

# Dr Andrew R. McCluskey

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Developing an international research and leadership profile in applied data science for analytical chemistry and physics through fundamental research and collaborations. Interested in developing sophisticated analytical techniques and improving instrumentation through the use of data-driven methods. Driven by a collaborative approach to research and a founding member of the Open Reflectometry Standards Organisation. Experienced educator and developer of open educational resources, passionate about engaging others in scientific research and practice.

## Employment

### University of Bristol

BRISTOL, GB

LECTURER IN CHEMISTRY

AUG. 2023 - ONGOING

- Leading the statistical chemical analysis methods research group at the University of Bristol
- Teaching on the MSc Scientific Computing with Data Science program, focusing on training physical and life scientists in computational skills

### European Spallation Source ERIC

KØBENHAVN, DK & LUND, SE

INSTRUMENT DATA SCIENTIST FOR NEUTRON REFLECTOMETRY

JAN. 2021 - AUG. 2023

- Leading data reduction and analysis development for reflectometry instruments at the European Spallation Source Data Management and Software Centre
- Interfacing between the software development and instrument groups to ensure data-centric aspects of instrumentation are ready for beam on target
- Working with the Open Reflectometry Standards Organisation to develop best practices
- Independent research focusing on improving experimental analysis approaches using Bayesian methodologies
- Work package leader for the PaNOSC (photon and neutron open science cloud) subproject on User Training and e-Learning

### Diamond Light Source

HARWELL-OXFORD, GB

DATA ANALYSIS SCIENTIST – REFLECTIVITY

APR. 2019 - DEC. 2020

- A collaborative project between Diamond Light Source, ISIS Neutron and Muon Source and the Ada Lovelace Centre to increase automation in neutron and X-ray reflectometry reduction and analysis
- Supporting reflectometry users through local contacting on the I07 beamline; including instrument set-up, data collection, data reduction and analysis
- Assisting both neutron and X-ray reflectometry users with data analysis; developing batch time-resolved analysis methodologies

## Education

### University of Bath & Diamond Light Source

BATH & HARWELL-OXFORD, GB

PHD IN CHEMISTRY

SEPT. 2015 - APR. 2019

- Undertook a PhD supervised by Prof. Karen Edler, Prof. Stephen Parker, Dr Andrew Smith and Dr Jonathan Rawle
- Developed computational methodologies to improve the analysis of neutron and X-ray reflectometry
- Implemented high-performance optimisation & sampling algorithms to rationalise experimental scattering data
- Participated in many reflectometry and small-angle scattering experiments at Diamond Light Source and ISIS Neutron and Muon Source
- Developed open educational resources to introduce classical simulation methods, including the pylj Python package and an introduction to classical simulation for users of small-angle scattering

### University of Edinburgh

EDINBURGH, GB

MCHEM IN MATERIALS CHEMISTRY WITH A YEAR IN INDUSTRY

SEPT. 2010 - JUN. 2015

- Degree Classification: **First Class**
- Year in Industry at Cytec Industries in Stamford, US

## Invited Positions

### Diamond Light Source

HARWELL-DIDCOT, GB

VISITING SCIENTIST

MAR. 2024 - ONGOING

- Collaboration with the Machine Learning and Artificial Intelligence team at Diamond Light Source

### European Spallation Source ERIC

KØBENHAVN, DK & LUND, SE

VISITING SCIENTIST

SEPT. 2023 - ONGOING

- Assisting with ongoing data reduction development efforts

### University of Bath

BATH, GB

VISITING LECTURER

SEPT. 2019 - SEPT. 2022

- Co-organisation and delivery of final year Chemistry course (CH40208), focused on introducing Python programming and applications of programming to computational chemistry
- Developed and delivered twenty-one hours of lecture-workshop hybrid classes to a cohort of seventy students
- Successfully transferred this module to a completely online learning module in 2020

- Delivery of workshops devoted to the analysis of small-angle scattering and reflectometry as a component of a final year undergraduate course

## ISIS Neutron Training Course

HARWELL-OXFORD, GB

### LECTURER

MAR. 2017 - MAR. 2018

- Twice invited to lecture at the ISIS Neutron Training Course
- Developed and delivered a one hour lecture and interactive tutorial introducing classical molecular dynamics simulations and showing how they can be applied to neutron scattering

## Funding Secured

- **Carlsberg Fondet** – Conference grant for DMSC Summer School (60 000 DKK)
- **DanScatt** – Sponsorship of DMSC Summer School (25 000 DKK)
- **Diamond Light Source Year in Industry Studentship 2020/2021** – Development of a Bayesian regularisation framework for the analysis of reflectometry (~£20 000)
- **Royal Society of Chemistry Higher Education Group Kickstart Scheme** – pythoninchemistry Hackathon (£300)
- **University of Bath Travel Fund for Teaching Development** – VICEPHEC18 Travel Grant (£135)
- **Royal Society of Chemistry Tertiary Education Group** – VICEPHEC18 Group Bursary (£70)
- **Armourers & Brasiers' Gauntlet Trust** – Research Student Travel Grant (£900)

## Awards

- 2018/10/12 **IUCr Journals Prize for the Best Student Lecture**, SAS2018
- 2018/06/14 **The Computational Prize – Best Oral Presentation**, University of Bath Bolland Symposium
- 2018/05/17 **Nominated for Faculty Teaching Assistant Award**, University of Bath Faculty of Science
- 2017/06/12 **Best Talk Award – Sponsored by Santander**, University of Bath Faculty of Science Graduate School Research Afternoon

## Computational/Linguistic Skills

### PROGRAMMING FLUENCY & SOFTWARE FAMILIARITY

**Beginner** FORTRAN90, C++, SQL, Docker

**Experienced** Julia, C, Java, OpenMP, MPI, Qt, HTML, CSS, TensorFlow, Keras, PyMC3, BinderHub, AWS, Google Cloud

**Expert** Python, Git, Jupyter-Framework, emcee, dynesty

### SOFTWARE DEVELOPMENT

**uravu** An open-source Bayesian data analysis Python package. This gives access to powerful Bayesian inference libraries through a simple interface for model-dependent data analysis. Published in the Journal of Open Source Software.

**kinisi** A robust methodology for uncertainty quantification in *in-silico* diffusion, implemented in an open-source Python package and available on Github.

**islatsu** A open-source, documented package enabling reproducible and automated X-ray reflectometry reduction for data collected at the I07 beamline. Published in the Journal of Open Source Software.

**pylj** An open-source Python library to facilitate student interaction with classical atomistic simulation. It is designed to operate within the Jupyter notebook framework, making it easy to implement in the classroom or computer lab. Published in the Journal of Open-Source Education.

### LANGUAGE FLUENCY

**Mother tongue** English

**CEFR-level B2** Danish

## Service/Community

### Journal of Open Source Education

#### TOPIC EDITOR

OCT 2022 - PRESENT

- Served as a topic editor for the Journal of Open Source Education (Open Journals), focusing on computational chemistry and physics

### Various Academic Journals

#### PEER REVIEWER

MAY 2020 - PRESENT

- Carried out peer review for Journal of Physical Chemistry, Journal of Chemical Education (American Chemical Society), Journal of Open Source Software (Open Journals), Journal of Applied Crystallography (International Union of Crystallography) & Journal of Statistics and Data Science Education (Taylor & Francis)

## Open Reflectivity Standards Organisation

MEMBER

OCT. 2019 - PRESENT

- A founding member of an international collaborative organisation aiming to standardise reflectivity measurements
- Organised two workshops, bringing together experts in reflectometry to collaborate on open standards
- Chair of the Reproducibility working group

## RSC/IOP Neutron Scattering Group Committee

ORDINARY COMMITTEE MEMBER

JUN. 2017 - PRESENT

- Currently serve as a member of the NSG Committee, previously served as Early Career Representative
- Responsible for the organisation of Early Career Meetings for the group and acting as *de-facto* webmaster

## M4 Colloids

ORGANISING COMMITTEE MEMBER

JUL. 2016

- Organisation of the student-led M4 Colloids conference at the University of Bath

## Royal Society of Chemistry

MEMBER

SEPT. 2010 - PRESENT

- Member of the RSC since start of undergraduate
- Full member since August 2020

## Publications

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20. N. Shiaelis\*, L. A. Clifton, & **A. R. McCluskey\***. Investigating model influence on the analytical resolution of neutron reflectometry, *Preprint*, 2024. Available on arXiv: arXiv:2403.13566.
19. **A. R. McCluskey\***, S. W. Coles, & B. J. Morgan\*. Accurate Estimation of Diffusion Coefficients and their Uncertainties from Computer Simulation, *Submitted*, 2023. Available on arXiv: arXiv:2305.18244.
18. **A. R. McCluskey\***, P. Aulin, F. Bolmsten, M. Bertelsen, C. M. C. Lobley, J. Lewis, M. Novelli, C. Somani, A. Stefanov, M. Trajanovski, N. Vaytet, P. K. Willendrup, J.-L. Wynen, S. Yoo, T. Holm Rod\*. The First European Spallation Source Data Management and Software Centre Summer School, *Neutron News*, *Accepted*, 2024.
17. **A. R. McCluskey\***, A. G. Squires, J. Dunn, S. W. Coles, & B. J. Morgan\*. kinisi: Bayesian analysis of mass transport from molecular dynamics simulations, *J. Open Source Softw.*, **9**(94), 5984, 2024. DOI: 10.21105/joss.05984.
16. **A. R. McCluskey\***. Is there still a place for linearization in the chemistry curriculum?, *J. Chem. Educ.*, **100**(11), 4174-4176, 2023. DOI: 10.1021/acs.jchemed.3c00466.
15. G. Krenzer, J. Klarbring, K. Tolborg, H. Rossignal, **A. R. McCluskey**, B. J. Morgan\*, & A. Walsh\*. Nature of the Superionic Transition of Lithium Nitride from Machine Learning Force Fields, *Chem. Mater.*, **35**(15), 6133-6140, 2023. DOI: 10.1021/acs.chemmater.3c01271.
14. **A. R. McCluskey\***, A. J. Caruana\*, C. J. Kinane, A. J. Armstrong, T. Arnold, J. F. K. Cooper, D. L. Cortie, A. V. Hughes, J.-F. Moulin, A. R. J. Nelson, W. Potrzebowski, & V. Starostin. Advice on describing Bayesian analysis of neutron and X-ray reflectometry, *J. Appl. Crystallogr.*, **56**(1), 12-17, 2023. DOI: 10.1107/S1600576722011426.
13. R. Brearton\*, **A. R. McCluskey**, & T. Snow. islatu: A Python package for the reduction of reflectometry data, *J. Open Source Softw.*, **7**(77), 4397, 2022. DOI: 10.21105/joss.04397.
12. T. Arnold\*, A. Terry, E. Blackburn, U. Hejral, Z. Heyles, **A. R. McCluskey**, T. Nylander, & M. Wolff. The 16th International Conference on Surface X-ray and Neutron Scattering (SXNS16), *Neutron News*, **33**(2), 2, 2022. DOI: 10.1080/10448632.2022.2050633.
11. T. Arnold\*, B. Murphy, **A. R. McCluskey**, J. Stahn, & M. W. A. Skoda. A Report on the Third Meeting of the Open Reflectivity Standards Organisation (ORSO), *Neutron News*, **33**(1), 2, 2022. DOI: 10.1080/10448632.2021.2005422.
10. J. M. Dean, S. W. Coles\*, W. R. Saunders, **A. R. McCluskey**, M. J. Wolf, A. B. Walker, & B. J. Morgan\*. Overscreening and Underscreening in Solid-Electrolyte Grain Boundary Space-Charge Layers, *Phys. Rev. Lett.*, **127**(13), 135502, 2021. DOI: 10.1103/PhysRevLett.127.135502.
9. A. Markvardsen\*, T. Rees, M. Wathen, A. Lister, P. Odagiu, A. Anuchitanukul, T. Farmer, A. Lim, F. Montesino, T. Snow, & **A. McCluskey**. FitBenchmarking: an open source Python package comparing data fitting software, *J. Open Source Softw.*, **6**(62), 3127, 2021. DOI: 10.21105/joss.03127.
8. **A. R. McCluskey**, K. S. W. Hung, B. Marzec, J. O. Sindt, N. A. J. M. Sommerdijk, P. J. Camp, & F. Nudelman\*. Disordered Filaments Mediate the Fibrillogenesis of Type-I Collagen in Solution, *Biomacromolecules*, **21**(9), 3631-3643, 2020. DOI: 10.1021/acs.biomac.0c00667
7. **A. R. McCluskey\***, T. Arnold, J. F. K. Cooper, & T. Snow. A general approach to maximise information density in neutron reflectometry analysis, *Mach. Learn.: Sci. Technol.*, **1**(3), 035002, 2020. DOI: 10.1088/2632-2153/ab94c4.
6. **A. R. McCluskey\***, & T. Snow. uravu: making Bayesian data analysis easy(er), *J. Open Source Softw.*, **5**(50), 2214, 2020. DOI: 10.21105/joss.02214.
5. **A. R. McCluskey\***, J. Grant, A. J. Smith, J. L. Rawle, D. J. Barlow, M. J. Lawrence, S. C. Parker, & K. J. Edler\*. Assessing molecular simulation for the analysis of lipid monolayer reflectometry, *J. Phys. Comm.*, **3**(7), 075001, 2019. DOI: 10.1088/2399-6528/ab12a9.
4. **A. R. McCluskey\***, J. Grant, A. R. Symington, T. Snow, J. Dutch, B. J. Morgan\*, S. C. Parker, & K. J. Edler. An introduction to classical molecular dynamics simulation for experimental scattering users, *J. Appl. Crystallogr.*, **52**(3), 665-668, 2019. DOI: 10.1107/S1600576719004333.

3. **A. R. McCluskey\***, A. Sanchez-Fernandez, K. J. Edler, S. C. Parker, A. J. Jackson, R. A. Campbell, & T. Arnold\*. Bayesian determination of the effect of a deep eutectic solvent on the structure of lipid monolayers, *Phys. Chem. Chem. Phys.*, **21**(11), 6133-6141, 2019. DOI: 10.1039/C9CP00203K.
  2. **A. R. McCluskey\***, B. J. Morgan, K. J. Edler, & S. C. Parker. pylj: A teaching tool for classical atomistic simulation, *J. Open Source Educ.*, **1**(2), 19-21, 2018. DOI: 10.21105/jose.00019.
  1. **A. R. McCluskey**, & K. J. Edler\*. Model-dependent Small-angle Scattering for the Study of Complex Organic Materials, *Curr. Org. Chem.*, **22**(8), 750-757, 2018. DOI: 10.2174/1875692115666170612104439.
- \* Denotes corresponding authorship.

## Presentations

### INVITED TALKS

2024/03/12	<b>Introduction to Reflectometry: With a Focus on Analysis</b> , French-Swedish Academy for Scattering Experiments and Modelling for Life Science	LUND, SE
2022/07/05	<b>Developing and sharing an undergraduate chemistry course for Python</b> , 2022 RACI National Congress, Physical and Computational Chemistry Education Symposium – <b>Keynote Speaker</b>	HYBRID (BRISBANE, AU)
2020/04/03	<b>Reflectometry and data science</b> , #theLightStuff Webinars (youtu.be/PHBLK_3sf8)	ONLINE
2017/06/19	<b>Surfactants and Molecular Dynamics</b> , CCP-SAS Joint Meeting, Cardiff University	CARDIFF, GB
2017/06/12	<b>Putting computers to work for large experiments</b> , Faculty of Science Graduate School Research Afternoon, Bath University – <b>Best Talk Award</b>	BATH, GB
2016/05/23	<b>SAS, Sims and Soft Matter Self-Assembly</b> , CCP-SAS Joint Meeting, NIST	GAITHERSBURG, US

### CONTRIBUTED TALKS

2023/09/22	<b>A perspective on probabilistic chemical models to complement quantum algorithms</b> , Scientific Applications of Quantum Computing: Materials, Chemistry and Biology	LONDON, GB
2022/09/21	<b>PaN-Training e-Learning: education and training for scientists and students</b> , NOBUGS (New Opportunities for Better User Group Software) 2022	HYBRID (VILLIGEN, CH)
2022/08/22	<b>Using Bayesian inference as a tool to more completely understand neutron reflectometry</b> , International Conference on Neutron Scattering 2022	BUENOS AIRES, AR
2019/07/12	<b>Automating reflectometry reduction and analysis at Diamond Light Source</b> , M4 COLLOIDS	BATH, GB
2019/05/07	<b>Bayesian determination of the effect of a deep eutectic solvent on the structure of lipid monolayers</b> , BAYES@LUND 2019	LUND, SE
2018/10/30	<b>Comparing coarse-grained simulation-derived and traditional analysis method for monolayer reflectometry</b> , Trends and Perspectives in Neutron Instrumentation	TUTZING, DE
2018/10/12	<b>Using high-performance computing and molecular dynamics to rationalise micelle structure from small-angle scattering</b> , SAS2018	TRAVERSE CITY, US
2018/10/09	<b>pylj: an open-source Python library for teaching the interaction between molecular simulation and scattering</b> , SAS2018 – <b>Best Student Lecture Prize</b>	TRAVERSE CITY, US
2018/09/16	<b>Introducing programming to undergraduate chemists: and the tools we've developed to help them</b> , PYCON UK	CARDIFF, GB
2018/08/23	<b>Introducing programming to undergraduate chemists: and the tools we've developed to help them</b> , VICEPHEC18	SHEFFIELD, GB
2018/06/14	<b>Using markov chain monte-carlo to estimate uncertainties in x-ray reflectometry modelling</b> , University of Bath Bolland Symposium	BATH, GB
2018/02/09	<b>Probabilistic analysis of reflectometry data: Phospholipids at the DES-air interface</b> , Neutrons and Global Challenges II: Health and Healthcare	LONDON, GB
2017/09/12	<b>Simulations to understand reflectivity: How coarse can we go?</b> , CCP5 AGM	GLASGOW, GB
2017/04/13	<b>Simulations to understand reflectivity: How coarse can we go?</b> , Faraday Joint Interest Group Conference	WARWICK, GB
2017/03/23	<b>Coarse graining and reflectivity: a love story?</b> , CompChem Seminar, University of Bath	BATH, GB
2017/02/28	<b>Reflectivity: from simulation to experiment</b> , International Soft Matter Workshop	HELDFORD, GB
2016/06/23	<b>Smart analysis of soft matter</b> , Bombannes Summer School	BOMBANNES, FR