Vincent **Bouchard**

Professor · Associate Chair Undergraduate · Rhodes Scholar (Québec and Magdalen, 2001)

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Education

University of Oxford, Magdalen College — *Oxford, UK*

D.Phil. Mathematics — *2001–2005*

- Supervisor: Rouse Ball Professor Philip Candelas
- Recipient of a Rhodes Scholarship
- Recipient of an NSERC PGS Doctoral Fellowship and a FCAR Doctoral (B2) Scholarship
- Recipient of an NSERC PGS Master's Scholarship and a FCAR Master's (B1) Scholarship

Université de Montréal — *Montréal, QC*

B.Sc. Physics — *1998–2001*

- Palmarès de la doyenne, GPA: 4.3/4.3
- Recipient of an NSERC Undergraduate Student Research Award
- Recipient of a Welcome Award from Université de Montréal

Positions

Department of Mathematical and Statistical Sciences, University of Alberta — *Edmonton, AB*

Associate Chair (Undergraduate) — *2016–…*

- As Associate Chair (Undergraduate), I am responsible for most things related to undergraduate teaching in the Department of Mathematical and Statistical Sciences.

Department of Mathematical and Statistical Sciences, University of Alberta — *Edmonton, AB*

Professor — *2020–…*

Department of Mathematical and Statistical Sciences, University of Alberta — *Edmonton, AB*

Associate Professor — *2013–2020*

Department of Mathematical and Statistical Sciences, University of Alberta — *Edmonton, AB*

Assistant Professor — *2009–2013*

Physics Department, Harvard University — *Cambridge, MA, USA*

Postdoctoral Fellow — *2007–2009*

Perimeter Institute for Theoretical Physics — *Waterloo, ON*

Postdoctoral Fellow — *2006–2007*

- Recipient of a NSERC Postdoctoral Fellowship.

Mathematical Sciences Research Institute — *Berkeley, CA, USA*

Postdoctoral Fellow — *2006*

Department of Mathematics, University of Pennsylvania — *Philadelphia, PA, USA*

Postdoctoral Fellow — *2005*

Grants

Research

2018–2023	**NSERC Discovery Grant,** $360,000	*NSERC*
2013–2018	**NSERC Discovery Grant,** $225,000	*NSERC*
2010–2013	**NSERC Discovery Grant,** $130,000	*NSERC*
2009-2012	**Startup Research Grant,** $50,000	*University of Alberta*

Teaching

2017–2020	**Faculty of Science Teaching Fellowship,** $60,000	*University of Alberta*

Significant Awards

2019	**TELUS World of Science - Edmonton Science Fellow,** This fellowship recognizes an outstanding researcher or innovator based in Northern Alberta.	*TELUS World of Science*
2018	**Rutherford Award for Excellence in Undergraduate Teaching,** UofA's premier teaching award	*University of Alberta*
2016	**Innovation in Teaching Award,** Faculty of Science	*University of Alberta*
2016	**Excellence in Teaching Award,** Interdisciplinary Science Students' Society	*University of Alberta*
2016	**Instructor of the Month,** Faculty of Science (December)	*University of Alberta*
2015	**Blended Learning Award,** Center for Teaching and Learning (MATH 134 – co-applicant)	*University of Alberta*
2015	**Instructor of Distinction Honor Roll,** Faculty of Science	*University of Alberta*
2014	**Blended Learning Award,** Center for Teaching and Learning (MATH 144 – lead instructor)	*University of Alberta*
2001	**Rhodes Scholarship,** Magdalen College, University of Oxford	*Oxford*
2001	**Forces Avenir,** Finalist in the "Personnalité – 1er cycle" category	*Québec*
1996	**Governor General's Academic Medal,** Bronze (secondary school level)	*Canada*

Publications

HQPs under my supervision are identified with an asterisk in joint publications.

Submitted Publications

[1] V. Bouchard and K. Mastel*, "A New Class of Higher Quantum Airy Structures as Modules of $\mathcal{W}(\mathfrak{gl}_r)$-Algebras," arXiv:2009.13047 [math-ph].

[2] V. Bouchard and K. Osuga*, "$\mathcal{N} = 1$ Topological Recursion," arXiv:2007.13186 [math-ph].

[3] G. Borot, V. Bouchard, N.K. Chidambaram*, T. Creutzig and D. Noshchenko, "Higher Airy structures, W algebras and topological recursion," arXiv:1812.08738 [math-ph] .

Refereed Publications

[1] V. Bouchard, P. Ciosmak, L. Hadasz, K. Osuga*, B. Ruba, and P. Sułkowski, "Super Quantum Airy Structures," accepted for publication in Commun.Math.Phys [arXiv:1907.08913 [math-ph]].

[2] V. Bouchard, T. Creutzig and A. Joshi*, "Hecke operators on vector-valued modular forms," SIGMA **15** (2019), 041, 31 p. [arXiv:1807.07703 [math.NT]].

[3] V. Bouchard and K. Osuga*, "Supereigenvalue models and topological recursion," JHEP **1804** 138 (2018) [arXiv:1802.03536 [hep-th]].

[4] V. Bouchard, N. Chidambaram* and T. Dauphinee*, "Quantizing Weierstrass," Commun.Num.Theor.Phys. **12** 253-303 (2018) [arXiv:1610.00225 [math-ph]].

[5] V. Bouchard and B. Eynard, "Reconstructing WKB from topological recursion," Journal de l'Ecole polytechnique – Mathematiques **4**, 845-908 (2017) [arXiv:1606.04498 [math-ph]].

[6] V. Bouchard, T. Creutzig, D.-E. Diaconescu, C. Doran, C. Quigley* and A. Sheshmani, "Vertical D4-D2-D0 bound states on K3 fibrations and modularity," Comm. Math. Phys. **350**, 1069-1121 (2017) [arXiv:1601.04030 [hep-th]].

[7] V. Bouchard, D. Hernandez Serrano, X. Liu and M. Mulase, "Mirror symmetry for orbifold Hurwitz numbers," J. Differential Geom. **98**, 375-423 (2014) [arXiv:1301.4871 [math.AG]].

[8] V. Bouchard, J. Hutchinson*, P. Loliencar*, M. Meiers* and M. Rupert*, "A generalized topological recursion for arbitrary ramification," Annales Henri Poincaré, **15**, 143-169 (2014) [arXiv:1208.6035 [math-ph]].

[9] V. Bouchard and B. Eynard, "Think globally, compute locally," JHEP **02**, 143 (2013) [arXiv:1211.2302 [math-ph]].

[10] V. Bouchard, A. Catuneanu*, O. Marchal* and P. Sułkowski, "The remodeling conjecture and the Faber-Pandharipande formula," Lett.Math.Phys. **103**, 59-77 (2013) [arXiv:1108.2689 [math.AG]].

[11] V. Bouchard and P. Sułkowski, "Topological recursion and mirror curves," Adv.Theor.Math.Phys. **16**, 1443-1483 (2012) [arXiv:1105.2052 [hep-th]].

[12] V. Bouchard, J.J. Heckman, J. Seo and C. Vafa, "F-theory and Neutrinos: Kaluza-Klein Dilution of Flavor Hierarchy," JHEP **1001** 061 (2010) [arXiv:0904.1419 [hep-ph]].

[13] A. Bak, V. Bouchard and R. Donagi, "Exploring a new peak in the heterotic landscape," JHEP **1006** 108 (2010) [arXiv:0811.1242 [hep-th]].

[14] V. Bouchard, A. Klemm, M. Mariño and S. Pasquetti, "Topological open strings on orbifolds," Commun.Math.Phys. **296** 589-623 (2010) [arXiv:0807.0597 [hep-th]].

[15] V. Bouchard and R. Cavalieri, "On the mathematics and physics of high genus invariants of $[\mathbb{C}^3/\mathbb{Z}_3]$," Adv.Theor.Math.Phys. **13** 695-719 (2009) [arXiv:0709.3805 [math.AG]].

[16] V. Bouchard, A. Klemm, M. Mariño and S. Pasquetti, "Remodeling the B-model," Commun.Math.Phys. **287**, 117-178 (2009) [arXiv:0709.1453 [hep-th]].

[17] V. Bouchard, "Perils and promises of heterotic standard models," Can.J.Phys. **87** 279-284 (2009).

[18] V. Bouchard and R. Donagi, "On heterotic model constraints," JHEP **0808** 060 (2008) [arXiv:0804.2096 [hep-th]].

[19] V. Bouchard and M. Mariño, "Hurwitz numbers, matrix models and enumerative geometry." In: From Hodge Theory to Integrability and tQFT: tt*-geometry, Proceedings of Symposia in Pure Mathematics, AMS (2008) [arXiv:0709.1458 [math.AG]].

[20] V. Bouchard and R. Donagi, "On a class of non-simply connected Calabi-Yau threefolds," Commun.Num.Theor.Phys. **2** 1-61 (2008) [arXiv:0704.3096 [math.AG]].

[21] M. Aganagic, V. Bouchard and A. Klemm, "Topological strings and (almost) modular forms," Commun.Math.Phys. **277** 771-819 (2008) [arXiv:hep-th/0607100].

[22] V. Bouchard, M. Cvetic and R. Donagi, "Tri-linear couplings in an heterotic minimal supersymmetric standard model," Nucl.Phys. **B745** 62-83 (2006) [arXiv:hep-th/0602096].

[23] V. Bouchard and R. Donagi, " An $SU(5)$ heterotic standard model," Phys,Lett. **B633** 783-791 (2006) [arXiv:hep-th/0512149].

[24] V. Bouchard, B. Florea and M. Mariño, "Topological open string amplitudes on orientifolds," JHEP **0502** 002 (2005) [arXiv:hep-th/0411227].

[25] V. Bouchard, B. Florea and M. Mariño, "Counting higher genus curves with crosscaps in Calabi-Yau orientifolds," JHEP **0412** 035 (2004) [arXiv:hep-th/0405083].

[26] V. Bouchard and H. Skarke, "Affine Kac-Moody algebras, CHL strings and the classification of tops," Adv.Theor.Math.Phys. **7** 205-232 (2003) [arXiv:hep-th/0303218].

Books

[1] R. Cavalieri and E. Miles, *Riemann Surfaces and Algebraic Curves*, vol. 87 of Student Texts. London Mathematical Society (2016). I contributed "Appendix D: Does Physics Have Anything to Say About Hurwitz Numbers?".

[2] V. Bouchard, C. Doran, S. Mendez-Diez, and C. Quigley, eds., *String-Math 2014*, Proceedings of Symposia in Pure Mathematics. AMS (2016).

Non-refereed Publications

[1] V. Bouchard, "Lectures on complex geometry, Calabi-Yau manifolds and toric geometry," in *Proceedings of the Modave Summer School in Mathematical Physics 2005*. Solvay Institute (2007) [arXiv:hep-th/0702063 [hep-th]].

Research

Research Interest

- My research program focuses on the fascinating interface between mathematics and physics, more precisely geometry and string theory. In particular, I am interested in using string dualities to uncover new mathematical structures in geometry, such as in mirror symmetry.

Presentations

- Over 100 research talks at conferences and universities all around the world.
- 7 presentations on Teaching & Learning.
- *List of presentations available upon request.*

Supervision

- I am currently supervising 2 MSc students, and co-supervising 1 postdoctoral fellow and 1 PhD student.
- In the last 10 years, I have successfully supervised 6 postdoctoral fellows, 2 PhD students, 7 MSc students, 17 NSERC Undergraduate Summer Research Students (USRAs), numerous undergraduate research projects and 1 graduate student in the Teaching & Learning Program.
- *Student names and present positions available upon request.*

Organization

- I co-organized research workshops and conferences in BIRS, AIM, CMS, as well as the String-Math 2014 international conference in University of Alberta.

Refereeing and Reviewing

- Referee for a large number of research journals in Mathematics and Physics.
- Scientific referee for a number of research grants.
- Reviewer for Mathematical Reviews and MathSciNet.

Contributions to Teaching & Learning

Curriculum Renewal

- I received a Faculty of Science Teaching Fellowship (2017–2020) to redesign the Mathematics undergraduate curriculum, which is work in progress!

Course Design

- I was the lead instructor and course designer for MATH 144 and 146 (Calculus for the Physical Sciences I and II), under a Blended Learning Award. I designed both courses following a blended learning and flipped pedagogy. I produced all online material (about 75 short videos), and developed in-class activities for a flipped environment in a large classroom setting.

Teacher Training

- I am co-organizing and co-leading an instructor training program for postdoctoral fellows and graduate students in the Department of Mathematical and Statistical Sciences.

Outreach and Extra Teaching

- Every summer from 2013 to 2018 I have helped organize a two-week Mathematics Summer Camp at the Ermineskin Cree Nation (south of Edmonton), for grade 6–9 students. It involves a day-trip to the University of Alberta campus, which I organize.
- I gave series of lectures on Physical Mathematics at the Algebra Summer School (Summer 2018, University of Alberta), at the International Summer Enrichment Program in Mathematics (Summer 2017, University of Alberta), at the Alberta Summer Mathematics Institute (2010, 2011, University of Alberta), and graduate level mini-courses in University of Toronto (2014), Harvey Mudd College (CA, USA, 2009), CERN (Geneva, 2007), Modave (Belgium, 2005).

Committees

2020–… **Member,** Faculty of Science representative on the Learning Technologies Advisory Committee

2017–2019 **Member,** Faculty of Science Canada Research Chair Advisory Committee

2016–2019 **Member,** Faculty of Science representative on the Faculty of Engineering Council

2016–2018 **Member,** Faculty of Science Excellence in Teaching Awards Committee

2016–… **Member,** Department of Mathematical and Statistical Sciences Executive Committee

2016–… **Member,** Department of Mathematical and Statistical Sciences Curriculum/Honors Committee

2016–… **Member,** Department of Mathematical and Statistical Sciences Teaching Awards Committee

2014–2016 **Elected Representative,** Faculty Evaluation Committee (FEC)

2014–2016 **Member,** Department of Mathematical and Statistical Sciences Graduate Committee

2013–2015 **Member,** Science 100 (InSciTE) Redevelopment Committee

2011–… **Member,** Various MSc and PhD candidacy and examination committees