

# Jamie M. Taylor

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## RESEARCH INTERESTS

- Asymptotic analysis in the calculus of variations.
- Mean-field models applied to the study of phase transitions in liquid crystals.
- Inverse problems and their treatment via techniques of machine learning.

## EDUCATION

**University of Oxford**, Oxford, UK.

DPhil Mathematics. (October 2012 - September 2016)

- Dissertation Topic: “Mathematical Models of Liquid Crystals and Related Materials”.
- Supervisor: John M. Ball

**Cardiff University**, Cardiff, UK

MMath Mathematics, *First-class honours*. (September 2008 - July 2012)

- Final year thesis topic: “Reaction-diffusion equations”.
- Final year thesis supervisor: Nicolas Dirr.

## POSITIONS HELD

**Postdoctoral fellow**, Basque Center for Applied Mathematics (BCAM), Bilbao, Spain

September 2018 - Present

- In the *Applied Analysis* research group, mentored by Prof. Arghir Zarnescu

**Postdoctoral research scholar**, Liquid Crystal Institute and Department of Mathematical Sciences, Kent State University, Ohio USA.

March 2017 - August 2018 (Research leave granted July 2017 - January 2018)

- In the research group of Prof. Peter Palffy-Muhoray.

**Postdoctoral research assistant**, Mathematical Institute, University of Oxford, UK.

October 2016-January 2018 (Research leave granted March 2017-July 2017)

- Working under the SOLLIQ ERC grant, P.I. Prof. Sir John M. Ball.

## HONORS AND AWARDS

**Dr George Greaves Prize**

Awarded by Cardiff University for highest overall grade in MMath course (2012).

## PUBLICATIONS

**Effective surface energies in nematic liquid crystals as homogenised rugosity effects**  
*Accepted, to appear in Communications in Contemporary Mathematics. Preprint available at arXiv:2108.11133*

R. Ceuca, J. M. Taylor, A.D. Zarnescu

**On quadrature rules for solving Partial Differential Equations using Neural Networks**  
*Computer Methods in Applied Mechanics and Engineering* 393 (2022): 114710.

J.A. Rivera, J. M. Taylor, Á. J. Omella, D. Pardo

**Hölder regularity and convergence for a non-local model of nematic liquid crystals in the large-domain limit**

*Nonlinear Analysis* 215 (2022): 112641.

G. Canevari, J.M. Taylor

**Cavity volume and free energy in hard particle systems**

*Journal of Nonlinear Science* 31.87 (2021)

J.M Taylor, T. Fai, E.G. Virga, X. Zheng, P. Palffy-Muhoray

**On a probabilistic model for martensitic avalanches incorporating mechanical compatibility**

*Nonlinearity* 34.7 (2021): 4844.

F. Della Porta, A. Rüländ, J.M. Taylor, C. Zillinger

**Leaky Cell Model of Hard Spheres**

*The Journal of Chemical Physics* 154.10 (2021): 104505.

T. Fai, P. Palffy-Muhoray, J.M Taylor, E.G. Virga, X. Zheng

**$\Gamma$ -convergence of a mean-field model of a chiral doped nematic to the Oseen-Frank description of cholesterics**

*Nonlinearity*, 33.6 (2020): 3062.

J.M. Taylor

**Convex Integration Arising in the Modelling of Shape-Memory Alloys: Rigidity, Flexibility and Some Numerical Implementations**

*Journal of Nonlinear Science*, 29.5 (2019): 2137-2184.

A. Rüländ, **J.M. Taylor**, and C. Zillinger

**The excluded volume of two-dimensional convex bodies: Non-uniqueness and shape reconstruction**

*Journal of Physics A: Mathematical and Theoretical*, 52.9 (2019): 095002

**J.M. Taylor**

**Contributions of repulsive and attractive interactions to nematic order**

*Liquid Crystals* 45.13-15 (2018): 2352-2360.

P. Palffy-Muhoray, **J.M. Taylor**, E.G. Virga, X. Zheng

**An analysis of equilibria in dense nematic liquid crystals**

*SIAM Journal on Mathematical Analysis*, 50.2 (2018): 1918-1957.

**J.M. Taylor**

**Oseen-Frank-type theories of ordered media as the  $\Gamma$ -limit of a mean-field free energy**

**J.M. Taylor**

*Mathematical Models and Methods in Applied Sciences* 28.04 (2018): 615-657.

**Density functional theory for dense nematics with steric interactions.**

E.S. Nascimento, P. Palffy-Muhoray, **J.M. Taylor**, E.G. Virga, X. Zheng

*Physical Review E*, 96.2 (2017): 022704

**Finite extensibility and non-Gaussian chain statistics in liquid crystal elastomers.**

**J.M. Taylor**

*Molecular crystals and liquid crystals*, 632.1 (2016): 79-88

**Maximum entropy as the bridge between microscopic and macroscopic theory.**

**J.M. Taylor**

*Journal of Statistical Physics*, 164.6 (2016): 1429-1459.

UNDER REVIEW

**Multimodal Bayesian variational autoencoder for inverse problems in geophysics**

O. Rodriguez, J.M. Taylor, D. Pardo

CONFERENCE  
PRESENTATIONS  
(ORAL)

**Deep learning methods for liquid crystal driven transformation optics**

8th European Congress on Computational Methods in Applied Sciences and Engineering (*Oslo, June 2022*)

**On quadrature rules for solving differential equations using Deep Learning**

HPC, Deep Learning and Numerics in Geophysics (*Bilbao, November 2021*)

**Rugosity effects in liquid crystals**

SIAM Conference on Mathematical Aspects of Materials Science (*Online - Bilbao, May 2021, Invited*).

**Revisiting the hard particle equation of state**

SIAM Conference on Mathematical Aspects of Materials Science (*Online - Bilbao, May 2021, Invited*).

**Microscopic to macroscopic modelling of liquid crystals**

New trends in the variational modeling and simulation of liquid crystals (*Erwin Schrödinger International Institute for Mathematics and Physics, December 2019, Invited*).

**A forward and inverse problem on the excluded volume of convex bodies**

International Congress on Industrial and Applied Mathematics (ICIAM) (*Valencia, July 2019, Invited*).

**Asymptotic Analysis of the Helical Twisting Power of Chirally Doped Nematics**

Materials Research Society, Spring Meeting (*Arizona, April 2019*)

**Construction of two dimensional convex shapes from their excluded volumes**

Workshop on Optimal Design of Complex Materials (DNM1) (*Isaac Newton Institute, Cambridge, January 2019, Invited*).

**Maximum Entropy, Duality and Onsager**

International Conference on Liquid Crystals (*Kent State University, August 2016*)

**Finitely extensible polymer chains in nematic elastomers**

SIAM Mathematical Aspects of Materials Science conference (*Philadelphia, May 2016*)

**Convex duality methods for a non-convex minimisation problem**

SIAM Student Chapter Conference (*University of Oxford, April 2016*)

**Maximum entropy methods in Onsager's mean field free energy**

Young Researchers in Mathematics Conference (*University of Oxford, August 2015*)

**A physical model to predict a ferroelectric nematic phase**

Mathematics of Liquid Crystals Young Researchers Meeting (*Isaac Newton Institute, May 2013*)

CONFERENCE  
PRESENTATIONS  
(POSTERS)

**From mean field to Oseen-Frank by techniques of Gamma-convergence**, IMA Workshop - Liquid Crystals, Soft-matter Packing, and Active Systems: Materials and Biological Applications, (*University of Minnesota, January 2018*)

**Dense liquid crystals and duality methods for finding equilibria**, PIRE-CNA Summer School - New Frontiers in Nonlinear Analysis for Materials, (*Carnegie Mellon University, June 2016*);

**Maximum entropy and Onsager's free energy**, NYU-Oxford Workshop on Mathematical Models of Defects and Patterns, (*Courant Institute of Mathematical Sciences, New York University, January 2016*);

**Non-Gaussian chain statistics and finite extensibility in liquid crystal elastomers**, Euro-

pean Conference on Liquid Crystals, (*University of Manchester, September 2015*)

SEMINAR  
PRESENTATIONS

**Cavity volume and free energy in the hard particle system**

*CUNEF, Madrid, February 2022*

**Convergence of variational problems and an example with liquid crystals.**

*Escuela Doctoral de Matemática y Estadística. Pontificia Universidad Católica de Chile, October 2021*

**Microscopic to macroscopic modelling of liquid crystals**

*(University of Verona, December 2019)*

**Asymptotics of a mean-field model for nematics with chiral dopant**

*(AMLCI, Kent State University, February 2019)*

**Oseen-Frank as a Gamma limit of a non-local mean field free energy**

*(University of Sussex, November 2017)*

**Oseen-Frank as a Gamma limit of a non-local mean field free energy**

*(BCAM, October 2017)*

**Deriving the Oseen-Frank theory for liquid crystals from a mean-field free energy.**

*(Purdue University, March 2017)*

**Mean-field, Oseen-Frank, and the convergence of energy functionals**

Two-part seminar

*(Kent State University, March 2017)*

**From mean-field to Oseen-Frank with multiple elastic constants**

Solid and liquid crystals seminar

*(University of Oxford, January 2017)*

**Finite concentration effects in uniaxial nematics**

Solid and liquid crystals seminar

*(University of Oxford, November 2015)*

**Order parameters, entropy and mean-field free energy for macroscopic models**

Solid and liquid crystals seminar

*(University of Oxford, May 2015)*

**Challenges in modelling nematic elastomers**

Solid and liquid crystals seminar

*(University of Oxford, January 2014)*

RESEARCH  
PROGRAM  
INVITATIONS

**The Isaac Newton Institute for Mathematical Sciences, University of Cambridge,**

The Mathematical Design of New Materials

*January and May 2019*

**Institute for Mathematics and its Applications, University of Minnesota,**

Liquid Crystals, Soft-matter Packing, and Active Systems: Materials and Biological Applications

*January and May 2018*

SUPERVISORY  
EXPERIENCE

**University of Oxford**, Undergraduate Summer Research Project Supervisor (2015)  
Research Project: “Constrained Problems in the Calculus of Variations”  
Student: Thomas Swayze (Carnegie Melon University)

**University of Oxford**, Undergraduate Summer Research Project Supervisor (2014)  
Research Project: “Entropy and Moment Problems in Macroscopic Theory”  
Student: Maciej Buze (University of Strathclyde)

TEACHING  
EXPERIENCE

**Workshop, Ávila** (2022)

- Course and Workshop on Solving Partial Differential Equations with Deep Learning (50 hours)

**Basque Center for Applied Mathematics** (2019)

- Variational Models of Liquid Crystals: Materials Science at Many Length Scales (Short course with G. Canevari)

**Kent State University**, Instructor (2018)

- Analytic Geometry and Calculus 1 - Spring Semester 2018

**University of Oxford**, Teaching Assistant (2013-2015)

- Banach Spaces - Michaelmas term 2014-2015 academic year.
- Statistical Mechanics - Michaelmas term 2013-2014 academic year.

**Cardiff University**, Class Tutor (2011-2012)

- Analysis I - Second Semester 2011-2012 academic year.
- Elementary Differential Equations - First semester 2011-12 academic year.

**Backwell Comprehensive School**, Student Associate (2010)

- Working collaboratively with individual pupils and groups providing tutorial, mentoring and coaching support under supervision.
- Elements of widening participation, special educational needs, equal opportunities, behaviour management and working with gifted and talented students.

CONFERENCES  
ORGANISED

**Minisymposia organiser - SIAM Conference on Mathematical Aspects of Materials Science (May 2021)**

Minisymposia organiser for *MS12 - Complex microstructures in solid crystals* with Angkana Rüland.

**Young Researchers in Mathematics Conference 2015 - University of Oxford**

Member of the conference-wide organising committee.

ADDITIONAL SKILLS

Computing skills

- TensorFlow2.0 library (Python): Applications to machine learning and inverse problems.
- FEniCS library (Python): Finite element solvers.
- Mathematica: General use.

Languages

- English (Native)
- Spanish (C1, Awarded by Escuela Oficial de Idiomas, Bilbao).