Paul Druce

PERSONAL DETAILS

Address   21 East Glade Road,
Sheffield,
S12 4QR

Mobile   (+44) 07412503253,
Email   pjdruce@gmail.com

EDUCATION

PhD in Mathematical Physics, *School of Mathematical Sciences, University of Nottingham*   2015 — 2020
Thesis Title: Spectral Geometry of Fuzzy Spaces   *Supervisor: Prof. John Barrett*

BSc MMathPhys (Mathematics and Physics) — First Class, *University of Warwick*   2011 — 2015
Masters Project Title: Multiferroicity Emerging from Frustrated Spin Interactions
Supervisors: Prof. J Staunton and Dr. J Lloyd-Hughes

Year 1: 69.3%,   Year 2: 82.8%,   Year 3: 82.9%,   Year 4: 83.0%   Overall grade: 81.6%

A Levels: *King Edward VII School, Sheffield, UK: A^* A A*   2009 — 2011

GCSE: *King GCSEs, Birley Community College, Sheffield, UK: 9 A's, 2 B's and one C.*   2004 — 2009

PROFESSIONAL EXPERIENCE

— *Academic Tutor, self employed at MyTutor*   Aug 2017 - Current
— *Postgraduate Demonstrator at the University of Nottingham*   Sep 2015 - Jul 2019
— *Open Day Assistant at the University of Warwick*   Sep 2012 - Jul 2015
— *Administrative Worker at Split The Bills Ltd.*   Aug-Sep 2012
— *Warehouse Operative at River Island*   2010-2011
— *Voluntary Sale Assistant at British Heart Foundation*   2010-2011

Skills

— Experienced using LaTex (including TikZ and beamer) and the Microsoft Office suite.
— High performance computing in C
— Data analysis in Python and Mathematica
— Experience using Linux, macOS and Windows environments.
— Experienced using Git and Github/Bitbuckets for collaborative development.
— Basic knowledge of web development; HTML/CSS.
— Internet of Things development using ESP8266/ESP32 and other devicesi.e. Arduino framework, ESP-IDF framework, micropython as well as how to use PlatformIO.

I have a valid First Aid Certificate (2017-2020) and an Enhanced DBS check (2017-2020). I also have a full drivers licence and motorcycle licence.

ACADEMIC ACTIVITIES

Research Interests

My research interests span a wide area within Mathematical Physics. I am deeply interested in the mathematical description of the universe with emphasis on the precise nature of spacetime. With my recent work investigating the use of noncommutative geometry to model spacetimes with a high energy cutoff. I also interested in any novel use of mathematics in physical situations, such as the use of topology and algebraic methods in condensed matter studies.

Outreach

I am an enthusiastic advocate for mathematics and science. I was on the organisational committee for the international festival Pint of Science 2019. I helped organise the Nottingham branch where academics from the University of Nottingham go to the pubs of Nottingham to explain their current research to the public in an understandable manner. I am always looking for ways to bring mathematics and science out of the universities and into public view.

Research Projects

PhD Research Project - Spectral Geometry of Fuzzy Spaces   2015-2019

> *Keywords:* Noncommutative geometry, Monte Carlo simulations, spectral geometry, quantum gravity, symmetries in physics

My PhD research was concerned with the use of finite noncommutative geometries as candidates for quantum spacetimes. These so-called 'fuzzy spaces' possess an energy cutoff whilst retaining Lie group symmetries. My PhD research was to investigate the dimension and volume of these spaces by analysing the spectrum of the Dirac operator. I also investigated the role of Lie group symmetries in restricting the possible fuzzy spaces possible.

Masters Research Project - Multiferroicity Emerging from Frustrated Spin Interactions   2014-2015

> *Keywords:* Solid-state physics, Theoretical physics, mathematical modelling, frustrated systems, quantum mechanics.

During the Masters' year of my undergraduate degree, I undertook a research project, supervised by Prof. J. Staunton and Dr. J Lloyd-Hughes, in which we investigated the various spin configurations of materials with a multiferroic phase. We aimed to identify what was special about these materials spin configurations that caused them to possess a multiferroic phase. This project was conducted with the aim of aiding the design of high temperature multiferroic devices. We specifically studied Cupric Oxide (CuO) which has a multiferroic phase between 213K and 230K, primarily by using mean field model. This project resulted in a functional model which predicted a multiferroic phase at a temperature which is in reasonable agreement with the experimental values.

Undergraduate Summer Research - Knotted Nematics   August 2014-September 2014

> *Keywords:* Condensed Matter, Mathematical Physics, Liquid Crystals, statistical physics

This was funded under the Undergraduate Research Scholarship Scheme and was supervised under G P Alexander at The University of Warwick. The main aim of this research was to develop a construction for describing knotted liquid crystals, specifically knotted nematics. We improved upon existing ideas that used Milnor's Fibration Theorem and developed a method to construct the necessary complex polynomial for Milnor's theorem, for a given knot.

Publications

- *Spectral estimators for finite non-commutative geometries.* Barrett, J., Druce, P., Glaser, L.: J Phys Math Theor. 52, 275203 (2019). doi:10.1088/1751-8121/ab22f8

Grants and Awards

- *Non-commutative Geometry and Quantum Gravity* EPSRC Studentship, funding my PhD studies, hosted by the University of Nottingham (September 2015 - September 2018)
- *Knotted Nematics* - funded as an Undergraduate Research Scholarship Scheme by the University of Warwick, and supervised by Dr G. P. Alexander (August-September 2014).

Talks

— *Noncommutative Geometry and Gravity Models* - given at Collabor8.2 meeting at Lancaster University, UK, May 2018

— *Fuzzy Geometries and Spectral Zeta Functions*- Invited by Lisa Glaser at Radboud University, Netherlands, April 2017

— *Algebraic Knots and Liquid Crystals* - given at the Warwick Imperial Autumn Meeting, 2014 (University of Warwick, UK, November 2014)

— Poster presented at Quantum Gravity on the Computer conference March 2018.

Conferences Attended

— Gauge Theories and Noncommutative Geometry - Nijmegen, April 2016, `http://www.noncommutativegeometry.nl/ncg2016/`

— Quantum Structure of Spacetime - Belgrade, August 2016, `http://qssg16.ipb.ac.rs/`

— Quantum Spacetime - Porto, January 2017, `https://www.fc.up.pt/quantumspacetime17/`

— Talking Maths in Public - Bath, September 2017, `http://talkingmathsinpublic.uk/`

— Quantum Spacetime and Physics Models - Corfu, September 2017, `http://www.physics.ntua.gr/corfu2017/qg.html`

— Quantum Structure of Spacetime - Sofia, February 2018, `http://theo2.inrne.bas.bg/~dobrev/QST-18.htm`

— Quantum Gravity on the Computer - Stockholm, March 2018, `https://agenda.albanova.se/conferenceDisplay.py?confId=6242`

— Collabor8.2 - Lancaster, May 2018, `http://www.collabor8research.com/`

— Physical Applications of Fuzzy Spaces - Brussels, January 2019

Teaching

— *GCSE and A Level Tutoring*	Aug 2017 - Current
— *PhD Demonstrating and Marking*	Oct 2015 - Jul 2019
— *Seminar Series for Master Students*	Oct 2016 - Apr 2017
— *Undergraduate Revision Classes*	2012-2015

Miscellaneous

PhD Reading Groups: I have participated in and co-organised many reading groups on topics including Loop Quantum Gravity, Characteristic Classes and C* algebras.

REFERENCES

Prof. John Barrett
University of Nottingham
John.Barrett@nottingham.ac.uk

Dr. Alexander Schenkel
University of Nottingham
alexander.schenkel@nottingham.ac.uk

Dr. Gareth Alexander
University of Warwick
G.P.Alexander@warwick.ac.uk