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Dr Rachel Nicks MMath, PhD

Lecturer in Mathematics

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About

Rachel Nicks is a Lecturer in the School of Mathematics and a member of the Applied Mathematics research group.

Her research involves the application of Lie group theory to study symmetry in nonlinear dynamical systems and in models of crystals with defects.

She is interested in using dynamical systems theory and symmetric bifurcation theory to develop new methods for studying the dynamics of networks including neural networks.

Rachel's research has been published in significant international journals and she has presented her research at conferences in Europe and USA.

Qualifications

- PhD in Nonlinear Dynamics, University of Nottingham, 2010
- MMath in Mathematics, University of Warwick, 2006

Biography

Rachel Nicks graduated with a first class MMath in Mathematics from the University of Warwick in 2006. She went on to complete her PhD thesis "Bifurcations with spherical symmetry" at the University of Nottingham under the supervision of Dr Paul Matthews and Dr Stephen Cox, graduating in 2010.

From December 2009 to the end of 2012 she was employed as a research fellow in the School of Mathematical Sciences at the University of Nottingham. She worked on the EPSRC funded project "Modelling continuous and discrete defective crystals" in collaboration with Dr Gareth Parry.

Rachel joined the School of Mathematics at Birmingham as a Lecturer in January 2013. She is now investigating new techniques for studying the dynamics of networks of nonlinear oscillators, in particular, neural networks.

Teaching

Teaching Programmes

- Single Honours Mathematics (G100, G103, G141)
- Mathematics Majors: Mathematics with Business Management (G1N2); Mathematics with Engineering (J920); Mathematics with Philosphy (G1V5)
- Joint Honours Mathematics: Mathematics & Computer Science (GG14); Pure Mathematics & Computer Science (GGC4); Mathematics & Sport Science (GC17); Mathematics & Music (GW13); Mathematics & Philosophy (GV15)
- Theoretical Physics and Applied Mathematics (FG31)
- Mathematics Minors: French Studies and Mathematics (GR11); German Studies and Mathematics (GR12); Natural Sciences (CFG0, FCG0)

Postgraduate supervision

Rachel would be interested in supervising research students in nonlinear dynamics, symmetric bifurcation theory or related areas.

Research

Research themes

- Nonlinear dynamics
- Dynamical systems with symmetry
- Network dynamics (including neural networks)
- Pattern formation
- Symmetries of solid crystals with defects

Research activity

Rachel is interested in developing new techniques to better describe the dynamics of networks of nonlinear oscillators (e.g. models of neurons) in order to allow for strong

interactions between the nodes. This requires dynamical systems theory and symmetric bifurcation theory since a network of identical nodes has symmetry determined by the topology of the interactions. For this research she will be collaborating with Professor Stephen Coombes (Nottingham) and Professor Peter Ashwin (Exeter).

For her PhD research Rachel used symmetric bifurcation theory to determine the patterns which can be created when a dynamical system with spherical symmetry undergoes a bifurcation. In particular she determined the existence properties of symmetric spiral patterns on spheres. The symmetries of such patterns are described using group theory.

Lie group theory can also be used to determine the symmetries of solid crystals with defects. During her time as a research fellow Rachel worked with Dr Gareth Parry to generalise well-known symmetry properties of perfect crystals to the case of crystals with uniform distributions of defects.

Publications

- Nicks, R and Parry, G P (2012), On symmetries of crystals with defects related to a class of solvable groups (S2), Mathematical Methods in the Applied Sciences, 35: 1741-1755
- Nicks, R and Parry, G P (2012), On symmetries of crystals with defects related to a class of solvable groups (S1), Mathematics and Mechanics of Solids, 17: 631-651
- Parry, G P and Sigrist, R (2012), Reconciliation of local and global symmetries for a class of crystals with defects, J. Elast, 107: 81-104
- Sigrist, R and Matthews, P (2011), Symmetric spiral patterns on a sphere, SIAM J. Appl. Dyn. Syst. 10: 1177-1211
- Sigrist, R (2010), Hopf bifurcation with spherical symmetry, Nonlinearity 23: 3199-3225

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