CURRICULUM VITAE

Name: Drew F. Parsons

Research Grants:

Norwegian Research Council FRIPRO-FRINATEK 250346, 2016-2018 ($1,442,000)
Title: Casimir effect and van der Waals forces in multilayer systems
Investigators: Mathias Boström, Prof. Iver Brevik, Prof. Johan Høye, Stefan Buhmann, Prof. Kimball Milton, Prof. Clas Persson, Drew Parsons, Kristian Berland, Oleksandr Malyi, K. Shajesh, Prachi Parashar, Prof. Barry Ninham, Eduardo Lima

ARC Discovery Grant DP110102817, 2011 – 2013 ($540,000)
Title: Hofmeister at Work. Implementation of a paradigm shift in Physical Chemistry
Investigators: Prof. Barry Ninham and Dr. Drew Parsons

Research Associate on ARC Discovery Grant DP0878625, 2008 – 2010 ($338,000)
Title: Molecular forces: in colloid science, complex fluids and living matter.
Chief Investigator: Prof. Barry Ninham

Teaching Grants:

Australian New Colombo Plan Mobility Project
2017 ($33,000), 2018-2020 ($99,000)
Title: China: Future Chemist International Summer Camp
Consortium Partners: Murdoch University, Australian National University, Newcastle University, Flinders University, RMIT University

Professional Memberships:

Australian Colloid and Interface Society
International Association of Colloid and Interface Scientists
Engineers Australia (Affiliate Member)

Work Experience:

January 2015 – present
Senior Lecturer, Murdoch University (Times Ranking 401-500)
Duties: Research in surface adsorption and adhesion. Teaching in programming and extractive metallurgy.

Research on the relationship between surface charging and adhesive forces between particles, including ion specific effects in haemoglobin aggregation. Theory of forces between redox electrodes.

Teaching mineral processing (comminution, beneficiation); process design for metallurgical engineering students. Chair of implementation committee of the Metallurgical Education Partnership (a program of the Minerals Tertiary Education Council). Supervision of 4th year research students.

Negotiation of Memorandum of Understanding with East Kazakhstan State Technical University. Teaching Kazakh minerals industry Masters students as visiting lecturer.

July 2008 – December 2014
Research Fellow, Australian National University (Times Ranking 48)
Duties: Research in theory of ion specific effects and surface adhesion. University teaching. Supervision of research students.

A recent new theory I developed is a method for the theoretical calculation of surface forces which accounts for surface roughness. The technique uses a statistical description to characterise roughness and includes the impact of mechanical elastic forces due to contact between extreme asperities of the two surfaces.

I undertook research into the stability and properties of nanobubbles, supported by industrial funding in partnership with Prof. Vincent Craig.

Other research has been in the application of ionic dispersion forces to explain ion specific effects. Ion specific effects occur in electrolytes when phenomena such as pH or adhesion between surfaces is altered depending on the identity of the salt salt in the solution. It is important in biology, for instance with the ability of a virus particle to stick to a cell membrane depending on the balance of salts in the blood. Ion specific effects are also significant industrially, affecting the adhesion of oil in rock deposits and therefore impacting on the economics of oil extraction. These effects cannot be described by simple 20th Century electrostatic models of electrolytes, and instead require ion dispersion forces (van der Waals forces). My breakthroughs in this field have been in the use of quantum mechanical methods to calculate ionic dispersion forces. I developed a model of competitive ion binding to surface sites, addressing the impact that this competitive binding has on forces between surfaces.

I found promising applications of the new theory in salt-controlled separation of oil from rock surfaces and in optimising the capacity of electrolytic energy storage devices (supercapacitors, batteries).

My university teaching responsibilities have included lecturing, tutoring and setting assessment and exams for the second year course PHYS2020 “Statistical and Thermal Physics”. I have taken on the additional responsibility of chairing the course, mentoring colecturers and tutors and overseeing their contribution to the lectures and assessments of the course.

I have been the formal supervisor of students working in my research project at both PhD and Honours levels. Informally I also advise and provide mentoring for the graduate students of colleagues, particularly by helping experimental students with theoretical questions.

I have initiated and participated in collaborative work with international colleagues based in Italy, Germany, Sweden, Brazil and India. Colleagues in Italy, Germany and India perform experimental measurements of ion specific effects, while I work together with Swedish and Brazilian colleagues explaining from theory the results measured by experiment.

October 2004 – June 2008
Postdoctoral Research Fellow, Australian National University
Duties: Theory and simulation of single chain polymers. University teaching.

I participated in a project studying the conformations that a single polymer chain (homopolymers or block copolymers) can form when the chain collapses into a dense ball. I applied the novel Wang-Landau Monte Carlo technique, which I implemented in C++ using MPI parallelisation. This technique enables phase transitions between different conformations to be located.

I contributed to the lecturing, tutoring and assessment workload for the second year course PHYS2020 “Statistical and Thermal Physics”. I also ran tutorials for the physics course “Big Questions”, a course designed to help non-specialists tackle philosophical questions arising from modern physics, without having to get distracted by mathematical details.

January 2003 – October 2004
Science Teacher, Knox Grammar School, Sydney Australia
Duties: Teaching Physics and General Science.

October 2000 – March 2002.
Software Developer, Place2Trade, Sydney, Australia.
Development of a Business-To-Business (B2B) E-Commerce platform based on Java/JSP/SQL technology.

October 1999 – September 2000.
Postdoctoral Fellow, University of California, Davis, CA, U.S.A.
Postdoctoral research on theory of supercritical water.

September 1998 – September 1999.
Postdoctoral Fellow, Université Henri Poincaré, Nancy, France.
Post-doctoral research on hydrogen cracking in zeolite catalysts.

1990–1994
Research Assistant, CSIRO Division of Wool Technology, Ryde Laboratory, Sydney, Australia.
Development of image analysis software for wool processing.

Qualifications:

Graduate Diploma of Education, 29 April 2003, University of New South Wales.
Major in Science teaching (Physics), minor in Computing Studies.

Doctor of Philosophy, 10 July 1998, Karpov Institute of Physical Chemistry, Moscow, Russia. Major in physical and mathematical sciences (chemical physics).

Bachelor of Science with Honours, 22 April 1994, Australian National University, Canberra, Australia. Major in physics, mathematics and theoretical chemistry.
First Class Honours. University Medal.

Recognition:

Plenary Lecture, 16th Russian conference on Surface Forces, Kazan, 2018
Invited Talk, Fall Meeting of the European Materials Research Society, Warsaw 2017
Keynote Lecture, conference of the European Colloid and Interface Society, Bordeaux, 2015
Invited Talk, conference of the International Association of Colloid and Interface Scientists (IACIS), Sendai, 2012

University Medal, Australian National University, 1992
Adrien Albert Honours Prize, 1992.
Represented Australia in XX International Chemistry Olympiad, Helsinki, Finland, 1988.

Languages:

English (native), Russian (fluent), French (social), Mandarin Chinese (Certificate 1).

Scientific Research Interests:

Theory of electrodes: electrowinning and energy storage.
Surface forces and surface roughness.
Complex van der Waals forces.
Ion specific effects and ionic dispersion forces.
Dielectric properties of solvents (nonlocal continuum theory)
and surfaces, including biological membranes.
Soft-matter physics. Polymer physics (theory and simulation).
Supercritical fluids. Alkane cracking reactions in zeolites.

15 career-best academic research outputs

4 book chapters and 68 articles published in international journals for the physical sciences. Citation count: 1570 (Scopus), *h*-index: 24 (Scopus), 27 (Google Scholar), *i*10-index: 39 [May 2018]

1. **D. F. Parsons**, M. Boström, P. L. Nostro, B. W. Ninham,
Hofmeister effects: interplay of hydration, nonelectrostatic potentials, and ion size,
Physical Chemistry Chemical Physics 13 (2011) 1235212367.

Times cited (Scopus): 206
Journal ranked Q1, 17/149 in Physical and Theoretical Chemistry (SCImago Journal Rank, May 2018)

Reviews the paradigm shift needed to understand ions in solution, accounting for nonelectrostatic ion interactions. Listed in the top 10 most accessed and top 25 most read articles in 2011.

ARC Discovery Project DP110102817

2. **D. F. Parsons**, M. Boström, T. J. Maceina, A. Salis, B. W. Ninham,
Why direct or reversed Hofmeister series?: Interplay of hydration, non- electrostatic potentials, and ion size,
Langmuir, 26 (2010) 3323-3328.

Times cited (Scopus): 77
Journal ranked Q1, 8/62 in the field of Surfaces and Interfaces (SCImago Journal Rank, May 2018)

An application of our ab inito polarisabilities and hydration model, modelling for the first time the Hofmeister series reversal observed at alumina compared to silica.

3. M. Boström, **D. F. Parsons**, A. Salis, B. W. Ninham, M. Monduzzi,
Possible origin of the inverse and direct Hofmeister series for lysozyme at low and high salt concentrations,
Langmuir 27 (2011) 9504–9511.

Times cited (Scopus): 65
Journal ranked Q1, 8/62 in the field of Surfaces and Interfaces (SCImago Journal Rank, May 2018)
ARC Discovery Project DP110102817

Predicted that Hofmeister inversion was caused by surface charge reversal arising from ionic dispersion. Confirmed experimentally in Physical Chemistry Chemical Physics 14 (2012) 4343

4. **D. F. Parsons**, B. W. Ninham,
Importance of accurate dynamic polarizabilities for the ionic dispersion interactions of alkali halides,
Langmuir 26 (2010) 1816–1823.

Times cited (Scopus): 62
Journal ranked Q1, 8/62 in the field of Surfaces and Interfaces (SCImago Journal Rank, May 2018)

Explains the role of ab initio quantum calculations (including electron correlation) for determining ionic dispersion forces.

5. A. Salis, **D. F. Parsons**, M. Boström, L. Medda, B. Barse, B. W. Ninham, M. Monduzzi
Ion specific surface charge density of SBA-15 mesoporous silica,
Langmuir 26 (2010) 2484–2490.

Times cited (Scopus): 58
Journal ranked Q1, 8/62 in the field of Surfaces and Interfaces (SCImago Journal Rank, May 2018)

Applied theory of ion dispersion forces to interpret measurements of the surface charge accessible is mesoporous silica.

6. **D. F. Parsons**, B. W. Ninham,
Charge reversal of surfaces in divalent electrolytes: The role of ionic dispersion interactions,
Langmuir 26 (2010) 6430–6436

Times cited (Scopus): 51
Journal ranked Q1, 8/62 in the field of Surfaces and Interfaces (SCImago Journal Rank, Feb 2018)

Explains postulated surface binding energies of ions and indicates the contribution of dispersion forces to anomalous secondary repulsive forces.

7. † T. T. Duignan, **D. F. Parsons**, B. W. Ninham,
A continuum model of solvation energies including electrostatic, dispersion, and cavity contributions,
Journal of Physical Chemistry B 117 (2013) 9421–9429.

Times cited (Scopus): 47
Journal ranked 24/149 in the field of Physical and Theoretical Chemistry (SCImago Journal Rank, May 2018)
† First author was a PhD student supervised by CI Parsons

Introduces our theoretical model combining electrostatic, dispersion and cavity energies of an ion which successfully reproduces experimental aqueous solvation energies.

8. A. Salis, F. Cugia, **D. F. Parsons**, B. W. Ninham, M. Monduzzi
Hofmeister series reversal for lysozyme by change in pH and salt concentration: insights from electrophoretic mobility measurements,
Physical Chemistry Chemical Physics 14 (2012) 4343–4346.

Times cited (Scopus): 43
Journal ranked Q1, 17/149 in Physical and Theoretical Chemistry (SCImago Journal Rank, May 2018)

Used experimental measurements of lysozyme charge to confirm theoretical predictions of charge reversal.

9. † T. T. Duignan, **D. F. Parsons**, B. W. Ninham,
Collins's rule, Hofmeister effects and ionic dispersion interactions,
Chemical Physics Letters 608 (2014) 55 – 59

Times cited (Scopus): 40

Journal ranked Q2, 54/149 in the field of Physical and Theoretical Chemistry (SCImago Journal Rank, May 2017)
† First author was a PhD student supervised by CI Parsons

Introduces a robust method of theoretically quantifying Collin's notion of "matching water affinity" for ion-ion interactions in solution, based on dispersion energies determined by quantum chemical calculations.

10. L. Medda, B. Barse, F. Cugia, M. Boström, **D. F. Parsons**, B. W. Ninham, M. Monduz
zi, A. Salis, Hofmeister challenges: Ion binding and charge of the BSA protein as explicit examples,
Langmuir 28 (2012) 16355–16363.

Times cited (Scopus): 39
Journal ranked Q1, 8/62 in the field of Surfaces and Interfaces (SCImago Journal Rank, Feb 2018)

Applied theory of ion dispersion forces to interpret the charge and potential measured for BSA protein molecules.

11. **D. F. Parsons**, R. B. Walsh, V. S. J. Craig,
Surface forces: Surface roughness in theory and experiment,
Journal of Chemical Physics 140 (2014) 164701.

Times cited (Scopus): 19
Journal ranked Q1, 31/149 in the field of Physical and Theoretical Chemistry (SCImago Journal Rank, May 2018)

Presents a new theoretical methodology for describing the effect of surface roughness on forces between surfaces.

12. **D. F. Parsons**, A. Salis, Hofmeister effects at low salt concentration due to surface charge transfer**,**
Current Opinion in Colloid & Interface Science 23 (2016) 41 – 49.

Times cited (Scopus): 13

Journal ranked Q1, 3/15 in the field of Colloid and Surface Chemistry (SCImago Journal Rank, May 2018)

Ion specific effect are more commonly understood as a phenomemon in high salt concentrations. Here we demonstrated the mechanisms through which they may occur also at low salt concentrations.

13. **D. F. Parsons**, A. Salis
The impact of the competitive adsorption of ions at surface sites on surface free energies and surface forces,
Journal of Chemical Physics 142 (2015) 134707.

Times cited (Scopus): 12
Journal ranked Q1, 31/149 in the field of Physical and Theoretical Chemistry (SCImago Journal Rank, May 2018)

Presented a new theoretical model motivated by measurements of haemoglobin turbidity that combines nonelectrostatic physisorption with chemisorption of different ions at surface sites.

14. **D. F. Parsons**,
The impact of nonelectrostatic physisorption of ions on free energies and forces between redox electrodes: ion-specific repulsive peaks,
Electrochimica Acta 189 (2016) 137–146.

Times cited (Scopus): 4
Journal ranked Q1, 6/31 in the field of Electrochemistry (SCImago Journal Rank, May 2018)

Extends the theory of surface forces and ionic dispersion energies into the context of redox electrodes, opening the way for new theory of nonequilibrium surface forces modelling battery and electrode materials.

15. **D. F. Parsons**, T. T. Duignan and A. Salis.
Cation effects on haemoglobin aggregation: balance of chemisorption against physisorption of ions.
Interface Focus 7 (2017), 20160137.

Times cited (Scopus): 2
Journal ranked Q2, 42/127 in the field of Biophysics (SCImago Journal Rank, May 2018)

Applied a new model of chemisorption and nonelectrostatic physisorption and used second virial coefficients to interpret turbidity measurements of haemoglobin aggregation.