

Stephen M. McCormick

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Education

PhD in Mathematics

Monash University, Australia

THESIS TITLE: THE PHASE SPACE FOR THE EINSTEIN-YANG-MILLS EQUATIONS, BLACK HOLE MECHANICS, AND A CONDITION FOR STATIONARITY

2014

• Supervisor: Professor Robert Bartnik

Bachelor of Science (Honours)

Monash University, Australia

SPECIALISATION: MATHEMATICS

2008

Bachelor of Science

Monash University, Australia

SPECIALISATION: MATHEMATICS & PHYSICS

2007

Academic appointments

Uppsala University

Uppsala, Sweden

RESEARCHER

December 2019 – Present

POSTDOCTORAL RESEARCH FELLOW

December 2017 – December 2019

KTH Royal Institute of Technology

Stockholm, Sweden

POSTDOCTORAL RESEARCH FELLOW

*August 2016 – December 2017**

University of New England

Armidale, Australia

POSTDOCTORAL FELLOW

*June 2014 – June 2017**

**Concurrent appointments at 50% for a period.*

Publications and preprints

- 20xx **Chen, P.-N.; McCormick, S.**, Quasi-local Penrose inequalities with electric charge, preprint arXiv:2002.04557.
- 20xx **Alaee, A.; Cabrera Pacheco, A. J.; McCormick, S.**, Stability of a quasi-local positive mass theorem for graphical hypersurfaces of Euclidean space, *Trans. Amer. Math. Soc.* (to appear), preprint available at arXiv:1911.12343.
- 2020 **McCormick, S.**, Gluing Bartnik extensions, continuity of the Bartnik mass, and the equivalence of definitions, *Pacific J. Math*, **304**(2).
- 2019 **McCormick, S.**, On the charged Riemannian Penrose inequality with charged matter, *Class. Quantum Gravity*, **37**(1).
- 2019 **McCormick, S.; Miao, P.**, On the evolution of the spacetime Bartnik mass, *Pure Appl. Math. Q.* **15**(3).
- 2019 **McCormick, S.; Miao, P.**, On a Penrose-like inequality in dimensions less than eight, *Int. Math. Res. Not.*, **2019**(7).
- 2018 **Cabrera Pacheco, A. J.; Cederbaum, C.; McCormick, S.**, Asymptotically hyperbolic extensions and an analogue of the Bartnik mass, *J. Geom. Phys.*, **132**.
- 2018 **McCormick, S.**, On a Minkowski-like inequality for asymptotically flat static manifolds, *Proc. Am. Math. Soc.*, **146**(9).
- 2017 **Cabrera Pacheco, A. J.; Cederbaum, C.; McCormick, S.; Miao, P.**, Asymptotically flat extensions of CMC Bartnik data, *Class. Quant. Grav.* **34**(10).
- 2017 **McCormick, S.**, The asymptotically flat scalar-flat Yamabe problem with boundary, *J. Geom. Anal.*, **27**(3).
- 2015 **McCormick, S.**, A note on mass-minimising extensions, *Gen. Rel. Grav.* **47**(12).
- 2014 **McCormick S.**, First Law of Black Hole Mechanics as a Condition for Stationarity, *Phys. Rev. D* **90**, 104034.
- 2014 **McCormick S.**, The Phase Space for the Einstein-Yang-Mills Equations and the First Law of Black Hole Thermodynamics, *Adv. Theor. Math. Phys.* **18**(4).

Competitive research funding

Funding under Australia-Germany Joint Research Cooperation Scheme

Universities Australia/DAAD

- PROJECT: ON BARTNIK'S QUASI-LOCAL MASS FUNCTIONAL
APPROXIMATE VALUE OF €12500; JOINTLY FUNDED WITH PROF. DR. CARLA CEDERBAUM (TÜBINGEN).

2016-2017

UNE Research Seed Grant

University of New England, Australia

- PROJECT: THE YAMABE PROBLEM OUTSIDE A BALL AND THE BARTNIK MASS
VALUE OF APPROX. €3300.

2015

Selected talks

Gluing collars to manifolds; how and why

Universität Freiburg

FHST MEETING ON GEOMETRY AND ANALYSIS

January 2020

Gluing collars to manifolds; how and why

Institut Mittag-Leffler, Sweden

GENERAL RELATIVITY, GEOMETRY, AND ANALYSIS: BEYOND THE FIRST 100 YEARS AFTER EINSTEIN

November 2019

Bartnik's quasi-local mass

CIMAT (Guanajuato), Mexico

MATHEMATICAL RELATIVITY: A RIEMANNIAN APPROACH

May 2019

Some recent developments on Bartnik's quasi-local mass

Queen Mary University of London, UK

INVITED SEMINAR

Mar. 2019

Some recent results pertaining to Bartnik's quasi-local mass

University of Miami, USA

INVITED SEMINAR

Oct. 2018

Asymptotically hyperbolic extensions and estimates for an analogue of the Bartnik mass

Banff International Research Station, Canada

WORKSHOP ON ASYMPTOTICALLY HYPERBOLIC MANIFOLDS

May 2018

A Penrose-like inequality in dimensions less than eight

University of Sydney, Australia

INTERNATIONAL CONFERENCE ON PDES, GEOMETRIC ANALYSIS AND FUNCTIONAL INEQUALITIES

Mar. 2017

The first law of black hole mechanics as a condition for stationarity and staticity

Universität Tübingen, Germany

STATIC METRICS AND BARTNIK'S QUASI-LOCAL MASS CONJECTURE. (CONFERENCE)

May. 2016

Killing vectors as Lagrange multipliers

Monash University, Australia

WORKSHOP ON ANALYSIS, GEOMETRY AND MATHEMATICAL RELATIVITY:
A CELEBRATION OF ROBERT BARTNIK'S 60TH BIRTHDAY

Feb. 2016

The Phase Space for the Einstein-Yang-Mills Equations,

Universität Regensburg, Germany

INVITED SEMINAR

Oct. 2015

The First Law of Black Hole Mechanics as a Condition for Stationarity

ICMAT, Spain

INVITED SEMINAR

Oct. 2015

The Phase Space for the Einstein-Yang-Mills Equations and the First Law of Black Hole Thermodynamics

University of New England, Australia

MINI-WORKSHOP ON NONLINEAR PDES

Oct. 2014

The Phase Space for the Einstein-Yang-Mills Equations and the First Law of Black Hole Thermodynamics

University of Wollongong, Australia

INVITED SEMINAR

Sep. 2014

Research programs

Institut Mittag-Leffler

GENERAL RELATIVITY, GEOMETRY, AND ANALYSIS: BEYOND THE FIRST 100 YEARS AFTER EINSTEIN

Djursholm, Sweden

Sep. - Dec. 2019

Erwin Schrödinger Institute

GEOMETRY AND RELATIVITY PROGRAM

Vienna, Austria

Jul. - Aug. 2017

Institut Henri Poincaré

MATHEMATICAL GENERAL RELATIVITY PROGRAM

Paris, France

Sep. - Nov. 2015

Mathematical Sciences Research Institute (MSRI)

MATHEMATICAL GENERAL RELATIVITY PROGRAM

Berkeley, USA

Nov. 2013

Teaching experience

Postdoctoral Research Fellow

- THIS FELLOWSHIP COMES WITH A STANDARD 20% TEACHING LOAD, INCLUDING EXERCISE SESSIONS, LECTURES AND RESPONSIBILITY FOR COURSES.

Uppsala universitet, Sweden

2017 - Present

Postdoctoral Research Fellow

- THIS POSITION INCLUDED LECTURING AND COORDINATING SEVERAL COURES, INCLUDING DISCRETE MATHEMATICS, DIFFERENTIAL EQUATIONS AND A LARGE SERVICE COURSE.

University of New England, Australia

2014 - 2017

Sessional Lecturer

- PRIMARY DUTY WAS TEACHING THE FIRST HALF OF A VERY LARGE INTRODUCTORY CALCULUS/ANALYSIS COURSE.

Monash University, Australia

2014

Teaching Associate

- DUTIES INCLUDED TEACHING EXERCISE SESSIONS, GRADING ASSIGNMENTS AND EXAMS, AND OCCASIONALLY COVERING LECTURES, FOR ALL UNDERGRADUATE LEVELS OF MATHEMATICS. IN ADDITION, I WAS REGULARLY ONE OF THE STAFF MEMBERS RESPONSIBLE FOR DROP-IN HELP SESSIONS, AVAILABLE FOR ALL STUDENTS TAKING MATHEMATICS COURSES.

Monash University, Australia

2008 - 2014

Laboratory Demonstrator

- TEACHING PHYSICS LABORATORY CLASSES TO NON-PHYSICS MAJORS

Monash University, Australia

2007

Service/other

Outreach

Interview for Cosmos Magazine and associated video

(PROMOTIONAL PIECE FOR UNE)

<https://goo.gl/DKH56c>

2016

Talk - Complicated ideas in less than 140 characters

PART OF A SERIES TO GET STAFF AT UNE INVOLVED IN SCIENCE COMMUNICATION

<https://goo.gl/8wkWHU>

2016

Presenter for Far Out Science at UNE

A PROGRAM FOR SCHOOL KIDS OF VARIED AGES TO TO BE INTRODUCED TO FUN SCIENCE (AND MATH)

<https://goo.gl/8mfQe6>

2015-2016

Multiple radio interviews

I WAS INTERVIEWED ON ABC RN TAMWORTH (NEW ENGLAND RADIO) ON A FEW OCCASIONS TO SPEAK ABOUT MATHEMATICS, PHYSICS AND SCIENCE COMMUNICATION.

2015-2016

Presenter for the Science Experience at Monash University

A PROGRAM FOR SECONDARY SCHOOL KIDS TO BE INTRODUCED TO FUN SCIENCE (AND MATH)

<https://goo.gl/kNRJnH>

2012-2014

Casual Calculations

A (NOW OUTDATED) BLOG AIMED AT PRESENTING TOPICS RELATED TO MATHEMATICS AND MATHEMATICS EDUCATION TO THE AVERAGE INTERESTED READER

<https://goo.gl/4P12GM>

2013-2014

Elected positions

Jul. 2010 – **Faculty of Science Postgraduate Committee**, Representative for the School of Mathematical Sciences, Monash University
Mar 2014
2011 – 2012 **Council of the Australian Mathematical Society**, Student observer (non-voting member)

Conference organisation

Oct. 2014 **Mini-Workshop on Nonlinear PDEs**,
Jul. 2013 **2nd Annual Australian Mathematical Sciences Students' Conference**,
Jul. 2011 **Inaugural Australian Mathematical Sciences Students' Conference***,
Lead organiser

**The Australian Mathematical Sciences Students' Conference has now become a regular event.*
Website: www.amssc.org/

Conferences & workshops (Since 2014)

Jun. 2019 **Geometric Analysis and General Relativity: A conference in honour of Gerhard Huisken's 60th birthday**, ETH Zürich, Switzerland
May 2019 **Mathematical Relativity: A Riemannian Approach**, CIMAT (Guanajuato), Mexico
Aug. 2018 **Mathematical General Relativity**, Mathematisches Forschungsinstitut Oberwolfach, Germany
May. 2018 **Asymptotically Hyperbolic Manifolds**, Banff International Research Station, Canada
Apr. 2018 **Mass in General Relativity**, Simons Center for Geometry and Physics, NY, USA
Jul. 2017 **Between Geometry and Relativity**, Erwin Schrödinger Institute, Vienna, Austria
Mar. 2017 **International Conference on PDEs, Geometric Analysis and Functional Inequalities**, University of Sydney, Australia
May 2016 **Static metrics and Bartnik's quasi-local mass conjecture**, Universität Tübingen, Germany
Feb. 2016 **Workshop on Analysis, Geometry and Mathematical Relativity: a celebration of Robert Bartnik's 60th birthday**, Monash University, Australia
Nov. 2015 **General Relativity: A Celebration of the 100th Anniversary**, Institute Henri Poincaré, France
Oct. 2015 **Dynamics of Self-Gravitating Matter**, Institute Henri Poincaré, France
Sep. 2015 **Geometric Aspects of Mathematical Relativity**, Université de Montpellier, France
Sep. 2015 **Recent Advances in General Relativity**, Institute Henri Poincaré, France
Mar. 2015 **Andrejewski Days: 100 years of General Relativity**, Brandenburg an der Havel, Germany
Oct. 2014 **Mini-Workshop on Nonlinear PDEs**, University of New England, Australia
Sep. 2014 **Mini-Workshop on Geometric Analysis**, University of Wollongong, Australia
Jul. 2014 **AMSI/AustMS Conference on Geometric Analysis and Stochastic Methods in Geometry**, University of Queensland, Australia

Languages

English: Native.

Swedish: Good working knowledge. CEFR level: B1*

German: Elementary communication and reading. Estimated CEFR level: A1/A2

*Based on the completion of the course *Swedish for Academics 3* at Uppsala University.