

William A. Dawson

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RESEARCH INTERESTS

The study of dark energy with weak gravitational lensing surveys (LSST & WFIRST). The study of dark matter, plasma/particle acceleration physics, and galaxy evolution using optical, X-ray, and radio surveys of merging galaxy clusters (MC² & HST-RELICS).

EDUCATION

University of California

Davis, CA

2007-2013

Masters of Physics (2008)

Doctor of Philosophy (2013)

Advisor: DAVID WITTMAN

Thesis Title: *Constraining Dark Matter Through the Study of Merging Galaxy Clusters*

University of Texas

Austin, TX

2006-2007

Undergraduate studies in physics.

Texas A&M University

Galveston, TX

2000-2002

B.Sc., Maritime Systems Engineering

RESEARCH & WORK EXPERIENCE

Research Scientist, Physics Division

Lawrence Livermore National Lab, Livermore

2016-Present

Working on dark energy related science with the Large Synoptic Survey Telescope (LSST) and the Wide Field Infrared Survey Telescope (WFIRST); in particular understanding and improving weak gravitational lensing measurements. Performing laboratory astrophysics at the National Ignition Facility (NIF), through the creation of collisionless plasma shocks analogous to those associated with major galaxy cluster mergers.

Postdoctoral Scholar

Lawrence Livermore National Lab, Livermore

2013-2016

Working on dark energy related science with LSST and WFIRST.

Visiting Researcher

University of California, Davis
2013-Present

Merging Cluster Collaboration studies to constrain the dark matter self-interaction cross-section, effects of major mergers on galaxy evolution, and the plasma/particle physics of major mergers. LSST dark energy collaborative efforts.

Graduate Research Assistant

University of California, Davis
2008-2013

Investigating the properties of dark matter by using the techniques of weak gravitational lensing, X-ray astronomy, galaxy photometry & spectroscopy, and the Sunyaev-Zel'dovich effect to study merging galaxy clusters.

Undergraduate Research Assistant

University of Texas at Austin
2006-2007

Performed photomultiplier tube calibrations for the Cryogenic Low Energy Astrophysics Noble gases (CLEAN) dark matter detection experiment.

Senior Engineering Specialist

Technip, Houston
2002-2006

Performed offshore structural design and engineering of large floating oil platforms.

**TEACHING
EXPERIENCE**

Physics 10 TA

University of California at Davis
Fall 2009

Special and General Relativity for life sciences majors. Designing and teaching the discussion labs.

Physics 7C TA

University of California at Davis
Spring 2008

Waves, optics, electricity & magnetism, and modern physics for biological science majors.

Physics 7A TA

University of California at Davis
Fall 2007, Winter 2008

Conservation of energy, particle model of matter, and thermodynamics for biological science majors.

**GRANTS, AWARDS
& FELLOWSHIPS**

Hubble Space Telescope Cycle 24 AR-14559, 2016

Raiders of the Lost Arcs

\$120,000

LLNL Laboratory Directed R&D, 2015

Bayesian Image Analysis for Dark Energy Applications

\$1.3M

Hubble Space Telescope Cycle 23 GO-14096, 2015

RELICS: Reionization Lensing Cluster Survey

\$1 M total, \$120,000 to Dawson

NASA-ROSES: WFIRST Preparatory Science, 2015

Joint Analysis of Galaxy Imaging for Photometric Redshift Assignments in the WFIRST-AFTA Lensing Survey

\$240,000

Hubble Space Telescope Cycle 21 GO-13343, 2013

Probing Dark Matter with a New Class of Merging Clusters

\$130,000

UC HiPACC Grant, 2012-2014

UC Davis-Irvine Merging Cluster Collaboration

\$20,000

AAS Astronomy Ambassador 2012

A professional development program providing mentoring, training, and access to resources and a network of contacts within the astronomy EPO community.

UC Davis Graduate Program Fellowship, fall 2011 - spring 2013

\$20,000

Hubble Space Telescope Cycle 18 GO-12377, 2010

DLSCl J0916+2953: A New Transverse Cluster Merger

\$51,000

Chandra Space Telescope Cycle 12 GO-12800854, 2010

DLSCl J0916+2953: A New Transverse Cluster Merger

\$30,000

Jacques Franquelin Award

2006

A prestigious internal company award honoring those “who through their spirit of initiative, their creativity, or their sense of innovation and cooperation within the Group, contribute to the dynamism and development of Technip.”

~20 are awarded amongst ~20,000 employees each year

**OBSERVING
EXPERIENCE**

Magellan MegaCam

3 nights (2016B)
Observation plan, and observing.

Hubble: ACS & WFC3

212 orbits (Cycles 18, 21, & 23)
Target selection; APT visit planning of constrained parallel ACS & WFC3 observations.

Keck: DEIMOS

11 nights (2011A, 2013A, 2013B, 2014A, 2015A, & 2015B semesters)
Observation plan; target selection; slit mask design; observing; and data reduction.

Subaru: Suprime-Cam

8 nights (2013A, 2013B, 2014A, 2015A, & 2015B semesters)
Observation plan, observing, and data reduction.

Gemini: GMOS

2 nights (2015A semesters)
Observation plan, observing, and data reduction.

Chandra: ACIS-I

Visit planning and data reduction.

Lick: Kast Dual Spectrograph

3 nights (Winter 2009)
Planning and observing.

UCO/Lick Observational Astronomy Workshop

3 nights (Winter 2009)
Hands on experience will all aspects of the Kast spectrograph on the Shane telescope, the Hamilton spectrograph on the Coude Auxiliary Telescope (CAT), and direct imaging with the Nickel 1-m reflector

**INVITED
PUBLIC TALKS**

TriValley Stargazers

TriVally, California
4/15/2016
The rebirth of a radio phoenix in a major galaxy cluster collision

Valley Study Group

Pleasanton, California
04/13/2016
Merging Galaxy Clusters as Dark Matter Laboratories

The Mount Diablo Astronomical Society

Concord, California
03/26/2013
Merging Galaxy Clusters, Dissections of the Cosmos

**INVITED
ACADEMIC TALKS**

Stanford University

Stanford, California

2/8/2016

Merging Galaxy Clusters as Astrophysical Laboratories

Mocking the Universe: Better science through Data Sim.

Space Telescope Science Institute, Baltimore

7/28/2015

*Combining Image and Gravitational Lensing Simulations for
Cosmological Parameter Inference*

Harvard Institute of Theory and Computation

Cambridge, Massachusetts

9/16/2014

Merging Galaxy Clusters and Self-interacting Dark Matter

Harvard-Smithsonian Center for Astrophysics

Cambridge, Massachusetts

5/20/2014

Dark Matter and the Dynamics of Merging Clusters

**8th Harvard-Smithsonian Conference on Theoretical
Astrophysics**

Cambridge, Massachusetts

5/19/2014

Cluster Tests of Dark Matter Self-interaction

Leiden Observatory

Leiden, Netherlands

10/16/2013

Merging Galaxy Clusters and Self-interacting Dark Matter

Harvard Self-interacting Dark Matter Workshop

Cambridge, Massachusetts

8/9/2013

How Merging Clusters Will Determine if Dark Matter Self-interacts

**Identifying and Characterizing Dark Matter via Multiple
Probes Workshop**

KITP, Santa Barbara, California

5/15/2013

Evidence for Self-interacting Dark Matter

Cosmic Frontier Workshop

SLAC National Accelerator Laboratory, California

3/7/2013

Bullet Cluster and Other Merging Galaxy Clusters

Department of Physics & Astronomy, University of Pennsylvania

Philadelphia, Pennsylvania

2/22/2013

Evidence for Self-interacting Dark Matter: A Call for a Regime Change

Carnegie Institution for Science

Pasadena, California

2/1/2013

Evidence for Self-interacting Dark Matter: A Call for a Regime Change

Department of Physics & Astronomy, University of California

Santa Barbara, California

11/14/2012

Towards Measuring the Dark Matter Cross-section (Not Just Limiting It)

Department of Physics & Astronomy, Univ. of British Columbia

Vancouver, B.C., Canada

10/22/2012

Towards Measuring the Dark Matter Cross-section (Not Just Limiting It)

Lawrence Livermore National Laboratory

Livermore, California

10/2/2012

Towards Measuring the Dark Matter Cross-section (Not Just Limiting It)

Kavli Institute for Particle Astrophysics and Cosmology

Stanford, California

06/22/2012

The Dynamics of Dissociative Cluster Mergers: Bullet & Musket Ball Clusters

Department of Mathematics, University of California

Davis, California

02/22/2012

Discovery of a Dissociative Galaxy Cluster Merger with Large Physical Separation

Department of Physics, Rutgers University

Rutgers, New Jersey

02/09/2011

Gravitational Weak Lensing Tomography and Examples of its Application

**IN THE PRESS
AND PUBLIC EYE**

Through the Wormhole with Morgan Freeman

“The Invisible Universe”, 2014 Season

Interviewed and performed a demonstration on how merging galaxy clusters might be able to determine if dark matter self-interacts.

[Snippet from the episode.](#)

NPR Science Friday

“The Hunt for Dark Matter spotlight”, 10/14/2015

Interviewed regarding self-interacting dark matter and how the Merging Cluster Collaboration is investigating it.

Chandra & Hubble Press Release

“Giant galaxy cluster collision triggered ‘radio phoenix’”, 8/26/2015

Discovery of a major galaxy cluster merger that generated a plasma shock which re-excited a relativistic population of high-energy particles.

Chandra - [Chandra Data Suggest Giant Collision Triggered “Radio Phoenix”](#)

LLNL - [Giant galaxy collision triggered ‘radio phoenix’](#)

American Astronomical Society

Long Beach, CA

01/07/2013

Evidence for self-interacting dark matter in the Musket Ball Cluster points the direction towards an interesting new regime of dark matter research using merging galaxy clusters.

Articles (sample):

Wired - [Galactic Pile-Up May Point to Mysterious New Dark Force in the Universe](#)

New Scientist - [Hints of new dark force seen in galactic smash-ups](#)

Based on:

AAS 221st Meeting, Presentation 125.04D, Evidence for Self-interacting Dark Matter: A Call for a Regime Change, W.A. Dawson et al.

American Astronomical Society Press Conference

Austin, TX

01/10/2012

Astronomers observe a cluster merger in unexplored phase-space using a vast array of telescopes and constrain the properties of dark matter.

Video:

<http://youtu.be/fww7w73POIE>

Articles (sample):

Astronomy - [When Galaxy Clusters Collide](#)

Wired - [Galactic Collision May Contain Clues about Dark Matter](#)

BBC - [El’ Gordo is the Largest Distance Galaxy Cluster Ever Seen](#)

Based on:

Dawson, W.A. et al., 2011, Discovery of a Dissociative Galaxy Cluster Merger with Large Physical Separation, ApJ 747 L42.

**RECENT
CONFERENCE
PRESENTATIONS**

AAS 227th Meeting

Kissimme, FL

01/04/2016

Special Session: Astrophysical Constraints of Dark Matter Properties
Astronomical insights into dark matter particle constraints

Tools for Astronomical Big Data

Tuscon, AZ

03/09/2015

Inferring Intrinsic Galaxy Properties with the Dirichlet Process Prior

Wide-field InfraRed Surveys: Science & Techniques

Pasadena, CA

11/17/2014

LSST-WFIRST Synergy: A New Domain of Blending Challenges

AAS 223rd Meeting

Washington DC

01/09/2014

Using Radio Relics to Constrain Merging Cluster Properties

Identifying and Characterizing Dark Matter via Multiple Probes

KITP, Santa Barbara, CA

05/15/2013

Evidence for Self-interacting Dark Matter

AAS 221th Meeting

Long Beach, CA

01/07/2013

Evidence for Self-interacting Dark Matter: A Call for a Regime Change

**ACCEPTED
PROPOSALS**

Hubble Space Telescope Cycle 24 AR-14559, 2016 “Raiders of the Lost Arcs”, **PI**

Hubble Space Telescope Cycle 21 GO-13343, 2013 “Probing Dark Matter with a New Class of Merging Clusters”, **Co-PI**, ~\$130,000

Keck DEIMOS / Subaru Suprime-Cam, 2014A “Merging Clusters as Dark Matter Colliders”, Co-I

CFHT MegaCam, 2013B “Dark matter-radio shock wave interactions in merging clusters”, Co-I

Keck DEIMOS / Subaru Suprime-Cam, 2013B “Probing Dark Matter with Large Nonhadron Colliders”, Co-I

Hubble Space Telescope Cycle 18 GO-12377, 2010 “DLSCl J0916+2953: A New Transverse Cluster Merger”, **PI**, ~\$51,000

Chandra Space Telescope Cycle 12 GO-12800854, 2010 “DLSCl J0916+2953: A New Transverse Cluster Merger”, **PI**, ~\$30,000

UC HiPACC, 2012-2014, "UC Davis-Irvine Merging Cluster Collaboration", **PI**, ~\$20,000 (\$10,000 pending)

Keck DEIMOS / Subaru Suprime-Cam, 2013A "A Smashing Proposal", Co-I

Keck DEIMOS, 2012B "Star Formation in Merging Clusters: Boom or Bust?", **Co-PI***

WSRT, 2012B "A Search for Radio Relics in the Musket Ball Cluster", Co-I

CARMA SZA c0679, 2011A "DLSCl J0916+2953: A New Transverse Cluster Merger", **PI**

Keck DEIMOS, 2011A "DLSCl J0916+2953: A New Transverse Cluster Merger", **Co-PI***

KPNO MOSAIC, 2011 "Medium-band imaging of a $z=0.53$ merging cluster", Co-I

CTIO NEWFIRM, 2011 "A Near Infrared View Of The Deep Lens Survey", Co-I

*The UCO TAC requires that the PI of a Keck proposal be UC faculty.

PROFESSIONAL ACTIVITIES

Co-founder and PI of the [Merging Cluster Collaboration](#), a multi-institution consortium focused on the study of dark matter through observations and simulations of merging galaxy clusters.

Member of the LSST Dark Energy Science Collaboration. Elected member of the DESC Collaboration Council (2014-2016). One of five on the Publications Committee.

Founding member of the HST:

Co-advisor of Physics REU student [Emily Quinn Finney](#) from Scripps College, Summer 2012. Research project: *Correlation of cluster galaxy alignment with associated cosmic filaments*.

Organizer for the Cosmology in Northern California (CINC) 2011 conference at UC Davis.

[AAS Astronomy Ambassador](#)

Referee: Science, and MNRAS.

NSF DAS review panel.

Member of AAS.

PUBLICATIONS

- Dawson, W.A.**; Schneider, M.D.; Tyson, J.A.; Jee, M.K., 2015. *The Ellipticity Distribution of Ambiguously Blended Objects*, [ApJ 816 1](#)
- van Weeren, R.; Brunetti, G.; Bruggen, M.; Andrade-Santos, F.; Ogrean, G.; Williams, W.; Rottgering, H.; **Dawson, W.A.**; et al., 2015. *LOFAR and Chandra Observations of the Toothbrush Galaxy Cluster: An Application of the LOFAR Facet Calibration Scheme*, accepted ApJ
- Ogrean, G.; van Weeren, R.; Jones, C.; Forman, W.; **Dawson, W.A.**; et al., 2015. *Frontier Fields Clusters: Deep Chandra Observations of the Complex Merger MACS J1149.6+2223*, accepted ApJ
- De Gasperin, F.; Intema, H.; van Weeren, R.; **Dawson, W.A.**; et al., 2015. *A powerful double radio relic system discovered in PSZ1 G108.18-11.53: evidence for a shock with non-uniform Mach number?*, [MNRAS 453 3483](#)
- Ng, K.Y.; **Dawson, W.A.**; Wittman, D.; Jee, M.J.; Hughes, J.P.; Menanteau, P.; & Sifon, C., 2015. *The return of the merging galaxy subclusters of El Gordo?*, [MNRAS 453 153](#)
- Rodney, S.; Bradley, L.; Coe, D.; ...; **Dawson, W.A.**; et al., 2015. *RELICS: Discovery of a Probable SN in Galaxy Cluster MACSJ0949.8+1708*, [ATel 8170](#)
- Jee, J.; **Dawson, W.A.**; et al., 2015. *MC²: Mapping the Dark Matter Distribution of the "Toothbrush" Cluster RX J0603.3+4214 with Hubble Space Telescope and Subaru Weak-lensing*, accepted ApJ, [arXiv:1510.03486](#)
- Stroe, A.; Oosterloo, T.; Rottgering, H.; Sobral, D.; van Weeren, R.; **Dawson, W.A.**; et al., 2015. *Neutral hydrogen gas, past and future star formation in galaxies in and around the 'Sausage' merging galaxy cluster*, [MNRAS 452 2731](#)
- Mandelbaum, R.; Rowe, B.; ...; **Dawson, W.A.**, et al., 2015. *GREAT3 results I: systematic errors in shear estimation and the impact of real galaxy morphology*, [MNRAS 450 2963](#)
- Andrade-Santos, F.; Jones, C.; Forman, W.R.; Murry, S.S.; Kraft, R.P.; Vikhlinin, A.; van Weeren, R.J.; Nulsen, P.E.J.; David, L.P.; **Dawson, W.A.**; Arnaud, M.; Pointecouteau, E.; Pratt, G.W.; & Melin, J., 2014. *Chandra and XMM-Newton Observations of the Bimodal Planck SZ-detected Cluster PLCKG345.40-39.34 (A3716) with High and Low Entropy Subcluster Cores*, [ApJ 803 108](#)
- Schneider, M.D.; Hogg, D.W.; Marshall, P.J.; **Dawson, W.A.**; Meyers, J.; Bard, D.J.; Lang, D., 2015. *Hierarchical probabilistic inference of cosmic shear*, [ApJ 807 87](#)
- Bard, D.; Kratochvil, J.M.; & **Dawson, W.A.**, 2015. *Masked Areas in Shear Peak Statistics: A Forward Modeling Approach*, submitted to ApJ, [arXiv:1410.5446](#)

Sobral, D.; Stroe, A.; **Dawson, W.A.**; et al., 2015. MC²: boosted AGN and star formation activity in CIZA J2242.8+5301, a massive post-merger cluster at $z = 0.19$, [MNRAS 450 630](#)

Dawson, W.A.; Jee, M.J.; Stroe, A.; Ng, Y.K.; Golovich, N.; Wittman, D.; Sobral, D.; Bruggen, M.; Rottgering, H.J.A.; & van Weeren, R.J., 2014, MC²: Galaxy Imaging and Redshift Analysis of the Merging Cluster CIZA J2242.8+5301, submitted to ApJ, [arXiv:1410.2893](#)

Jee, M.J.; Stroe, A.; **Dawson, W.A.**; Wittman, D.; Hoekstra, H.; Bruggen, M.; Rottgering, H.J.A.; Sobral, D.; van Weeren, R.J., 2014, MC²: Constraining the Dark Matter Distribution of the Violent Merging Galaxy Cluster CIZA J2242.8+5301 by Piercing through the Milky Way, [ApJ 802 46](#)

Stroe, A.; Sobral, D.; **Dawson, W.A.**; Jee, M.J.; Hoekstra, H.; Wittman, D.; van Weeren, R.J.; Bruggen, M.; Rottgering, H.J.A., 2014, The rise and fall of star-formation in $z \sim 0.2$ merging galaxy clusters, [MNRAS 450 646](#)

de Gasperin, F.; Ogorean, A.; van Weeren, R.A.; **Dawson, W.A.**; Bruggen, M.; Bonafede, A.; and Simionescu, A., 2014. Abell 1033: birth of a radio phoenix, [MNRAS 448 2197](#)

de Gasperin, F.; Evoli, C.; Bruggen, M.; Hektor, A.; Cardillo, M.; Thorman, P.; **Dawson, W.A.**; Morrison, C.B., 2014. Discovery of Supernova Remnant G351.0-5.4, [A&A 568 107](#)

Dawson, W.A., 2014. MCMAC: Monte Carlo Merger Analysis Code, [ASCL 1407.004](#)

Ascaso, B.; Wittman, D.; **Dawson, W.A.**, 2014. Optical Galaxy Clusters in the Deep Lens Survey, [MNRAS 439 1980](#)

Wittman, D.; **Dawson, W.A.**; Benson, B., 2013. Shedding light on the matter of Abell 781, [MNRAS 279 1W](#)

Dawson, W.A., 2013. The Dynamics of Merging Clusters: A Monte Carlo Solution Applied to the Bullet and Musket Ball Clusters. [ApJ 772 131](#)

Wittman, D., & **Dawson, W.A.**, 2012. Constraining Source Redshift Distributions with Gravitational Lensing. [ApJ 756 140](#)

Dawson, W.A. et al., 2012. Discovery of a Dissociative Galaxy Cluster Merger with Large Physical Separation. [ApJ Letters 747 L42](#)

REFERENCES

Prof. David Wittman	530 754 5354 (thesis advisor)
Prof. Tony Tyson	530 752 3830
Prof. James Bullock	949 824 7727
Dr. Michael Schneider	925 422 4287
Prof. Maruša Bradač	530 752 6762