauge theory, *Adv. Math.* **117** (1996), 253–272.
34. Spin networks in nonperturbative quantum gravity, in *The Interface of Knots and Physics*, ed. Louis Kauffman, American Mathematical Society, Providence, Rhode Island, 1996, pp. 167–203.
35. Four-dimensional BF theory as a topological quantum field theory, *Lett. Math. Phys.* **38** (1996), 129–143.
36. Knots and quantum gravity: progress and prospects, in *Proceedings of the Seventh Marcel Grossman Meeting on General Relativity*, ed. Robert T. Jantzen and G. Mac Keiser, World Scientific Press, Singapore, 1996, pp. 779–797.
37. Higher-dimensional algebra I: braided monoidal 2-categories, with Martin Neuchl, *Adv. Math.* **121** (1996), 196–244.
38. An introduction to n -categories, *7th Conference on Category Theory and Computer Science*, eds. Eugenio Moggi and Giuseppe Rosolini, Lecture Notes in Computer Science vol. 1290, Springer, Berlin, 1997, pp. 1–33.
39. Higher-dimensional algebra II: 2-Hilbert spaces, *Adv. Math.* **127** (1997), 125–189.
40. Functional integration on the space of connections, with Stephen Sawin, *Jour. Funct. Analysis* **50** (1997), 1–27.
41. 2-Tangles, with Laurel Langford, *Lett. Math. Phys.* **43** (1998), 187–197.
42. Quantum geometry and black hole entropy, with Abhay Ashtekar, Alejandro Corichi and Kirill Krasnov, *Phys. Rev. Lett.* **80** (1998), 904–907.
43. Higher-dimensional algebra III: n -categories and the algebra of opetopes, with James Dolan, *Adv. Math.* **135** (1998), 145–206.
44. Spin foam models, *Class. Quantum Grav.* **15** (1998), 1827–1858.
45. Degenerate solutions of general relativity from topological field theory, *Commun. Math. Phys.* **193** (1998), 219–231.
46. Diffeomorphism-invariant spin network states, with Stephen Sawin, *Jour. Funct. Analysis* **158** (1998), 253–266.
47. Quantization of diffeomorphism-invariant theories with fermions, with Kirill Krasnov, *Jour. Math. Phys.* **39** (1998), 1251–1271.
48. Categorification, with James Dolan, in *Higher Category Theory*, eds. Ezra Getzler and Mikhail Kapranov, Contemp. Math. 230, American Mathematical Society, Providence, Rhode Island, 1998, pp. 1–36.
49. The quantum tetrahedron in 3 and 4 dimensions, with John Barrett, *Adv. Theor. Math. Phys.* **3** (1999), 815–850.
50. An introduction to spin foam models of BF theory and quantum gravity, in *Geometry and Quantum Physics*, eds. Helmut Gausterer and Harald Grosse, Lecture Notes in Physics, Springer, Berlin, 2000, pp. 25–93.
51. From finite sets to Feynman diagrams, with James Dolan, in *Mathematics Unlimited - 2001 and Beyond*, vol. 1, eds. Björn Engquist and Wilfried Schmid, Springer, Berlin, 2001, pp. 29–50.

52. Higher-dimensional algebra and Planck-scale physics, in *Physics Meets Philosophy at the Planck Length*, eds. Craig Callender and Nick Huggett, Cambridge U. Press, Cambridge, 2001, pp. 177–195.
53. Quantum geometry of isolated horizons and black hole entropy, with Abhay Ashtekar and Kirill Krasnov, *Adv. Th. Math. Phys.* **4** (2001), 1–94.
54. Integrability for relativistic spin networks, with John Barrett, *Class. Quantum Grav.* **18** (2001), 4683–4700.
55. The octonions, *Bull. Amer. Math. Soc.* **39** (2002), 145–205.
56. Positivity of spin foam amplitudes, with J. Daniel Christensen, *Class. Quantum Grav.* **19** (2002), 2291–2306.
57. Spin foam models of Riemannian quantum gravity, with J. Daniel Christensen, Thomas R. Halford and David C. Tsang, *Class. Quantum Grav.* **19** (2002), 4627–4648.
58. Uncertainty in measurements of distance, with S. Jay Olson, *Class. Quantum Grav.* **19** (2002), L121–L125.
59. Asymptotics of $10j$ symbols, with J. Daniel Christensen and Greg Egan, *Class. Quantum Grav.* **19** (2002), 6489–6513.
60. Spin foam perturbation theory, in *Diagrammatic Morphisms and Applications*, eds. David Radford, Fernando Souza, and David Yetter, Contemp. Math. **318**, American Mathematical Society, Providence, Rhode Island, 2003, pp. 9–21.
61. Higher-dimensional algebra IV: 2-tangles, with Laurel Langford, *Adv. Math.* **180** (2003), 705–764.
62. Higher-dimensional algebra V: 2-groups, with Aaron D. Lauda, *Th. Appl. Cat.* **12** (2004), 423–491.
63. Higher-dimensional algebra VI: Lie 2-algebras, with Alissa S. Crans, *Th. Appl. Cat.* **12** (2004), 492–528.
64. The meaning of Einstein’s equation, with Emory F. Bunn, *Amer. Jour. Phys.* **73** (2005), 644–652.
65. Quantum quandaries: a category-theoretic perspective, in *Structural Foundations of Quantum Gravity*, eds. Steven French, Dean Rickles and Juha Saatsi, Oxford U. Press, Oxford, 2006, pp. 240–265.
66. Higher gauge theory, with Urs Schreiber, in *Categories in Algebra, Geometry and Mathematical Physics*, eds. Alexei Davydov, Michael Batanin, Michael Johnson, Stephen Lack and Amnon Neeman, Contemp. Math. **431**, American Mathematical Society, Providence, Rhode Island, 2007, pp. 7–30.
67. Quantization of strings and branes coupled to BF theory, with Alejandro Perez, *Adv. Theor. Math. Phys.* **11** (2007), 1–19.
68. From loop groups to 2-groups, with Alissa S. Crans, Danny Stevenson and Urs Schreiber, *Homotopy, Homology, and Appl.* **9** (2007), 101–135.
69. Exotic statistics for strings in 4d BF theory, with Alissa S. Crans and Derek Wise, *Adv. Theor. Math. Phys.* **11** (2007), 707–749.
70. Lectures on n -categories and cohomology, with Michael Shulman, in *Towards Higher Categories*, eds. John Baez and Peter May, Springer, Berlin, 2009.

71. The classifying space of a topological 2-group, with Danny Stevenson, in *Algebraic Topology: the Abel Symposium 2007*, eds. Nils Baas, Eric Friedlander, Bjørn Jahren and Paul Arne Østvær, Springer, Berlin, 2009.
72. Categorized symplectic geometry and the classical string, with Alexander E. Hoffnung and Christopher L. Rogers, in *Comm. Math. Phys.* **293** (2010), 701–715.
73. Categorized symplectic geometry and the string Lie 2-algebra, with Christopher L. Rogers, in *Homotopy, Homology and Applications* **12** (2010), 221–236.
74. The algebra of grand unified theories, with John Huerta, *Bull. Amer. Math. Soc.* **47** (2010), 483–552.
75. Division algebras and supersymmetry I, with John Huerta, in *Superstrings, Geometry, Topology, and C*-algebras*, eds. Robert Doran, Greg Friedman, and Jonathan Rosenberg, *Proc. Symp. Pure Math.* **81**, AMS, Providence, Rhode Island, 2010, pp. 65–80.
76. Higher-dimensional algebra VII: groupoidification, with Alexander E. Hoffnung and Christopher D. Walker, *Th. Appl. Cat.* **24** (2010), 489–553.
77. Physics, topology, logic and computation: a Rosetta Stone, with Mike Stay, in *New Structures for Physics*, ed. Bob Coecke, Lecture Notes in Physics vol. 813, Springer, Berlin, 2011, pp. 95–174.
78. A prehistory of n -categorical physics, with Aaron D. Lauda, in *Deep Beauty: Mathematical Innovation and the Search for an Underlying Intelligibility of the Quantum World*, ed. Hans Halvorson, Cambridge U. Press, Cambridge, pp. 13–128.
79. Convenient categories of smooth spaces, with Alexander E. Hoffnung, *Trans. Amer. Math. Soc.* **363** (2011), 5789–5825.
80. An invitation to higher gauge theory, with John Huerta, *General Relativity and Gravitation* **43** (2011), 2335–2392
81. Algorithmic thermodynamics, with Mike Stay, to appear in *Math. Struct. Comp. Sci.*
82. Division algebras and quantum theory, to appear in *Found. Phys.*
83. Division algebras and supersymmetry II, with John Huerta, to appear in *Adv. Theor. Math. Phys.*
84. A characterization of entropy in terms of information loss, with Tobias Fritz and Tom Leinster, to appear in *Entropy*.

POPULARIZATIONS

1. Social structures that enable inventions, in *The Greatest Inventions of the Past 2000 Years*, ed. John Brockman, Simon and Schuster, 2000, pp. 68–69.
2. The quantum of area?, *Nature* **421** (2003), 702–703.
3. The string-loop war, in *What Have You Changed Your Mind About?*, ed. John Brockman, Harper, 2009, pp. 156–158.
4. The Earth—for physicists, *PhysicsWorld*, August 2009, 22–26.
5. The strangest numbers in string theory, with John Huerta, *Scientific American*, May 2011, pp. 60–65.

BOOK REVIEWS

1. *The Physical Basis of the Direction of Time*, by H. D. Zeh, review in *Math. Intelligencer* **16** (1994), 72–75.
2. *On Quaternions and Octonions: Their Geometry, Arithmetic, and Symmetry*, by John H. Conway and Derek A. Smith, review in *Bull. Amer. Math. Soc.* **42** (2005), 229–243.

RECENT TALKS

1. “Loop Quantum Gravity”, plenary talk at the ACM-SIAM Symposium on Discrete Algorithms (SODA), Vancouver, British Columbia, January 2005.
2. “From Loop Groups to 2-Groups”, Algebra Seminar, Mathematics Department of the University of California at Irvine, May 2005.
3. “The Mysteries of Counting: Euler Characteristic Versus Homotopy Cardinality”, public lecture at Categories in Algebra, Geometry and Mathematical Physics, a conference in honor of Ross Street’s 60th birthday, Sydney, Australia, July 2005.
4. “Higher Gauge Theory”, two talks at Categories in Algebra, Geometry and Mathematical Physics, a conference in honor of Ross Street’s 60th birthday, Sydney and Canberra, Australia, July 2005.
5. “Higher Gauge Theory, Homotopy Theory and n -Categories”, four lectures at a graduate summer school on Topics in Homotopy Theory at the Pacific Institute of Mathematical Sciences, Calgary, Canada, August 2005.
6. “Higher Gauge Theory: 2-Connections”, plenary talk at the Union College Mathematics Conference, Union College, Schenectady, New York, December 2005.
7. “Universal Algebra and Diagrammatic Reasoning”, nine lectures at Geometry of Computation 2006, Centre International de Recontres Mathématiques, Marseille, France, February 2006.
8. “Fundamental Physics: Where We Stand Today”, Faculté des Sciences de Luminy, Marseille, France, February 2006.
9. “Loop Quantum Gravity”, Physics Department of California State University, Long Beach, March 2006.
10. “Higher Gauge Theory, Higher Categories”, three lectures, 24th annual Unni Namboodiri Lectures in Geometry and Topology, University of Chicago, April 2006.
11. “ n -Categories and Cohomology”, three talks in the Category Theory Seminar, Department of Mathematics, University of Chicago, April 2006.
12. “Higher Gauge Theory”, three lectures, 2006 Barrett Lectures, University of Tennessee, Knoxville, April 2006.
13. “Higher-Dimensional Algebra: a Language for Quantum Spacetime”, Perimeter Institute, Waterloo, Canada, May 2006.
14. “Fundamental Physics: Where We Stand Today”, Department of Physics, University of Western Ontario, June 2006.
15. “Tales of the Dodecahedron”, Reese Prosser Memorial Lecture, Mathematics Department, Dartmouth College, November 2006.

16. “Higher Gauge Theory”, joint physics/mathematics colloquium, Louisiana State University, November 2006.
17. “Higher Gauge Theory”, Mathematics Department, Stanford University, December 2006.
18. “The Homotopy Hypothesis”, lecture at Higher Categories and Their Applications, Fields Institute, Toronto, January 2007.
19. “Quantum Quandaries: a Category-Theoretic Perspective”, lecture at Philosophical and Formal Foundations of Modern Physics, Les Treilles, France, April 2007.
20. “Cartan Geometry and MacDowell–Mansouri Gravity: the Work of Derek Wise”, lecture at the AstroParticule et Cosmologie (APC) group at Université Paris 7, July 2007.
21. “Why Mathematics is Boring”, lecture at Mathematics and Narrative, Delphi, July 2007.
22. “Higher Gauge Theory and Elliptic Cohomology”, lecture at the 2007 Abel Symposium, Oslo, August 2007.
23. “Higher Gauge Theory and the String Group”, lecture at Poisson Geometry and Sigma Models, Erwin Schrödinger Institut, Vienna, August 2007.
24. “2-Hilbert Spaces”, London Analysis and Probability Seminar, University College, London, September 2007.
25. “Higher Gauge Theory and the String Group”, plenary talk, 22nd British Topology Meeting, Sheffield University, Sheffield, England, September 2007.
26. “Spans in Quantum Theory”, keynote talk at Deep Beauty: Mathematical Innovation and the Search for an Underlying Intelligibility of the Quantum World, Princeton University, October 2007.
27. “Fundamental Physics: Where We Stand Today”, James Madison University, Harrisonburg, Virginia, November 2007.
28. “5”, Mathematics Department, George Washington University, Washington DC, May 2008.
29. “Groupoidification”, Groupoids in Analysis and Geometry Seminar, Department of Mathematics, U. C. Berkeley, May 2008.
30. “5”, Google, Mountain View, California, May 2008.
31. “Topological 2-Groups and Their Classifying Spaces”, Workshop on Categorical Groups, Universitat de Barcelona, Spain, June 2008.
32. “Lie 2-Algebras”, two lectures, Department of Algebra, University of Granada, Spain, June 2008.
33. “Groupoidification”, invited lecture, Homotopy Theory and Higher Categories 2008, Centre de Recerca Matemàtica, Barcelona, Spain, June 2008.
34. “Computation and the Periodic Table”, plenary talk at Algebraic Topological Methods in Computer Science 2008, University of Paris Diderot, Paris, July 2008.
35. “Classifying Spaces for Topological 2-Groups”, talk at the Instituto Superior Tecnico, Lisbon, Portugal, July 2008.

36. “Groupoidification”, talk at the Preuves, Programmes et Systemes group at Université Paris Diderot, Paris, July 2008.
37. “My Favorite Numbers”, 3 talks forming the 2008 Rankin Lectures at the University of Glasgow, Scotland, September 2008.
38. “Classifying Spaces for Topological 2-Groups” and “Groupoidification”, 2 talks at the Joint Mathematics Meeting, Washington D.C., January 2009.
39. “Categorification and Topology”, talk at Categorification and Geometrisation from Representation Theory, University of Glasgow, April 2009.
40. “Categorification and Topology”, plenary talk at Graduate Student Topology and Geometry Conference, University of Wisconsin, April 2009.
41. “Why Smooth Spaces?”, invited talk at the Fields Institute workshop on Smooth Structures in Logic, Physics and Category Theory, University of Ottawa, May 2009.
42. “Computation and the Periodic Table”, invited talk at the 24th Annual IEEE Symposium on Logic in Computer Science (LICS 2009), UCLA, July 2009.
43. “My Favorite Numbers” (3 talks), “Fundamental Physics: Where We Stand Today”, and “Zooming Out in Time”, lectures given as Cecil & Ida Green Honors Chair, Mathematics Department, Texas Christian University, Fort Worth, Texas, September 2009.
44. “Categorification in Mathematical Physics”, 5-lecture course given at the 2nd School and Workshop on Quantum Gravity and Quantum Geometry, Corfu Summer Institute, Greece, September 2009.
45. “Who Discovered the Icosahedron?”, invited talk at the History and Philosophy of Mathematics special session of the 2009 Fall Western Section Meeting of the AMS, U.C. Riverside, November 2009.
46. “Quantum Gravity”, Southern California Reading Group in the Philosophy of Physics, January 2010.
47. “8”, Mathematics Department, Fullerton College, California, March 2010.
48. “5” and “Physics, Topology, Logic and Computation: a Rosetta Stone”, Mathematics and Physics Departments, California State University, Fresno, April 2010.
49. “Electrical Circuits”, Einstein Chair Mathematics Seminar, City University of New York, May 2010.
50. “Duality in Logic and Physics”, Quantum Physics and Logic 10, Oxford University, May 2010.
51. “Energy, the Environment, and What Mathematicians Can Do”, Department of Mathematics, Hong Kong University, March 2011.
52. “8”, Institute of Mathematical Sciences, Chinese University of Hong Kong, March 2011.
53. “Higher Gauge Theory, Division Algebras and Superstrings,” Workshop on Geometry and Lie Groups, Department of Mathematics, Hong Kong University, March 2011.
54. “Higher Gauge Theory, Division Algebras and Superstrings,” Quantum Theory and Gravitation, ETH Zurich, June 2011.
55. “Operads and the Tree of Life”, Combinatorics Seminar, Department of Mathematics, Université du Québec Montréal, July 2011.