

# Mark Bugden

## Curriculum Vitae

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Mathematical Sciences Institute

Australian National University

Canberra ACT 0200, Australia

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## Education

**Doctor of Philosophy**, [Finalising Revisions]

Mathematical Sciences Institute, Australian National University

Thesis Title: *A Tour of T-duality - Geometric and Topological Aspects of T-dualities*

**Bachelor of Mathematics Advanced (Honours)**, Completed 2013

School of Mathematics and Applied Statistics, University of Wollongong

- Honours Class I

Thesis Title: *KMS States in Quantum Statistical Mechanics*

**Bachelor of Science (Physics)**, Completed 2012

School of Physics, University of Wollongong

- With Distinction

Minor in International Studies

**Bachelor of Mathematics**, Completed 2012

School of Mathematics and Applied Statistics, University of Wollongong

- With Distinction

## Publications

**P. Bouwknegt, M. Bugden, C. Klimčik, K. Wright,**

*Hidden Isometry of "T-duality without isometry".*

J. High Energy. Phys. 08 (2017) 116. [arXiv: 1705.09254 [hep-th]]

**M. Bugden,**

*Spherical Photon Orbits around a 5D Myers-Perry Black Hole.*

Gen. Relativ. Gravit. (2018) 50:30, [arXiv: 1801.03389 [gr-qc]]

**M. Bugden, C. Paganini,**

*The  $\Lambda$  to Zero Limit of Spacetimes and its Physical Interpretation.*

Class. Quant. Grav. 36 (2019), [arXiv: 1810.00436 [gr-qc]]

**M. Bugden,**

*Non-abelian T-folds*

[arXiv: 1901.03782 [hep-th]]

## Travel Grants/Awards

- **Australian Mathematical Society** Liftoff Fellowship: \$4000 AUD
- **AMSI Winter School 2018:** Winner of Participant Talks  
*Talk Title: Light orbiting a five-dimensional black hole*
- **Australian National University** Vice-Chancellor's HDR Travel Grant: \$1300 AUD
- **Australian Academy of Science** Heidelberg Laureate Forum Travel Grant: \$1500 AUD
- **COST MP1210 The String Theory Universe** Travel Grant: \$3290 AUD
- **Institut Henri Poincaré** Mathematical General Relativity Trimester visitor: €1000
- **Institut Henri Poincaré** Mathematics of String Theory Trimester visitor: €1000
- **Australian Mathematical Sciences Institute:** Various local workshops and conferences
- **Australian Mathematical Society:** Various local summer schools and conferences

## Conferences/Workshops/Schools attended

### 2019

- ANZAMP 2019 (*Merimbula, Australia*)  
*Talk Title: Spherical Photon Orbits in Five Dimensions*

### 2018

- String and M-theory: The New Geometry of the 21st Century (*Singapore, Singapore*)
- Australian Mathematical Sciences Institute Winter School on Curvature (*Brisbane, Australia*)  
*Talk Title: Light orbiting a five-dimensional black hole*
- Higher Structures in M-theory: LMS/EPSRC Durham Symposium (*Durham, England*)
- 18th Hellenic School and Workshops on Elementary Particle Physics and Gravity: Dualities and Generalized Geometries (*Corfu, Greece*)  
*Talk Title: Attempts to invert non-abelian T-duality: a gauging approach*

### 2017

- Australian Mathematical Sciences Student Conference (*Wollongong, Australia*)  
*Talk Title: Photon Spheres Around Higher Dimensional Black Holes*
- String Geometries and Dualities (*Adelaide, Australia*)  
*Talk Title: Comments on non-isometric T-duality*
- Recent Advances in T/U-Dualities and Generalised Geometries (*Zagreb, Croatia*)  
*Talk Title: Comments on non-isometric T-duality*
- Gauge Theories, Supergravity, and Superstrings (*Benasque, Spain*)
- ANZAMP 2017 (*Kiama, Australia*)  
*Talk Title: It's T-duality, but not as we know it*

### 2016

- AUSTMS 2016 (*Canberra, Australia*)  
*Talk Title: It's T-duality, but not as we know it*
- Low-Dimensional Topology and Quantum Algebra (*Canberra, Australia*)
- W.E. Heraeus Summer School on "Foundations and New Methods in Theoretical Physics" (*Thüringen, Germany*)
- 4th Heidelberg Laureate Forum (*Heidelberg, Germany*)
- Oberwolfach Workshop on Singularities (*Oberwolfach, Germany*)
- Second Workshop on String Theory and Gender (*Paris, France*)
- Cargèse Summer School on Quantum Gravity, Cosmology and Particle Physics (*Cargèse, France*)

- String-Math 2016 (*Paris, France*)

## 2015

- Introduction to Mathematical General Relativity (*Paris, France*)
- Recent Advances in General Relativity (*Paris, France*)
- Geometric Aspects of Mathematical Relativity (*Montpellier, France*)
- Dynamics of Self-Gravitating Matter (*Paris, France*)
- General Relativity - A Celebration of the 100th Anniversary (*Paris, France*)
- The Mathematics of Conformal Field Theory (*Canberra, Australia*)
- Symmetries and Spinors: Interactions between Geometry and Physics (*Adelaide, Australia*)
- Geometric Quantisation (*Adelaide, Australia*)
- AMSI/AUSTMS Winter School (*Brisbane, Australia*)

*Talk Title: A Tour of T-Duality*

- AMSI/AUSTMS Summer School (*Canberra, Australia*)
- Australian Mathematical Sciences Student Conference (*Hobart, Australia*)

*Talk Title: Photon Spheres Around Higher Dimensional Black Holes*

## 2014

- AustMS/NZMS 2014 (*Melbourne, Australia*)

*Talk Title: T-duality for Higher Rank Torus Bundles, Revisited*

- Australian Mathematical Sciences Student Conference (*Newcastle, Australia*)

*Talk Title: T-duality in String Theory*

## 2013

- Australian Mathematical Sciences Student Conference (*Canberra, Australia*)

## Research Interests

### String Theory and M-theory

- Geometry and topology of T-dualities
- Noncommutative and nonassociative geometry in string theory
- Generalized geometry and exceptional geometry
- Supergravity and string compactifications
- Higher structures and M-theory

### Mathematical Aspects of General Relativity

- Limits of spacetimes
- Black holes in higher dimensions
- Photon spheres
- Solution generating techniques in general relativity

### Knot Theory

- Wild and non-compact knot theory
- Applications to statistical mechanics and quantum field theory

## Teaching Experience

### **Australian National University**

#### **Mathematical Sciences Institute**

Tutor: Math2222 - Problem Solving and Proofs, Autumn 2018

Tutor: 2nd/3rd Year Mathematics Drop-in Sessions, Autumn 2018

Tutor: Math1005 - Discrete Mathematical Models, Autumn 2018

Tutor: Math2242 - Introduction to Geometry, Spring 2017

Guest Lecture: Math2242 - Fractiling the Euclidean Plane; Aperiodic Tilings and Fractal Duals

Tutor: Math2222 – Problem Solving and Proofs, Autumn 2017

Tutor: Math1116 – Mathematics and Applications 2 – Honours, Spring 2016

Tutor: First Year Mathematics Drop-in Sessions, Spring 2016

Tutor: Math1115 – Mathematics and Applications 1 – Honours, Autumn 2016

Tutor: First Year Mathematics Drop-in Sessions, Autumn 2016

Tutor: Math1115 – Mathematics and Applications 1 – Honours, Autumn 2015

Tutor: Math1116 – Mathematics and Applications 2 – Honours, Spring 2014

Tutor: Math2320 – Analysis 1: Metric Spaces and Applications, Autumn 2014

### **University of Wollongong**

#### **School of Mathematics and Applied Statistics**

Tutor: Math202 – Differential Equations 2, Spring 2013

Tutor: Math111 – Applied Mathematical Modelling 1, Spring 2013

Tutor: Math203 – Linear Algebra, Autumn 2013

Tutor: Math010 – Enabling Mathematics for Engineers, Autumn 2013

Tutor: Math111 – Applied Mathematical Modelling 1, Spring 2012

Tutor: Math302 – Differential Equations 3, Autumn 2012

Tutor: Math151 – General Mathematics 1A, Autumn 2012

Tutor: Math151 – General Mathematics 1A, Autumn 2011

### **University of Wollongong**

#### **University College**

Lecturer/Tutor/Coordinator: FSPW116 – Mathematics 1, Spring 2013

Lecturer/Tutor: UAP004 – Mathematics and Statistics, Spring 2013

Lecturer/Tutor/Coordinator: FSPW116 – Mathematics 1, Autumn 2013

Tutor: FSPW118 – Foundations in Mathematics, Spring 2012

## Outreach

[Shirty Science](#) - A collaborative art project. Design based on my research on photon spheres.

[Physics at the Pub](#) - Public talks on physics.

[3 Minute Thesis](#) - Describing your thesis to a general audience, in just 3 minutes.

[Vigorous Handwaving](#) - A shared math and physics blog aimed at graduate students.

[Joules Per Second](#) - A math and physics blog for a general audience.

## References

### **Professor Peter Bouwknecht**

*PhD supervisor and Director*

Mathematical Sciences Institute

Australian National University

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Email: [peter.bouwknecht@anu.edu.au](mailto:peter.bouwknecht@anu.edu.au)

### **Professor Ctirad Klimčik**

*Professor*

Institut de Mathématiques de Luminy

Aix Marseille Université

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### **Dr David Ridout**

*Senior Lecturer*

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School of Mathematics and Statistics

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