Curriculum Vitae

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1 General details.

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Dates	University	Position
2013 -	University of Plymouth	Lecturer
2009 - 2013	University of Wuppertal	Postdoc
2006 - 2009	University of Glasgow	SUPA advanced fellow
2004 - 2006	University of Liverpool	Temporay lecturer
2002 - 2004	University of Liverpool	UKQCD software manager, PI Alan Irving
2001 - 2002	University of Liverpool	Physicist programmer, PI Alan Irving
1998 - 2001	University of Liverpool	Postdoc, PI Chris Michael
1995 - 1998	University of Utah	Postdoc, PI Carleton DeTar
1992 - 1995	University of Kentucky	Postdoc, PI Terry Draper
1989 - 1992	University of Edinburgh	Ph.D (supervisors Dr. Bowler and Dr. Pendleton)
1986 - 1989	Imperial College	BSc Undergraduate in Physics (first class degree)

Table 1: Education and work history

2 Teaching experience

2.1 My experience in lecturing

University of Plymouth, Software Development and Databases, 2 years
This is a 20 credit module taught in MSc program Data Science and Business Analytics. This is a conversion MSc, so many students have no prior experience with programming.

University of Plymouth, Operational Research and Monte Carlo Methods, 9 years
This course is taught to 30 to 70 students over a semester. The course is fully assessed via coursework. I started teaching the students with the statistical language R, switched to Matlab, and finally I now teach using python.

University of Plymouth, Project, 3 years I am the module leader for the final year projects in Mathematical Sciences. I have supervised three final year undergraduate projects.

University of Plymouth, Foundation Year Physics, 6 years
I taught A-level physics to 120 Engineering students on the foundation year. I also supervised the experimental laboratory sessions.

University of Plymouth, Professional Experience in Mathematics Education / Education Proje

I marked the essays and contributed to the discussion sessions.

University of Plymouth, The Quantum Universe, 3 years
This was an interdisciplinary 20 credit module, which was taught immersively over a month to first year undergraduate students.. I presented material in the planetarium on campus and some lectures on particle physics and medical applications of physics.

University of Plymouth, Mathematical Programming, 1 year
I developed this module and wrote the module record. Students were taught python and Vpython. Juypter notebooks were used as well as an online system.

University of Plymouth, Numerical and Computational Methods, 1 year

I lectured basic numerical methods, such as Simpson's rule, to 70 students. I also supervised students in the computer lab, where they worked with Maple and Matlab.

University of Plymouth, Engineering Statistics, 2 years

I taught statistics to 120 final year mechanical engineering students. The course was assessed via course-work and a class test.

University of Liverpool, Special and General Relativity, 2 years

I taught a course on special and general relativity to third year undergraduate mathematics students. There were 36 lectures and 12 class tutorials.

University of Liverpool, Mathematical Methods, 2 years

I taught a mathematical methods course to 70 first year undergraduate science students. The course content was "advanced calculus" and there were 36 lectures with 12 class tutorials.

University of Utah, Computational Physics, 2 years

The course was partly an introduction to numerical analysis, as well as an introduction to the use of the tools on a UNIX system to solve scientific problems. I taught the following topics: interpolation, numerical solution of ODEs, finding roots of equations, and numerical linear algebra. The students wrote simple programs in C or Fortran. When I taught the course in 1998, the students were introduced to the C++ programming language. The maple computer algebra package was used for about half the course.

2.2 My experience in teaching small groups of undergraduates

University of Wuppertal, Computational Physics, 1 year

I wrote the homework problems for an undergraduate course on computational physics. Matlab was used for topics such as conjugate gradient and the Ising model.

University of Glasgow, Physics 2X/2Y, 3 years

I was a course tutor for the Physics 2X/2Y course for the second year undergraduate students in the Physics Department. I met with 4 students for 1 hour per week, and I marked their homework. The following topics were covered: physics of waves, dynamics, physics of solids, thermal physics, electricity and magnetism, nuclear and particle physics, physics of optics, and mathematical techniques.

University of Liverpool, first year linear algebra (M103), 2 years

I met with a small group of students, discussed homework, and marked their work.

University of Liverpool, first year calculus (M101), 2 years

I met with a small group of students, discussed calculations, and marked their homework.

University of Liverpool, Introduction to Java Programming (C101), 3 years

I worked with the students for 1 hour in the computer lab. I graded their computer programs and documentation.

University of Liverpool, Essay projects, 2 years

I supervised a 3rd and 4th year Mathematical Physics project.

2.3 Teaching MSc students

At the University of Plymouth, the MSc with the largest number of students in the Faculty of Science and Engineering is the data science and business analytics program. I was the program manager for this MSc for the year 2021 to 2022 to cover for a staff member on maternity leave. This year the MSc had 50 students and one of the challenges was finding supervisors for the project module. Typically I used to supervise 2 MSc projects in data science per year (and do 4 vivas), but given the growth in student numbers, I expect to supervise around 6 MSc projects per year in the future.

Titles of completed MSc projects

2017-2018 The relationship between the life satisfaction of the citizen in European countries and their academic level.

2018-2019 Using machine learning models to classify and detect avian wildlife around wind farms using time-lapse images.

2018-2019 The use of machine learning to study the performance of wind farms.

2019-2020 Machine learning applied to Optometry/Cataracts.

2019-2020 A comparison of machine learning methods for the prediction of locational crime rates.

2020-2021 Using Convolutional Neural Networks for Tumour Identification in Magnetic Resonance Imaging Brain Scans.

2020-2021 Using machine learning to study the behavior of customers of British Telecom (BT).

2021-2022 Investigation of churn of customer of telecom industry using machine learning.

2021-2022 Investigating customer churn in british telecom.

2021-2022 Real-time data visualisation of pledge activity and trends.

2021-2022 Topic Modeling With Latent Dirichlet Allocation on mining journal to find out useful and meaningful insights.

2021-2022 Incorporating machine learning into business intelligence using spinnaker international ltd as a case study.

I have co-supervised the following MSc projects.

- Graphene as an attractive nanomaterial for biosensing.
- The use of tools to collect images from social media platforms for data collection and analysis of cultural ecosystem services across Europe.

At the University of Wuppertal, for one year, I was a tutor in a computer lab for a course on computational science, as part of a masters program.

2.4 My experience in supervising PhD students

I have supervised one PhD student in lattice field theory to completion. I am co-supervising a second year PhD student in data science on a project: "machine learning methods for next generation customer service" in cooperation with BT research. I am the lead supervisor for a first year PhD student in quantum computing. I co-supervise a PhD student in Optometry.

I was the external examiner for PhD students at Trinity College Dublin in 2006 and 2013, at Cambridge University in 2018, University of Adelaide in 2019, and the Universty of Swansea in 2022.

I have always worked closely with the graduate students in lattice gauge theory at all the Universities I have worked at. For example I co-authored papers with 4 graduate students at Liverpool. I wrote a paper with a graduate student at Edinburgh. For two years I organised a two day training workshop for postdocs and graduate students, known as "HackLatt", on lattice QCD codes in Edinburgh. I was the originator of the HackLatt workshops, that are now part of the culture of lattice QCD in the UK, and have been favourably reviewed by various international review panels.

I organized the seminars in the theoretical particle physics division at the University of Liverpool for about five years. At Glasgow I organized the seminars for the theory group. At the University of Utah, I organized an internal seminar series for particle theory, because there were so few external speakers. I was an active participant in the weekly particle theory postgraduate discussion group at the University of Liverpool. I attend a seminar for undergraduate students at the University of Wuppertal. I was a tutor at the BUSSTEPP summer school for first year graduate students in theoretical particle physics for two years.

2.5 Teaching qualifications and teaching CPD

I am a fellow of the Higher Education Authority, which is the standard teaching qualification in the UK.

During my time at University of Plymouth, I have attended external workshops on online assessment and Physics Education Research. In June 2022, I co-organized a one day workshop: "Involving employers in the development of the mathematical sciences curriculum," supported by the RSS and IMA (`https://sites.google.com/view/employersandmathscurriculum/home`).

In September 2005, I attended a two day workshop in Birmingham about teaching mathematics. In January 1999, I attended a very good lecture at Liverpool about the art of lecturing.

3 Teaching philosophy

3.1 Undergraduate teaching

I aim to train students in skills they can either use in academic work or in industry. I would also like the students to learn about the many interesting topics in mathematics and physics, that they may never need professionally (for example the physics of black holes) after they end their undergraduate studies, but are part of our culture and fun to follow in the popular press. I realize that some students may only want to pass the final exam with a reasonable mark, and I am happy to help them do this.

I have tried various methods of providing brief summaries of the material at the start of the lecture and on-line. After marking too many exam scripts from students who did not know that $i^2 = -1$, I provided a checklist guide for revision (approved by two senior Professors) for an exam, in addition to the exam papers and solutions of previous exams.

To try to more effectively teach calculus to first year students I looked in books such as "how to ace calculus" and Polya's "how to solve it" for hints. I also created a mind map for the different ways of solving integrals. I only want to innovate in a small section of the course, so that I could then measure the success, but without the risk of a poor average mark in the final exam.

3.2 Small group tutorials and projects

I work very hard on getting the students to join in the discussions and try problems in small tutorial groups. I try to create a friendly and nonjudgmental environment (even when students forget how to solve a quadratic equation). I try to provide useful feedback on marked homework, as soon as possible to the students. I learned a lot about the difficulties students have learning mathematics and physics, when I talked to them in small tutorial groups.

I view essay and student projects as crucial to developing problem solving skills. I try to design projects that are simultaneously well structured, yet require the students some initiative.

I usually try to create projects that are a little bit "cool," but still doable by undergraduates. For example in the project I designed for students in a Masters course at Wuppertal, I got them to solve the one dimensional Schrödinger's equation. Towards the end of the project I suggested they used a screened potential to look at the melting of mesons in the quark gluon plasma. I also hope that the additional motivation for the project will help them, if they interview for graduate studies.

3.3 Graduate teaching

My aim in graduate education is develop in the students: independent problem solving skills, the ability to critically review material, and the ability to develop new areas of research. My involvement in the postgraduate discussion group at Liverpool was aimed at developing the last two skills.

I want the students to use modern computer techniques, such as scripting, C++, python, standard numerical analysis libraries, rather than using some old legacy FORTRAN program, because this will help them get jobs in industry, if they so wish.

4 Service to the theory community

I have refereed papers for the journals: Phys.Rev.D, Phys.Rev.Lett., The European Physical Journal C, SIAM J. Matrix Anal. Appl., Phys. Lett. B, Journal of American Physics, Nucl.Phys. A, Canadian Journal of Physics, and Computer Physics Communications. I was on the local organizing committee for the international lattice 2005 conference held in Dublin Ireland. I was one of the three editors of the proceedings for the lattice 2005 conference that was published in the Proceedings of Science journal (PoS). I was on the local organizing committee for the international conference Extreme QCD, which was held in Plymouth 2015. I published a summary of the conference in the CERN courier magazine.

In 2008 I organized a collaboration meeting at Glasgow for the European Twisted Mass lattice collaboration with 17 participants: from France, Germany, Italy, and the Netherlands.

I organized a two day workshop at Glasgow in April 2008 with the title: "The nuclear physics challenge to lattice QCD" (http://nuclear.gla.ac.uk/nuclat/). The aim of the meeting was to open a dialog between the nuclear experimental and lattice QCD communities. There were 65 participants at the meeting.

In January 2009, I was an invited reviewer for the midterm review of the project: "A national computational infrastructure for Lattice Quantum Chromodynamics" funded by the US Department of Energy under the SciDac-II program (Scientific Discovery through Advanced Computing). I attended a two day meeting in Washington DC and wrote a report on the status of the project.

I am a member of the Institute of Physics and I can use CPhys MInstP after my name. I am a member of the British Computer Society.

5 Outreach and public understanding of science

In 2017, 2021, 2022, and 2023 I co-organized a particle physics master class at Plymouth, for students at local schools (http://math-sciences.org/masterclass .) I have run shows on dark matter, to visiting school students, in the planetarium on campus. I have hosted small groups of school students on work experience and Nuffield schemes. They worked on particle physics or quantum computing projects.

I organized a one day festival of Physics with the South West branch of the IOP at the University of Plymouth in 2019 and 2022. In June 2022, I organized a visit of physics school teachers to visit the Engineering and Physics facilities at the University of Plymouth (`https://sites.google.com/view/visit-of-physics-teachers/home`).

6 Review talks at conferences

I regularly present review talks at international conferences with audiences of both theorists and experimentalists. A list of my main conference presentations follows.

- I presented a topical plenary talk at the international lattice 2013 conference in Mainz.
- In April 2013, I presented results of my lattice QCD calculations with the charm quark in two talks, at the 9th International Workshop on Heavy Quarkonium 2013 at IHEP, Beijing, China.
- In March 2013, I presented a review talk [15] on "Determination of the strong coupling and quark masses from Lattice QCD" at a workshop at the Institute for Advanced Studies, Nanyang Technological University, Singapore.
- I presented a talk at the 8th International Workshop on Heavy Quarkonium 2011 GSI, Germany between 4 - 7 October 2011. At the same meeting I was also a panel member in round table discussion about the importance of including charm in the sea of lattice QCD calculations.

- I presented an invited talk "Physics from staggered fermions with light quark masses" at the meeting: "Hadrons, Lattice QCD and Chiral Perturbation Theory", September 13 - 16, 2010 Graz, Austria.

- In November 2009 I presented an invited talk on resonances and lattice QCD at a workshop on Hadronic excitations at TRIUMF lab in Canada.

- In August 2009 I presented an invited review talk "strong decays on the lattice", at the Charmed Exotics meeting in Bonn Germany.

- In June 2009, I was invited to present a talk at the "QCD Bound States" Workshop at the Physics Division of Argonne National Laboratory.

- In July 2008, I reviewed results for glueballs from lattice QCD at the QCD08 conference in Montpellier, France.

- In May 2008 I gave a review on hadron spectroscopy at the international conference "Nuclear Structure at the Extremes" held in Paisley Scotland.

- In March 2008 I presented an invited review talk on lattice QCD at the Photon-hadron physics with the GlueX detector at Jefferson Lab workshop, in Virgina USA.

- In 2007 I presented a plenary review talk on hadron spectroscopy at the international lattice 2007 conference held in Germany.

- In 2007, I reviewed the spectroscopy of scalar mesons obtained from lattice QCD at the International Symposium on Meson-Nucleon Physics and the Structure of Hadrons (MENU2007) in Juelich, Germany.

- I gave a short talk at the Workshop on Light-Cone Distribution Amplitudes at IPPP Durham (September 2006).

- I presented an invited review talk at the ICHEP'06 conference in Moscow (July 2006) about lattice QCD calculations of the new heavy hadrons.

- I presented an invited talk at the meeting "Highly Excited Hadrons" in Trento (July 2005).

- In September 2004, I was invited to give a review talk in Japan at a meeting called "Lattice QCD simulations via International Research Network".

- I reviewed the status of hybrids and glueballs calculations from lattice QCD at the future physics at Compass meeting at CERN in September 2002.

- I gave a mini-review on unquenching the f_B decay constant at the UK Phenomenology Workshop on Heavy Flavour and CP Violation at Durham (September 2000).

- I reviewed the lattice QCD results for hybrid mesons and glueballs at the European workshop on the QCD structure of the nucleon (Ferrara, Italy) in April 2002.

- In March 1999, I reviewed the lattice results for hybrid mesons at the international conference on hadron spectroscopy in Frascati.

I have been a lecturer at the following summer schools:

- In July 2012, I presented two lectures about hadron physics and the PANDA experiment, as part of Helmholtz Graduate School for Hadron and Ion Research (HGS-HIRe) for FAIR in Germany.
- I presented two lectures on heavy quarks in lattice QCD at the international school on heavy quark physics in Dubna, Russia (June 2002).

I have made many presentations at the annual international conference on lattice field theory. Below are some recent seminars that I have presented.

- In April 2013 I presented the talk: "Implications of heavy glueball results from lattice QCD for the PANDA experiment," at a SFB meeting in Regensburg.
- In March 2011, I presented a talk: "Status of the Regensburg-Wuppertal charm project" at a SFB meeting in Regensburg.
- In October 2009 I presented a seminar with the title: "Decay constants in charmonium", at the Helmholtz-Institut für Strahlen- und Kernphysik at the University of Bonn.
- In May 2009, I presented the talk: "Using a compute grid" at the e-science institute in Edinburgh.
- I presented the talk "Lattice QCD and charm physics" to the Bristol HEP group at their away day. (December 2008)
- I presented the talk: "A lattice QCD calculation of the decay constants of heavy and light mesons", at the University of Regensburg, Germany (November 2008).
- I presented the talk: "Some decay constants from twisted mass QCD." at the Humboldt University in Berlin Germany (June 2008).

7 Research plans

I have been doing research into theoretical particle physics since 1989. Since I have been working at the University of Plymouth, I have started a program of research into data science.

7.1 Research plans in data science

I have started a project on extracting the geometry of the eye using MRI scans of a patient. The ultimate aim of the research is to develop evidence based treatments of Myopia. I work on the data analysis and we have preliminary results from the work done by an Undergraduate student working on a summer internship. This project is done in collaboration with researchers in Optometry in the School of Health Professions, and the director of the Brain Image Research Center at the University of Plymouth. I co-supervise a PhD student in the School of Health Professions.

I am working with a collaborator to build machine learning models to predict customer churn in the Telecom industry. The goal is to incorporate natural language processing techniques, such as topic modelling, to the classifiers. This research is done in collaboration with BT research, and I am co-supervising a PhD student on the project. This is a spin off from various MSc projects I have supervised. The project has produced a refereed paper in the proceedings of the 5th International Conference on Statistics: Theory and Applications (ICSTA'23). We are planning of developing an REF impact case from this research.

7.2 Research plans in theoretical particle physics

The exciting experimental measurement of the anomalous magnetic moment of the muon (a_μ) from the Fermilab Muon g-2 experiment, combined with the earlier result from BNL, raises the hope of a measurable failure of the standard model of particle physics. However, a recent lattice QCD calculation of the leading hadronic order hadronic correction to a_μ ($a_\mu^{\rm HVP,LO}$) from the BMW collaboration found better agree with experiment, thus motivating further improvements in the lattice QCD calculations. I have been working with the FNAL lattice, HPQCD, MILC collaboration to compute $a_\mu^{\rm HVP,LO}$.

I am leading the effort in the FNAL lattice,HPQCD, MILC collaborations to compute the required disconnected diagrams and QCD+QED contributions to $a_\mu^{\rm HVP,LO}$. This calculation, combined with others, is a crucial component of the effort to reduce the error on $a_\mu^{\rm HVP,LO}$to under 0.5%. The results on disconnected QCD contributions and connected QCD+quenched QED are being finalized with results at three lattice spacings.

After the previous work has been finished, I will work on computing the disconnected QCD+QED contributions and the contribution of QED and QCD in the sea. I have been working on getting a HMC code, originally developed by the MILC collaboration, that includes the dynamics of QCD+QED in the sea, ready for production running. Other groups have found these contributions to be small, so the calculations will be challenging.

Understanding the experimental X,Y, and Z mesons in terms of quark and glue degrees of freedom is still a hot topic. With a PhD student, I have computed the mass of the 1^{-+} hybrid ($\overline{q}q$ mesons with excited glue) meson in charmonium in the continuum limit for the first time. This extends the work on the precision study of the properties of charmonium by the HPQCD collaboration. The next step will be to include scattering states in the calculation. Another direction planned is to look at hybrids with bottom quarks, which is possible with the HISQ formulation

I will investigate a variety of machine learning algorithms focused on reducing the statistical errors on phenomenologically relevant quantities computed in lattice QCD calculations. For example, I will study symbolic regression, which can extract a fit model from data without human input, by cleverly searching the huge parameter space. I am currently investigating the use of Gaussian

processes for continuum extrapolations.

The staggered fermion formalism is the only formalism that doesn't use multi-grid matrix inverters. A formalism has been developed and implemented in the open source QUDA library, but the algorithm has many parameters to tune. I will investigate the use of the hyper-parameter search techniques commonly used in deep learning to tune parameters of the multi-grid algorithm.

I am supervising a PhD student who is studying the Variational Quantum Eigensolver (VQE) on quantum computers, with application to lattice QCD applications.

8 Other relevant skills

In March 2012 I passed an exam in the German language at the B1 level in the EU classification. This corresponds to around 300 hours of study.

9 Publications

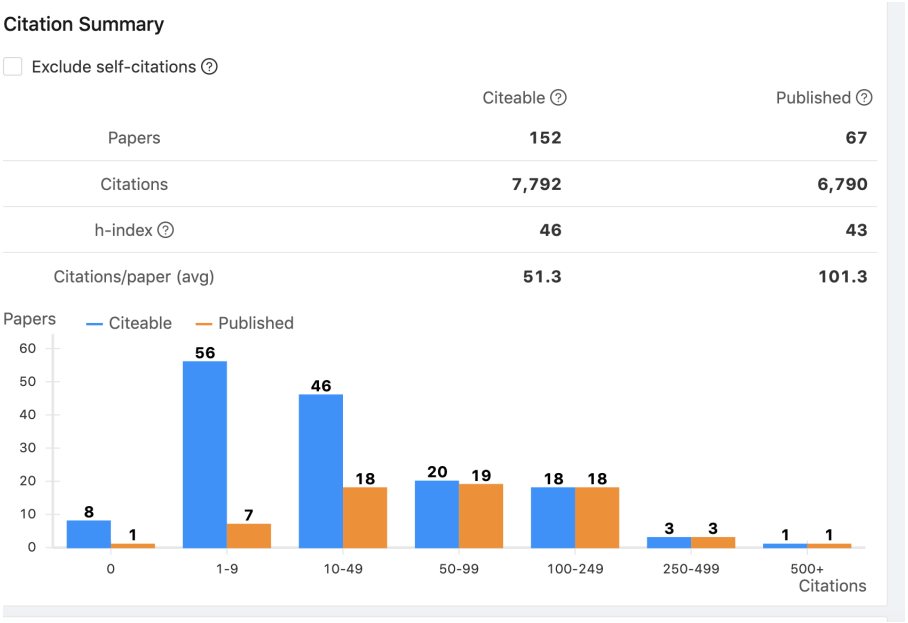

Figure 1: Summary of my publications from the Inspire database (Dec 2022.)

10 Journal articles

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11 Publications in conference proceedings

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