

# Branimir Ćaćić

## CURRICULUM VITAE ET STUDIORUM

### *Contact*

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### *Research Interests*

Foundations of noncommutative differential and Riemannian geometry; applications of noncommutative geometry to mathematical physics and applied harmonic analysis.

### *Employment*

07/2022– *Associate Professor* (with tenure), Department of Mathematics and Statistics, University of New Brunswick, Fredericton.

07/2019–06/2022 *Associate Professor*, Department of Mathematics and Statistics, University of New Brunswick, Fredericton.

07/2016–06/2019 *Assistant Professor*, Department of Mathematics and Statistics, University of New Brunswick, Fredericton.

08/2013–06/2016 *Visiting Assistant Professor*, Department of Mathematics, Texas A&M University.  
POSTDOCTORAL MENTOR: Guoliang Yu.

### *Visiting Positions*

10/2014–12/2014 *Visitor*, Institut des Hautes Études Scientifiques.

09/2014 *Visitor*, Hausdorff Research Institute for Mathematics, University of Bonn.

### *Education*

09/2009–06/2013 *Doctor of Philosophy*, Mathematics Option, California Institute of Technology.  
THESIS: *On reconstruction theorems in noncommutative Riemannian geometry*.  
ADVISOR: Matilde Marcolli.

09/2007–08/2009 Doctoral studies, International Max Planck Research School in Moduli Spaces, Max Planck Institute for Mathematics.  
ADVISOR: Matilde Marcolli.

09/2007–07/2008 Qualifying year, Bonn International Graduate School in Mathematics, University of Bonn.

09/2003–06/2007 *Honours Bachelor of Science* (with High Distinction), Mathematics and Physics Specialist, St. Michael's College, University of Toronto.

## Grants & Awards

04/2024–	<i>Classical Abelian gauge theory on noncommutative manifolds</i> , Discovery Grant, Natural Sciences and Engineering Research Council of Canada.
05/2021–06/2022	<i>Classical physics on quantum spaces</i> , Harrison McCain Foundation (Young Scholars Award), University of New Brunswick.
01/2018–12/2018	<i>CMS Summer 2018 Session on Noncommutative Geometry and Topology</i> , Conferences and Workshops Funding, Atlantic Association for Research in the Mathematical Sciences.
05/2017–12/2018	<i>Principal bundles in noncommutative differential geometry</i> , University Research Fund (New Faculty), University of New Brunswick.
04/2017–03/2024	<i>Principal bundles in noncommutative differential geometry</i> , Discovery Grant, Natural Sciences and Engineering Research Council of Canada.
04/2014–03/2015	<i>Noncommutative Geometry Festival, April 30–May 3, 2014</i> (co-PI with Guoliang Yu, lead co-PI, and Zhizhang Xie, co-PI), Standard Grant (Conferences and Workshops in the Mathematical Sciences), National Science Foundation.
07/2013–06/2015	<i>AMS–Simons Travel Grant</i> , American Mathematical Society.
05/2013	<i>Apostol Award for Excellence in Teaching</i> , Mathematics Option, California Institute of Technology.
01/2013	<i>Graduate Student Travel Grant</i> for attendance at the 2013 Joint Mathematics Meetings, American Mathematical Society.
08/2012	<i>NSF Travel Grant</i> for attendance at the xviiiith International Congress on Mathematical Physics.

## Publications & Manuscripts

### PUBLICATIONS

1. Branimir Ćaćić, *Geometric foundations for classical  $U(1)$ -gauge theory on noncommutative manifolds*, Comm. Math. Phys. (85 pp.), in press.
2. Branimir Ćaćić and Bram Mesland, *Gauge theory on noncommutative Riemannian principal bundles*, Comm. Math. Phys. 388 (2021), 107–198.
3. Branimir Ćaćić, *A reconstruction theorem for Connes–Landi deformations of commutative spectral triples*, J. Geom. Phys. 98 (2015), 82–109.
4. Branimir Ćaćić, Matilde Marcolli, and Kevin Teh, *Coupling of gravity to matter, spectral action and cosmic topology*, J. Noncommut. Geom. 8 (2014), no. 2, 473–504.
5. Branimir Ćaćić, *Real structures on almost-commutative spectral triples*, Lett. Math. Phys. 103 (2013), no. 7, 793–816.
6. Branimir Ćaćić, *A reconstruction theorem for almost-commutative spectral triples*, Lett. Math. Phys. 100 (2012), no. 2, 181–202.
7. Branimir Ćaćić, *Moduli spaces of Dirac operators for finite spectral triples*, in *Quantum groups and noncommutative spaces: perspectives on quantum geometry*, eds. M. Marcolli and D. Parashar, Vieweg Verlag, 2011, 9–68.

## MANUSCRIPTS

1. Branimir Ćaćić and Timmavajjula Venkata Karthik, *Maxwell's equations in vacuo on noncommutative Riemannian manifolds*, in preparation.
2. Branimir Ćaćić and Gaia Noseworthy, *The noncommutative Riemannian geometry of fuzzy tori*, in preparation.
3. Branimir Ćaćić, *Classical gauge theory on quantum principal bundles*, arXiv:2108.13789 [math-ph] (85 pp.), under revision.

## Invited Talks

### CONFERENCE TALKS

- 12/2023 *Quantum principle  $U(1)$ -bundles: differential, Riemannian, and metric geometry*, Workshop on Noncommutative Geometry and its Applications, Fields Institute.
- 05/2023 *Quantum principle  $U(1)$ -bundles: differential, Riemannian, and metric geometry*, 51<sup>st</sup> Canadian Annual Symposium on Operator Algebras and Their Applications, University of Western Ontario.
- 06/2020 *Principal bundles in noncommutative Riemannian geometry*, Zagreb Workshop on Operator Theory, University of Zagreb; online.
- 09/2019 *Principal bundles in noncommutative Riemannian geometry*, Quantum Flag Manifolds in Prague, Charles University.
- 08/2019 *Gauge theory on noncommutative Riemannian principal bundles*, Workshop on New Geometry of Quantum Dynamics, Fields Institute.
- 08/2017 *Spectral triples for discrete groups*, MCA 2017 Satellite Conference on Operator Algebras, Fields Institute.
- 06/2017 *Riemannian principal bundles in unbounded  $KK$ -theory*, Workshop on Analysis, Noncommutative Geometry, and Operator Algebras, Department of Mathematical Sciences, Chalmers University of Technology–University of Gothenburg.
- 10/2016 *Spectral triples for discrete groups*, Conference on Noncommutative Index Theory, Stefan Banach International Mathematical Centre.
- 09/2015 *Good quotients of noncommutative Riemannian manifolds*, Wabash Modern Analysis Miniconference, Indiana University–Purdue University Indianapolis.
- 07/2015 *Principal bundles in unbounded  $KK$ -theory*, Workshop on Noncommutative Geometry and Spectral Invariants, Université de Québec à Montréal.
- 03/2015 *Splitting homomorphisms in strict deformation quantisation*, Workshop on the Geometry of Noncommutative Manifolds, Fields Institute.
- 09/2014 *A reconstruction theorem for Connes–Landi deformations of commutative spectral triples*, Workshop on Quantum Physics and Noncommutative Geometry, Hausdorff Research Institute for Mathematics.
- 06/2013 *A reconstruction theorem for toric noncommutative manifolds*, Conference on Noncommutative Geometry and Quantum Groups (in honour of Marc Rieffel), Fields Institute.
- 10/2012 *Reconstruction theorems in noncommutative Riemannian geometry*, West Coast Operator Algebra Seminar 2012, University of Oregon.

07/2012 *A reconstruction theorem for (real) almost-commutative spectral triples*, Final Workshop, ESI Programme on K-Theory and Quantum Fields, Erwin Schrödinger Institute.

#### SEMINAR TALKS

04/2024 *Quantum principal  $U(1)$ -bundles: analysis and synthesis*, Seminar on Cartan Geometry, Noncommutative Geometry, and Quantum Groups, University of Bologna; online.

03/2022 *Differentiable Cuntz–Pimsner constructions for Hermitian line modules with connection*, Noncommutative Geometry and Topology Seminar, Charles University and Institute of Mathematics of the Czech Academy of Sciences; online.

11/2021 *Classical gauge theory on quantum principal bundles*, Quantum Field Theory Seminar, Mathematical Institute, University of Oxford; online.

10/2021 *Classical gauge theory on quantum principal bundles*, Global NCG Seminar (Europe); online.

01/2021 *Building blocks for gauge theory on quantum principal bundles*, Noncommutative Geometry and Topology Seminar, Charles University and Institute of Mathematics of the Czech Academy of Sciences; online.

05/2020 *Gauge theory on quantum principal bundles*, NYC Noncommutative Geometry Seminar, St. John’s University; online.

11/2018 *Noncommutative principal bundles in unbounded  $KK$ -theory*, Thematic Programme on Bivariant  $K$ -Theory in Geometry and Physics, Erwin Schrödinger International Institute for Mathematics and Physics.

03/2016 *Spectral triples for discrete groups*, Analysis Seminar, Department of Mathematics, University of Houston.

12/2015 *Sketches of noncommutative geometry*, Functional Analysis Seminar, Department of Mathematics, University of Zagreb.

11/2015 *Good quotients of spectral triples*, Noncommutative Geometry Seminar, Mathematics Option, California Institute of Technology.

10/2015 *Good quotients of noncommutative manifolds*, Colloquium, Department of Mathematics, Washington University in St. Louis.

07/2015 *Principal bundles in unbounded  $KK$ -theory*, Oberseminar Analysis und Theoretische Physik, Institut für Angewandte Mathematik, Gottfried Wilhelm Leibniz Universität Hannover.

12/2014 *A reconstruction theorem for Connes–Landi deformations of commutative spectral triples*, Operator Algebras Seminar, Institut de Mathématiques de Jussieu.

10/2014 *A reconstruction theorem for Connes–Landi deformations of commutative spectral triples*, Operator Algebras Seminar, Department of Mathematical Sciences, Norwegian University of Science and Technology.

06/2014 *An introduction to strict deformation quantisation, A reconstruction theorem for noncommutative  $G$ -manifolds*, Noncommutative Geometry Seminar, Department of Mathematics, University of Western Ontario.

03/2014 *Twisted group algebras and strict deformation quantisation*, Noncommutative Geometry Seminar, Mathematics Option, California Institute of Technology.

## *Mentoring & Thesis Supervision*

### POSTDOCTORAL SCHOLARS

05/2017–04/2018 Fereshteh Yazdani (co-mentored with Bahram Rangipour), Department of Mathematics and Statistics, University of New Brunswick, Fredericton.

### DOCTORAL STUDENTS

01/2022– Derrick Kirby (co-supervised with Nicholas Touikan).

09/2018– Timmavajjula Venkata Karthik.

01/2018–09/2019 Yavar Abdolmaleki (co-supervised with Dan Kučerovský).

### MASTERS STUDENTS SUPERVISED

09/2020– Cole Dunphy (co-supervised with Nicholas Touikan).

### HONOURS STUDENTS SUPERVISED

09/2023–04/2024 Jaden Monk, *The Theorema Egregium and surfaces of constant Gaussian curvature.*

01/2019–12/2019 Justin Furlotte, *Topology, measure theory, and analysis on fractals.*

### NSERC USRA RECIPIENTS

05/2022–08/2022 Gaia Noseworthy, *Geodesics in noncommutative Riemannian geometry.*

05/2021–08/2021 Gaia Noseworthy, *Geodesics in noncommutative Riemannian geometry.*

05/2019–08/2019 Benjamin Chase (co-mentored with Eddy Campbell), *Vector invariants of permutation groups.*

05/2018–08/2018 Benjamin Chase (co-mentored with Eddy Campbell and Jianjun Chuai), *Vector invariants of permutation groups.*

## *Teaching*

### DEPARTMENT OF MATHEMATICS & STATISTICS, UNIVERSITY OF NEW BRUNSWICK

Winter 2023 MATH 1013, *Introduction to Calculus ii* (course coordinator);  
MATH 2013, *Intermediate Mathematics ii.*

Fall 2023 MATH 3103, *Analysis i.*

Winter 2023 MATH 1013, *Introduction to Calculus ii*;  
MATH 2013, *Intermediate Mathematics ii.*

Fall 2021 MATH 3213, *Linear Algebra ii*;  
MATH 3243, *Complex Analysis.*

Winter 2021 MATH 3113, *Analysis ii.*

Fall 2020 MATH 3213, *Linear Algebra ii*;  
MATH 6151, *Advanced Topology.*

Winter 2020 MATH 4153/6153, *Topology.*

Fall 2019	MATH 2003, <i>Intermediate Mathematics i</i> ; MATH 3103, <i>Analysis i</i> .
Winter 2019	MATH 3063, <i>Geometry</i> .
Fall 2018	MATH 2513, <i>Multivariable Calculus for Engineers</i> ; MATH 4473/6473, <i>Introduction to Differential Geometry</i> .
Winter 2018	MATH 2513, <i>Multivariable Calculus for Engineers</i> .
Fall 2017	MATH 1503, <i>Introduction to Linear Algebra</i> ; MATH 3243, <i>Complex Analysis</i> .
Winter 2017	MATH 1063, <i>Enriched Calculus ii</i> ; MATH 2513, <i>Multivariable Calculus for Engineers</i> .
Fall 2016	MATH 3243, <i>Complex Analysis</i> .

DEPARTMENT OF MATHEMATICS, TEXAS A&M UNIVERSITY

Spring 2016	MATH 311, <i>Topics in Applied Mathematics i</i> .
Fall 2015	MATH 304, <i>Linear Algebra</i> (2 sections).
Spring 2015	MATH 304, <i>Linear Algebra</i> (3 sections).
Spring 2014	MATH 251, <i>Engineering Mathematics iii</i> (2 sections).
Fall 2013	MATH 251, <i>Engineering Mathematics iii</i> .

### *Outreach & Professional Service*

OUTREACH TALKS

05/2019	<i>The Impossible Tribar</i> , UNB-CMS Spring Mathematics Camp, University of New Brunswick, Fredericton.
03/2019	<i>The Impossible Tribar</i> , UNB Mathematics Society, University of New Brunswick, Fredericton.
01/2019	<i>Alexander Grothendieck</i> , Fredericton Tertulias.
05/2018	<i>Gauß's Theorema Egregium</i> , AARMS-Girl Guides Camp "All SySTEMs Go", University of New Brunswick, Fredericton.
05/2018	<i>Gauß's Theorema Egregium</i> , UNB-CMS Spring Mathematics Camp, University of New Brunswick, Fredericton.
02/2017	<i>Noncommutativity for fun and profit</i> , UNB Mathematics Society, University of New Brunswick, Fredericton.
02/2016	<i>Noncommutative tori I have known</i> , Mathematics Graduate Student Organisation, Texas A&M University.

CONFERENCE & WORKSHOP ORGANISATION

06/2021	Co-organiser, <i>Session on Noncommutative Geometry and Mathematical Physics</i> , 2021 CMS Summer Meeting (online, postponed from 2020 because of COVID-19).
06/2020	Co-organiser, <i>Zagreb Workshop on Operator Theory</i> , University of Zagreb (online).

- 04/2019 Co-organiser, *2019 Inter-Campus Seminar Day*, Mathematics and Statistics GAU, University of New Brunswick.
- 06/2018 Co-organiser, *Session on Noncommutative Geometry and Topology*, 2018 CMS Summer Meeting, Fredericton, NB.
- 04/2014 Co-organiser, *Noncommutative Geometry Festival*, Department of Mathematics, Texas A&M University.

#### INSTITUTIONAL COLLABORATIONS

- 01/2023– UNB node coordinator, *Operator algebras that one can see* (PI: Piotr Hajac, IMPAN), Horizon MSCA Staff Exchange, European Research Council.

#### PEER REVIEW

- JOURNALS: Annales Henri Poincaré; Journal of Geometry and Physics; Journal of Operator Theory; Journal of Topology and Analysis; Mathematical Physics, Analysis, and Geometry; Münster Journal of Mathematics; Journal of Noncommutative Geometry.
- PROCEEDINGS: *Quanta of Maths*, eds. E. Blanchard, D. Ellwood, M. Khalkhali, M. Marcolli, H. Moscovici and S. Popa, Clay Math. Proc. 11, Amer. Math. Soc., 2010.

#### EXTERNAL SERVICE

- 11/2017–06/2018 Scientific Organising Committee, *2018 CMS Summer Meeting*, Canadian Mathematical Society.

### *University Service*

#### DEPARTMENTAL OF MATHEMATICS & STATISTICS

- 12/2017–04/2018 Search Committee (continuing position in algebra/combinatorics).
- 04/2018–05/2018 Department Chair Search Committee.
- 10/2019–12/2020 Search Committee (continuing position in data science).

#### FACULTY OF SCIENCE

- 07/2019–06/2020 Faculty Curriculum Committee (*sabbatical replacement*).
- 02/2020–06/2022 SCI 1001/1002 Review Committee.
- 01/2023– Priestman Lecture Committee.

#### FREDERICTON CAMPUS

- 07/2018– *Faculty of Science Representative*, Senate.
- 07/2018– Senate Library Committee.
- 07/2019–06/2021 Senate Nominating Committee (*alternate*).
- 11/2019–06/2020 Search Committee (Associate Dean of Engineering).
- 01/2020– Senate Review Committee.

07/2021–12/2021 Review Committee (Dean of Computer Science).

07/2023– Senate Nominating Committee (*primary*).

UNIVERSITY OF NEW BRUNSWICK

09/2019–04/2020 Fredericton Senate Representative, Dean of Libraries Review Advisory Committee.

01/2020–05/2020 Collective Bargaining Team (Full-Time Group), Association of University of New Brunswick Teachers.

03/2021–06/2021 Collective Bargaining Team (Full-Time Group), Association of University of New Brunswick Teachers.