

# Cristóbal Sifón

Postdoctoral Research Associate  
Department of Astrophysical Sciences  
Princeton University  
Peyton Hall, 4 Ivy Ln, Princeton, NJ 08544

E-mail: [sifon@astro.princeton.edu](mailto:sifon@astro.princeton.edu)  
Phone: +1 (609) 258 0026  
<http://www.astro.princeton.edu/~sifon/>  
<https://github.com/cristobal-sifon/>

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## Research Interests

I am an observational astrophysicist. My research focuses on galaxy cluster physics including observable–mass scaling relations for cosmological analyses, brightest cluster galaxies, the mass content of cluster galaxies and merging clusters. I am also interested in intrinsic galaxy alignments, both as contaminants for cosmic shear and as a physical mechanism in their own right. I use various tools and techniques to study these phenomena, including weak gravitational lensing, spectroscopy, the exploitation of optical surveys in general, and most recently analyses involving hydrodynamical simulations.

**Collaborations:** Atacama Cosmology Telescope (ACT) — Canadian Cluster Comparison Project (CCCP) — Galaxy Cluster Mass Reconstruction Project — Hyper-Suprime Cam survey (HSC) — Kilo-Degree Survey (KiDS) — Large Synoptic Survey Telescope Dark Energy Science Collaboration (LSST-DESC) — Multi-Epoch Nearby Cluster Survey (MENeCS).

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## Employment and Education

[2016 – Present] Postdoctoral Research Associate, Princeton University, USA  
[2012 – 2016] Ph.D. Astrophysics, Universiteit Leiden, The Netherlands  
[2010 – 2012] M.Sc. Astrophysics, P. Universidad Católica de Chile, Chile  
[2005 – 2010] B.Sc. Astronomy, P. Universidad Católica de Chile, Chile

### Internships

[2011] Science Intern, Gemini South Observatory  
[2011] Internship, Rutgers University  
[2009] Science Intern, Gemini South Observatory (*B.Sc. thesis*)

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## Teaching & Mentoring

### Student Mentoring

[2018 – Present] Malik Walker, Princeton University: Undergraduate Summer Research Program and Junior Project.  
[2017 – Present] Naomi Robertson, Oxford University (UK): co-advising PhD thesis project.  
[2013-2014] Joshua Albert, Universiteit Leiden: co-advised MSc thesis project.

### Teaching Assistant

[Leiden] Stellar dynamics  
[U. Católica] Extragalactic astrophysics; Experimental astrophysics; Laboratory of thermodynamics and kinetic theory

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## Successful Observing Proposals (as PI)

I have been the PI of 5 different successful observing proposals in three different telescopes:

**[Gemini South]** 24 h for imaging and spectroscopy of high-redshift galaxy clusters

**[Giant Metrewave Radio Telescope]** 44 h to search for diffuse radio emission in galaxy clusters

**[VLT Survey Telescope]** 6 h for weak lensing observations of galaxy clusters

**Observing Experience:** I have spent roughly 180 hours observing in optical (Gemini South) and near-infrared (La Silla-2.2m) telescopes performing both imaging and spectroscopy of galaxy clusters.

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## Community Activity

I have served as a referee for A&A, ApJ, MNRAS, and Nature Astronomy.

### Informal courses

**[2016]** *Making Better Figures*, Universiteit Leiden (<http://bit.ly/2NTznxW>)

### Press articles

**[July 2017]** *Galaxy clusters: Falling into line* (Nature Astronomy, July 2017)

**[July 2013]** *Featured Science: Dynamical masses of galaxy clusters discovered with the Sunyaev-Zel'dovich effect* (Gemini Focus)

### Outreach

**[2018]** *Public Astronomical Observations in Spanish*, Princeton University.

**[2012]** *Astronomy Course for Seniors*, U. Católica.

**[2011]** *Stars Night*, observation nights for elementary and middle school students in social risk organized by ESO-Santiago.

**[2010]** Invited talk on board the "FFG14 Almirante Latorre" Chilean Navy ship, Valparaiso, Chile.

**[2010]** *The Universe*, series of talks for elementary school students in social risk organized by U. Católica.

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## Technical skills

I am an experienced python programmer, and I also have some experience with IRAF/PyRAF. I have written pygmos, a Python/PyRAF pipeline to reduce Gemini-GMOS spectra which is available [here](#). I am one of the lead developers and maintainers of the galaxy-galaxy lensing pipeline used by the KiDS collaboration (written in python, but which is not public at the moment). Other codes I have written are posted at my [github](#) page.

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## Other Work Experience

**[2007 – 2008]** Ski instructor at Homewood Mountain Ski Resort in Lake Tahoe, CA. Obtained the certification as Level I ski instructor by the Professional Ski Instructors of America (PSIA).

**[2006 – 2007]** Ski lift operator at Sun Valley Resort, Sun Valley, ID.

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## References

- Prof. Henk Hoekstra (*PhD advisor*)  
Leiden Observatory, Universiteit Leiden  
Niels Bohrweg 2, NL-2333 CA Leiden, The Netherlands  
Phone: +31 (71) 527 5594  
E-mail: [hoekstra@strw.leidenuniv.nl](mailto:hoekstra@strw.leidenuniv.nl)
  - Prof. David N. Spergel  
Department of Astrophysical Sciences, Princeton University  
4 Ivy Ln, Princeton, NJ 08544, USA  
Phone: +1 (609) 258 3589  
E-mail: [dns@astro.princeton.edu](mailto:dns@astro.princeton.edu)
  - Prof. John P. Hughes  
Department of Physics and Astronomy, Rutgers University  
136 Frelinghuysen Rd., Piscataway, NJ 08854, USA  
Phone: +1 (848) 445 8878  
E-mail: [jph@physics.rutgers.edu](mailto:jph@physics.rutgers.edu)
  - Prof. L. Felipe Barrientos (*MSc advisor*)  
Instituto de Astrofísica, P. Universidad Católica de Chile  
Casilla 306, Santiago 22, Chile  
Phone: +56 (2) 2354 4941  
E-mail: [barrientos@astro.uc.cl](mailto:barrientos@astro.uc.cl)
  - Dr. Felipe Menanteau  
Department of Astronomy, University of Illinois at Urbana-Champaign  
1002 W. Green St., Urbana, IL 61801, USA  
Phone: +1 (217) 244 6297  
E-mail: [felipe@illinois.edu](mailto:felipe@illinois.edu)
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# Publication list

I have co-authored 56 scientific articles intended for peer-reviewed publication, including 7 first-author papers. They have been cited more than 2,000 times and have an  $h$ -index of 24, with more than 200 citations on my first-author papers. My publications include three companion reviews on galaxy alignments written for a special issue of Space Science Reviews (B. Joachimi et al. 2015, A. Kiessling et al. 2015, D. Kirk et al. 2015). The full list of publications is summarized below, and can be accessed at [this url](#). I also wrote an invited ‘News & Views’ article for the 4 July 2017 edition of Nature Astronomy, accessible [here](#).

This document is maintained live on [github](#).

## First-Author Papers

7. **C. Sifón**, R. Herbonnet, H. Hoekstra, R. F. J. van der Burg, M. Viola, “**The Galaxy-Subhalo Connection in Low-Redshift Galaxy Clusters from Weak Gravitational Lensing**”, 2018, [MNRAS](#), 478, 1244 [[arXiv](#)]
6. **C. Sifón**, R. F. J. van der Burg, H. Hoekstra, A. Muzzin, R. Herbonnet, “**A First Constraint on the Average Mass of Ultra Diffuse Galaxies from Weak Gravitational Lensing**”, 2018, [MNRAS](#), 473, 3747 [[arXiv](#)]
5. **C. Sifón** et al. (25 co-authors), “**The Atacama Cosmology Telescope: Dynamical Masses for 44 SZ-Selected Galaxy Clusters over 755 Square Degrees**”, 2016, [MNRAS](#), 461, 248 [[arXiv](#)]
4. **C. Sifón** et al. (26 co-authors), “**The Masses of Satellites in GAMA Galaxy Groups from 100 Square Degrees of KiDS Weak Lensing Data**”, 2015, [MNRAS](#), 454, 3938 [[arXiv](#)]
3. **C. Sifón**, H. Hoekstra, M. Cacciato, M. Viola, F. Köhlinger, R. F. J. van der Burg, D. J. Sand, M. L. Graham, “**Constraints on the Alignments of Galaxies in Galaxy Clusters from  $\sim 14,000$  Spectroscopic Members**”, 2015, [A&A](#), 575, A48 [[arXiv](#)]
2. **C. Sifón**, F. Menanteau, J. P. Hughes, M. Carrasco, L. F. Barrientos, “**Strong Lensing Analysis of PLCK G004.5–19.5, a Planck-Discovered Cluster Hosting a Radio Relic at  $z = 0.52$** ”, 2014, [A&A](#), 562, A43 [[arXiv](#)]
1. **C. Sifón** et al. (36 co-authors), “**The Atacama Cosmology Telescope: Dynamical Masses and Scaling Relations for a Sample of Massive Sunyaev-Zel’dovich Effect Selected Galaxy Clusters**”, 2013, [ApJ](#), 772, 25 [[arXiv](#)]

## Major Contributor Papers

11. M. Hilton, M. Hasselfield, **C. Sifón**, et al. (43 co-authors), “**The Atacama Cosmology Telescope: The Two-Season ACTPol Sunyaev-Zel’dovich Effect Selected Cluster Catalog**”, 2018, [ApJS](#), 235, 20 [[arXiv](#)]
10. J. G. Albert, **C. Sifón**, A. Stroe, F. Mernier, H. T. Intema, H. J. A. Röttgering, G. Brunetti, “**Complex Diffuse Emission in the  $z = 0.52$  Cluster PLCK G004.5–19.5**”, 2017, [A&A](#), 607, A4 [[arXiv](#)]
9. R. F. J. van der Burg, H. Hoekstra, A. Muzzin, **C. Sifón**, et al. (17 co-authors), “**The Abundance of Ultra-Diffuse Galaxies from Groups to Clusters: UDGs are Relatively More Common in More Massive Haloes**”, 2017, [A&A](#), 607, A79 [[arXiv](#)]

8. E. van Uitert, M. Cacciato, H. Hoekstra, M. Brouwer, **C. Sifón**, et al. (29 co-authors), **“The Stellar-to-Halo Mass Relation of GAMA Galaxies from 100 Square Degrees of KiDS Weak Lensing Data”**, 2016, [MNRAS, 459, 3251](#) [[arXiv](#)]
7. D. Kirk, M. L. Brown, H. Hoekstra, B. Joachimi, T. D. Kitching, R. Mandelbaum, **C. Sifón**, M. Cacciato, A. Choi, A. Kiessling, A. Leonard, A. Rassat, B. Malte Schäfer, **“Galaxy Alignments: Observations and Impact on Cosmology”**, 2015, [Space Sci. Rev., 193, 139](#) [[arXiv](#)]
6. A. Kiessling, M. Cacciato, B. Joachimi, D. Kirk, T. D. Kitching, A. Leonard, R. Mandelbaum, B. Malte Schäfer, **C. Sifón**, M. L. Brown, A. Rassat, **“Galaxy Alignments: Theory, Modelling & Simulations”**, 2015, [Space Sci. Rev., 193, 67](#) [[arXiv](#)]
5. B. Joachimi, M. Cacciato, T. D. Kitching, A. Leonard, R. Mandelbaum, B. Malte Schäfer, **C. Sifón**, H. Hoekstra, A. Kiessling, D. Kirk, A. Rassat, **“Galaxy Alignments: an Overview”**, 2015, [Space Sci. Rev., 193, 1](#) [[arXiv](#)]
4. R. F. J. van der Burg, H. Hoekstra, A. Muzzin, **C. Sifón**, M. L. Balogh, S. McGee, **“Evidence for the Inside-Out Growth of the Stellar Mass Distribution in Galaxy Clusters since  $z \sim 1$ ”**, 2015, [A&A, 577, 19](#) [[arXiv](#)]
3. M. Hilton, M. Hasselfield, **C. Sifón**, et al. (26 co-authors), **“The Atacama Cosmology Telescope: The Stellar Content of Galaxy Clusters Selected Using the Sunyaev-Zel’dovich Effect”**, 2013, [MNRAS, 435, 3469](#) [[arXiv](#)]
2. F. Menanteau, **C. Sifón**, et al. (26 co-authors), **“The Atacama Cosmology Telescope: Physical Properties of Sunyaev-Zel’dovich Effect Clusters on the Celestial Equator”**, 2013, [ApJ, 765, 67](#) [[arXiv](#)]
1. F. Menanteau, J. P. Hughes, **C. Sifón**, et al. (27 co-authors), **“The Atacama Cosmology Telescope: ACT-CL J0102–4915 “El Gordo,” a Massive Merging Cluster at Redshift 0.87”**, 2012, [ApJ, 748, 7](#) [[arXiv](#)]

## Contributing Author Papers (all including C. Sifón)

38. C. Hikage et al. (30 co-authors), **“Cosmology from Cosmic Shear Power Spectra with Subaru Hyper Suprime-Cam First-Year Data”**, 2018, [arXiv:1809.09148](#), submitted to PASJ
37. K. Knowles et al. (14 co-authors), **“GMRT 610 MHz Observations of Galaxy Clusters in the ACT Equatorial Sample”**, 2018, [arXiv:1806.09579](#), submitted to MNRAS
36. H. Miyatake et al. (58 co-authors), **“Weak-Lensing Mass Calibration of ACTPol Sunyaev-Zel’dovich Clusters with the Hyper Suprime-Cam Survey”**, 2018, [arXiv:1804.05873](#), submitted to ApJ
35. M. Brouwer et al. (18 co-authors), **“Studying Galaxy Troughs and Ridges using Weak Gravitational Lensing with the Kilo-Degree Survey”**, 2018, [MNRAS, 481, 5189](#) [[arXiv](#)]
34. R. Wojtak et al. (17 co-authors), **“Galaxy Cluster Mass Reconstruction Project - IV. Understanding the Effects of Imperfect Membership on Cluster Mass Estimation”**, 2018, [MNRAS, 481, 324](#) [[arXiv](#)]
33. A. Jakobs et al. (20 co-authors), **“Multi-Wavelength Scaling Relations in Galaxy Groups: a Detailed Comparison of GAMA and KiDS Observations to BAHAMAS Simulations”**, 2018, [MNRAS, 480, 3338](#) [[arXiv](#)]

32. A. Dvornik et al. (14 co-authors), **“Unveiling Galaxy Bias via the Halo Model, KiDS and GAMA”**, 2018, [MNRAS](#), **479**, 1240 [[arXiv](#)]
31. J. P. Greco et al. (13 co-authors), **“Illuminating Low-Surface-Brightness Galaxies with the Hyper Suprime-Cam Survey”**, 2018, [ApJ](#), **857**, 104 [[arXiv](#)]
30. J. F. Wu, P. Aguirre, A. J. Baker, M. J. Devlin, M. Hilton, J. P. Hughes, L. Infante, R. R. Lindner, **C. Sifón**, **“Herschel and ALMA Observations of Massive SZE-selected Clusters”**, 2018, [ApJ](#), **853**, 195 [[arXiv](#)]
29. E. Medezinski et al. (16 co-authors), **“Source Selection for Cluster Weak Lensing Measurements in the Hyper Suprime-Cam Survey”**, 2018, [PASJ](#), **70**, 30 [[arXiv](#)]
28. E. Medezinski et al. (12 co-authors), **“Planck Sunyaev-Zel’dovich Cluster Mass Calibration using Hyper Suprime-Cam Weak Lensing”**, 2018, [PASJ](#), **70**, 28 [[arXiv](#)]
27. R. Mandelbaum et al. (27 co-authors), **“The First-Year Shear Catalog of the Subaru Hyper Suprime-Cam SSP Survey”**, 2018, [PASJ](#), **70**, 25 [[arXiv](#)]
26. L. Old et al. (18 co-authors), **“Galaxy Cluster Mass Reconstruction Project: III. The Impact of Dynamical Substructure on Cluster Mass Estimates”**, 2018, [MNRAS](#), **475**, 853 [[arXiv](#)]
25. M. Velliscig et al. (17 co-authors), **“Galaxy-Galaxy Lensing in EAGLE: Comparison with Data from 180 Square Degrees of the KiDS and GAMA Surveys”**, 2017, [MNRAS](#), **471**, 2856 [[arXiv](#)]
24. A. Dvornik et al. (22 co-authors), **“A KiDS Weak Lensing Analysis of Assembly Bias in GAMA Galaxy Groups”**, 2017, [MNRAS](#), **468**, 3251 [[arXiv](#)]
23. M. M. Brouwer et al. (22 co-authors), **“First Test of Verlinde’s Theory of Emergent Gravity Using Weak Gravitational Lensing Measurements”**, 2017, [MNRAS](#), **466**, 2547 [[arXiv](#)]
22. M. M. Brouwer et al. (36 co-authors), **“Dependence of GAMA Galaxy Halo Masses on the Cosmic Web Environment from 100 Square Degrees of KiDS Weak Lensing Data”**, 2016, [MNRAS](#), **462**, 4451 [[arXiv](#)]
21. N. Battaglia et al. (39 co-authors), **“Weak-Lensing Mass Calibration of the Atacama Cosmology Telescope Equatorial Sunyaev-Zel’dovich Cluster Sample with the Canada-France-Hawaii Telescope Stripe 82 Survey”**, 2016, [JCAP](#), **08**, 013 [[arXiv](#)]
20. S. Bellstedt et al. (16 co-authors), **“The Evolution in the Stellar Mass of Brightest Cluster Galaxies over the Past 10 Billion Years”**, 2016, [MNRAS](#), **460**, 2862 [[arXiv](#)]
19. K. Knowles et al. (21 co-authors), **“A Giant Radio Halo in a Low-Mass SZ-Selected Galaxy Cluster: ACT-CL J0256.5+0006”**, 2016, [MNRAS](#), **459**, 4240 [[arXiv](#)]
18. D. Crichton et al. (22 co-authors), **“Evidence for the Thermal Sunyaev-Zel’dovich Effect Associated with Quasar Feedback”**, 2016, [MNRAS](#), **458**, 1478 [[arXiv](#)]
17. J. T. A. de Jong et al. (49 co-authors), **“The First and Second Data Releases of the Kilo Degree Survey”**, 2015, [A&A](#), **582**, 62 [[arXiv](#)]
16. K. Kuijken et al. (35 co-authors), **“Gravitational Lensing Analysis of the Kilo Degree Survey”**, 2015, [MNRAS](#), **454**, 3500 [[arXiv](#)]
15. K. Y. Ng, W. A. Dawson, D. Wittman, M. J. Jee, J. P. Hughes, F. Menanteau, **C. Sifón**, **“The Return of the Merging Galaxy Subclusters of El Gordo?”**, 2015, [MNRAS](#), **453**, 1531 [[arXiv](#)]

14. M. Viola et al. (27 co-authors), “Dark Matter Halo Properties of GAMA Galaxy Groups from 100 Square Degrees of KiDS Weak Lensing Data”, 2015, [MNRAS](#), 452, 3529 [[arXiv](#)]
13. R. R. Lindner et al. (25 co-authors), “The Atacama Cosmology Telescope: the LABOCA/ACT Survey of Clusters at All Redshifts”, 2015, [ApJ](#), 803, 79 [[arXiv](#)]
12. B. Kirk et al. (23 co-authors), “SALT Spectroscopic Observations of Galaxy Clusters Detected by ACT and a Type II Quasar Hosted by a Brightest Cluster Galaxy”, 2015, [MNRAS](#), 449, 4010 [[arXiv](#)]
11. L. Old et al. (24 co-authors), “Galaxy Cluster Mass Reconstruction Project: II. Results for Galaxy-Based Techniques with Improved Models”, 2015, [MNRAS](#), 449, 1897 [[arXiv](#)]
10. M. B. Gralla et al. (41 co-authors), “A Measurement of the Millimeter Emission and the Sunyaev-Zel’dovich Effect Associated with Low-Frequency Radio Sources”, 2014, [MNRAS](#), 445, 460 [[arXiv](#)]
9. L. Old et al. (21 co-authors), “Galaxy Cluster Mass Reconstruction Project: I. Methods and First Results on Galaxy-Based Techniques”, 2014, [MNRAS](#), 441, 1513 [[arXiv](#)]
8. M. J. Jee, J. P. Hughes, F. Menanteau, **C. Sifón**, L. F. Barrientos, L. Infante, R. Mandelbaum, K. Y. Ng, “Weighing “El Gordo” with a Precision Scale: Hubble Space Telescope Weak-Lensing Analysis of the Galaxy Cluster ACT-CL J0102-4915 at  $z = 0.87$ ”, 2014, [ApJ](#), 785, 20 [[arXiv](#)]
7. M. Hasselfield et al. (44 co-authors), “The Atacama Cosmology Telescope: Sunyaev-Zel’dovich Selected Galaxy Clusters at 148 GHz from Three Seasons of Data”, 2013, [JCAP](#), 07, 008 [[arXiv](#)]
6. E. Calabrese et al. (34 co-authors), “Cosmological Parameters from Pre-Planck Cosmic Microwave Background Measurements”, 2013, [Phys. Rev. D](#), 87, 103012 [[arXiv](#)]
5. N. Sehgal et al. (36 co-authors), “The Atacama Cosmology Telescope: Relation between Galaxy Cluster Optical Richness and Sunyaev-Zel’dovich Effect”, 2013, [ApJ](#), 767, 38 [[arXiv](#)]
4. H. Miyatake et al. (28 co-authors), “Subaru Weak-Lensing Measurement of a  $z = 0.81$  Cluster Discovered by the Atacama Cosmology Telescope Survey”, 2013, [MNRAS](#), 429, 3627 [[arXiv](#)]
3. B. D. Sherwin et al. (31 co-authors), “The Atacama Cosmology Telescope: Cross-correlation of CMB Lensing and Quasars”, 2012, [Phys. Rev. D](#), 86, 083006 [[arXiv](#)]
2. N. Hand et al. (58 co-authors), “Evidence of Galaxy Cluster Motions with the Kinematic Sunyaev-Zel’dovich Effect”, 2012, [Phys. Rev. Letters](#), 109, 041101 [[arXiv](#)]
1. E. D. Reese et al. (44 co-authors), “The Atacama Cosmology Telescope: High-Resolution Sunyaev-Zel’dovich Array Observations of ACT SZE-selected Clusters from the Equatorial Strip”, 2012, [ApJ](#), 751, 12 [[arXiv](#)]