

Curriculum Vitae
Hao-Yi (Heidi) Wu

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Current Position

California Institute of Technology Postdoctoral Scholar, Department of Physics Supervisor: Dr. Olivier Doré	2014-present
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Past Position

The University of Michigan Postdoctoral Research Fellow, Department of Physics Supervisor: Prof. Dragan Huterer	2011-2014
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Education

Stanford University Ph.D. Physics, awarded September 2011 Advisor: Prof. Risa Wechsler Thesis: "Precision Cosmology from Galaxy Cluster Surveys"	2005-2011
National Taiwan University B.S. Physics, awarded June 2005	2001-2005

Awards

Gabilan Stanford Graduate Fellowship, Stanford University	2008-2010
McMicking Stanford Graduate Fellowship, Stanford University	2008
Dean's Award, National Taiwan University	2005
Presidential Awards, National Taiwan University	2002-2004

Research

Research Interests

- Theoretical and computational cosmology and extragalactic astrophysics
- Cosmic far-infrared background and submillimeter galaxies as probes of star formation
- Galaxy clusters as laboratories of cosmology and astrophysics
- Large-scale structure as probes of dark energy

Major Research Results

- Physically interpreted **cosmic far-infrared background** and **submillimeter galaxies** observed by Planck and Herschel, constrained cosmic star-formation history, and optimized future survey strategies (1 publication, 5 presentations, 3 manuscripts to be submitted)
- Developed **Rhapsody-G hydrodynamic simulations of galaxy clusters**, quantified multi-wavelength observable–mass relations, and improved the accuracy of cluster mass calibration (3 publications, 1 manuscript to be submitted)
- Developed **Rhapsody N-body simulations of galaxy clusters**, achieved simultaneous high resolution and large statistics, and quantified the dark matter halo and subhalo properties in a new mass regime (4 publications)
- Optimized multi-wavelength **surveys of galaxy clusters**, identified important sources of systematic errors, and optimized the strategies to mitigate systematics (5 publications)

Proposal Award

Hubble Space Telescope Cycle 19

June 2011

“Massive Galaxy Clusters at High Redshift: A Challenge to CDM or to Cluster Mass Calibration?”

PI: R. Wechsler, Co-PI: **H.-Y. Wu** and O. Hahn

(Funding for supporting Prof. Wechsler’s student for a year)

Publications

[Astrophysics Data System Link](#)

- [17] **H.-Y. Wu**, O. Doré, and R. Teyssier. [Interpreting the cosmic far-infrared background anisotropies using a gas regulator model](#). *ArXiv:1607.02546*, 1607.02546, July 2016.
- [16] D. Martizzi, O. Hahn, **H.-Y. Wu**, A. E. Evrard, R. Teyssier, and R. H. Wechsler. [RHAPSODY-G simulations - II. Baryonic growth and metal enrichment in massive galaxy clusters](#). *Monthly Notices of the Royal Astronomical Society*, 459:4408–4427, July 2016.
- [15] O. Hahn, D. Martizzi, **H.-Y. Wu**, A. E. Evrard, R. Teyssier, and R. H. Wechsler. [Rhapsody-G simulations I: the cool cores, hot gas and stellar content of massive galaxy clusters](#). *arXiv:1509.04289*, September 2015.
- [14] **H.-Y. Wu**, A. E. Evrard, O. Hahn, D. Martizzi, R. Teyssier, and R. H. Wechsler. [RHAPSODY-G simulations: galaxy clusters as baryonic closed boxes and the covariance between hot gas and galaxies](#). *Monthly Notices of the Royal Astronomical Society*, 452:1982–1991, September 2015.
- [13] D. Huterer, D. Kirkby, R. Bean, A. Connolly, K. Dawson, S. Dodelson, A. Evrard, B. Jain, M. Jarvis, E. Linder, R. Mandelbaum, M. May, A. Raccanelli, B. Reid, E. Rozo, F. Schmidt, N. Sehgal, A. Slosar, A. van Engelen, **H.-Y. Wu**, and G. Zhao. [Growth of cosmic structure: Probing dark energy beyond expansion](#). *Astroparticle Physics*, 63:23–41, March 2015.
- [12] **H.-Y. Wu**, O. Hahn, A. E. Evrard, R. H. Wechsler, and K. Dolag. [Virial scaling of galaxies in clusters: bright to faint is cool to hot](#). *Monthly Notices of the Royal Astronomical Society*, 436:460–469, November 2013.
- [11] **H.-Y. Wu** and D. Huterer. [The impact of systematic uncertainties in N-body simulations on the precision cosmology from galaxy clustering: a halo model approach](#). *Monthly Notices of the Royal Astronomical Society*, 434:2556–2571, September 2013.
- [10] Y.-Y. Mao, L. E. Strigari, R. H. Wechsler, **H.-Y. Wu**, and O. Hahn. [Halo-to-halo Similarity and Scatter in the Velocity Distribution of Dark Matter](#). *Astrophysical Journal*, 764:35, February 2013.
- [9] **H.-Y. Wu**, O. Hahn, R. H. Wechsler, P. S. Behroozi, and Y.-Y. Mao. [Rhapsody. II. Subhalo Properties and the Impact of Tidal Stripping From a Statistical Sample of Cluster-size Halos](#). *Astrophysical Journal*, 767:23, April 2013.
- [8] **H.-Y. Wu**, O. Hahn, R. H. Wechsler, Y.-Y. Mao, and P. S. Behroozi. [Rhapsody. I. Structural Properties and Formation History from a Statistical Sample of Re-simulated Cluster-size Halos](#). *Astrophysical Journal*, 763:70, February 2013.

- [7] P. S. Behroozi, R. H. Wechsler, **H.-Y. Wu**, M. T. Busha, A. A. Klypin, and J. R. Primack. [Gravitationally Consistent Halo Catalogs and Merger Trees for Precision Cosmology](#). *Astrophysical Journal*, 763:18, January 2013.
- [6] P. S. Behroozi, R. H. Wechsler, and **H.-Y. Wu**. [The ROCKSTAR Phase-space Temporal Halo Finder and the Velocity Offsets of Cluster Cores](#). *Astrophysical Journal*, 762:109, January 2013.
- [5] E. Rozo, E. Rykoff, B. Koester, B. Nord, **H.-Y. Wu**, A. Evrard, and R. Wechsler. [Extrinsic Sources of Scatter in the Richness-mass Relation of Galaxy Clusters](#). *Astrophysical Journal*, 740:53, October 2011.
- [4] E. Rozo, **H.-Y. Wu**, and F. Schmidt. [Stacked Weak Lensing Mass Calibration: Estimators, Systematics, and Impact on Cosmological Parameter Constraints](#). *Astrophysical Journal*, 735:118, July 2011.
- [3] **H.-Y. Wu**, A. R. Zentner, and R. H. Wechsler. [The Impact of Theoretical Uncertainties in the Halo Mass Function and Halo Bias on Precision Cosmology](#). *Astrophysical Journal*, 713:856–864, April 2010.
- [2] **H.-Y. Wu**, E. Rozo, and R. H. Wechsler. [Annealing a Follow-up Program: Improvement of the Dark Energy Figure of Merit for Optical Galaxy Cluster Surveys](#). *Astrophysical Journal*, 713:1207–1218, April 2010.
- [1] **H.-Y. Wu**, E. Rozo, and R. H. Wechsler. [The Effects of Halo Assembly Bias on Self-Calibration in Galaxy Cluster Surveys](#). *Astrophysical Journal*, 688:729–741, December 2008.

Presentations

Public Outreach Presentation

Saturday Morning Physics, University of Michigan Dec. 2012
“Cosmic Rhapsody: From the Echo of Big Bang to the Orchestration of the Universe”
(an hour-long popular science talk and demonstrations to an audience of ~ 300 of the Ann Arbor Community, also broadcasted on Community Television Network and available on [YouTube](#))

Seminar Presentations

“A Physical Model for the Anisotropies of Cosmic Far-infrared Background” Feb. 2016
Postdoc Lunch Seminar Series, Caltech

“A Physical Model for the Anisotropies of Cosmic Far-infrared Background” Jan. 2016
KIPAC Tea Talk, Stanford University

“Cosmology from gas and stars of galaxy clusters: results from Rhapsody-G hydrodynamic simulations” June 2015
Astrophysics Luncheon Seminar, Jet Propulsion Laboratory

“Probing Dark Energy Using the Growth of Structure: the Role of Simulations” Apr. 2014
Cosmology Seminar, Case Western Reserve University

“Probing Growth of Structure Using Galaxy Dynamics: A Converging Picture of Velocity Bias” Aug. 2013
Cosmology Seminar, University of Pennsylvania

“Virial Scaling of Galaxies in Clusters: Bright to Faint is Cool to Hot” July 2013
Astronomy Seminar, ETH Zurich

“Precision Cosmology from Galaxy Clusters and Large-scale Structure: The Role of N-body Simulations” July 2013
Cosmology Seminar, University Observatory Munich

“Precision Cosmology from Galaxy Clusters and Large-scale Structure: The Role of N-body Simulations” May 2013
Astrophysics Colloquium, IAA Academia Sinica, Taipei

“N-body Simulations of Galaxy Clusters: Is Overmerging Still an Issue?” Dec. 2011
Cosmology Seminar, CCAPP, Ohio State University

“Precision Cosmology From Galaxy Cluster Surveys: Understanding the Observable-Mass Distribution” Feb. 2011
FLASH Seminar, UC Santa Cruz

“Precision Cosmology From Galaxy Cluster Surveys: Understanding the Observable-Mass Distribution” Cosmology Seminar, Yale University	Jan. 2011
“Precision Cosmology From Galaxy Cluster Surveys: Understanding the Observable-Mass Distribution” Cosmology Seminar, University of Michigan	Jan. 2011
“Precision Cosmology From Galaxy Cluster Surveys: Observational and Theoretical Challenges” KICP Friday Seminar, University of Chicago	Oct. 2010
“Precision Cosmology From Galaxy Cluster Surveys: Observational and Theoretical Challenges” Cosmology Group Seminar, UC Davis	Oct. 2010
“Precision Cosmology From Galaxy Cluster Surveys: Observational and Theoretical Challenges” Cosmology Seminar, BCCP, UC Berkeley	Sept. 2010

Conference Presentations

“A Physical Model for the Anisotropies of Cosmic Far-infrared Background” COSMO-16, Ann Arbor, Michigan (International conference, ~300 participants)	Aug. 2016
“Rhapsody-G simulations of galaxy clusters: the impact of AGN feedback on cool cores and X-ray scaling relations” Computing the Universe: At the Intersection of Computer Science and Cosmology Banff International Research Station, Oaxaca, Mexico (Invited participation, ~35 participants)	June 2016
“A Physical Model for the Anisotropies of Cosmic Far-infrared Background” SnowPAC 2016: The Galaxy-Halo Connection, Utah (International conference, ~150 participants)	Mar. 2016
“A Physical Model for the Anisotropies of Cosmic Far-infrared Background” Statistical sampling and non-sampling methods in Cosmology Berkeley Center for Cosmological Physics (International workshop, ~50 participants)	Jan. 2016
“What can we learn about star formation rate from resolved vs. unresolved dusty star-forming galaxies?” Santa Cruz Galaxy Workshop (Nationwide workshop, ~100 participants)	Aug. 2015
“Cluster mass cross-calibration: the covariance between hot gas and galaxies in clusters” SnowCLUSTER 2015, Utah (International conference, ~200 participants)	Mar. 2015

<p>“Rhapsody-G: Covariance between gas and stars in galaxy clusters” Computing the Universe Symposium and Workshop, Berkeley (Nationwide workshop, ~100 participants)</p>	Jan. 2015
<p>“Cosmology from gas and stars of galaxy clusters: results from Rhapsody-G hydrodynamical simulations” Caltech ObsCos Seminar</p>	Oct. 2014
<p>“Probing growth of cosmic structure using galaxy dynamics: a converging picture of velocity bias” COSMO-14, Chicago (International conference, ~300 participants)</p>	Aug. 2014
<p>“Quantifying the baryon mass fraction of galaxy clusters” Future Directions in Galaxy Cluster Surveys, Paris (International conference, ~150 participants)</p>	June 2014
<p>“Quantifying the baryon mass fraction of galaxy clusters” Zeldovich 100, Space Research Institute, Moscow (International symposium, ~200 participants)</p>	June 2014
<p>“Galaxies are not necessarily test particles: characterizing galaxy velocity bias” APS Ohio-Region Section Meeting, Cincinnati</p>	Oct. 2013
<p>“Galaxies are not necessarily test particles” Cosmology After Planck Workshop, University of Michigan (Nationwide workshop, ~50 participants)</p>	Sept. 2013
<p>“Rhapsody: Halo profiles and subhalo properties from a statistical sample of re-simulated cluster-size halos” SnowCLUSTER 2013, Utah (International conference, ~200 participants)</p>	Mar. 2013
<p>“Rhapsody: Halo profiles and subhalo properties from a statistical sample of re-simulated cluster-size halos” The Mass Profiles of Galaxy Clusters, Madonna di Campiglio, Italy (International conference, ~200 participants)</p>	Mar. 2013
<p>“Precision Cosmology with Galaxy Clustering: Impact of Theoretical Uncertainties” Galaxy Cluster Seminar, University of Michigan</p>	Nov. 2012
<p>“The Impact of Theoretical Systematics on Cosmological Parameter Constraints from Galaxy Clustering” Workshop on Cosmic Acceleration, Carnegie Mellon University (Nationwide conference, ~80 participants)</p>	Aug. 2012

<p>“Rhapsody Cluster Re-simulation Project: How does formation history affect (or not affect) the properties of clusters?” Galaxy Cluster Seminar, University of Michigan</p>	July 2012
<p>“Theoretical Uncertainties in the Modeling of Galaxy Clustering” Galaxy Cluster Seminar, University of Michigan</p>	Mar. 2012
<p>“N-body Simulations of Galaxy Clusters: Why Do We Need Orphan Galaxies?” KIPAC Tea Talk, Stanford University</p>	May 2011
<p>“Cluster Observable-Mass Distribution and Halo Assembly History” Essential Cosmology for the next Generation, Puerto Vallarta, Mexico (International conference, ~150 participants)</p>	Jan. 2011
<p>“Spectroscopic Follow-ups and Improvement of Dark Energy FoM from Cluster Counts” The Dark Energy Survey Collaboration Meeting, Fermilab (International conference, ~200 participants)</p>	Oct. 2010
<p>“Measuring Halo Bias in Galaxy Cluster Surveys: What Will We Learn About Halo Assembly and Cosmology?” Santa Cruz Galaxy Formation Workshop (International conference, ~100 participants)</p>	Aug. 2010
<p>“Precision Cosmology from Future Galaxy Cluster Surveys” Galaxy Clusters as Cosmic Laboratories, MIT (International workshop, ~100 participants)</p>	Jan. 2010
<p>“Precision Cosmology from Future Galaxy Cluster Surveys” Galaxy Clusters in the Early Universe, ESO Workshop in Chile (International conference, ~200 participants)</p>	Nov. 2009
<p>“Annealing Follow-up Programs for Optical Galaxy Cluster Surveys” Santa Fe Cosmology Summer Workshop (International conference, ~150 participants)</p>	July 2009
<p>“Dark Energy Figure of Merit for DES Clusters” DES Cluster Working Group Workshop, Stanford University</p>	Mar. 2009
<p>“Dark Energy Studies with Galaxy Clusters: The Efficacy of Self-Calibration and Follow-up Observations” KIPAC Tea Talk, Stanford University</p>	Jan. 2009
<p>“Projection of Dark Energy Figure of Merit for DES Clusters: Effects of Nuisance Parameters” The Dark Energy Survey Collaboration Meeting, Ohio State University (International conference, ~200 participants)</p>	Nov. 2008

“Self-Calibration: Systematics and Efficacy” Cosmology in Northern California, Stanford University	Apr. 2008
“Self-Calibration and Assembly Bias in Galaxy Cluster Surveys” KIPAC Tea Talk, Stanford University	Sept. 2007
“Self-Calibration and Assembly Bias in Galaxy Cluster Surveys” Santa Cruz Galaxy Formation Workshop (International conference, ~100 participants)	Aug. 2007

Poster Presentations

“A Physical Model for the Anisotropies of Cosmic Far-infrared Background” Signals from the Deep Past, Malta	July 2016
“What can we learn about galaxy evolution from cosmic infrared background (CIB)?” Gas, dust, and star formation from the local to the far Universe, Crete	May 2015
“Virial Scaling of Galaxies in Clusters: Bright to Faint is Cool to Hot” Tracing Cosmic Evolution with Clusters of Galaxies, Sesto, Italy	July 2013
“Impact of systematic uncertainties in N-body simulations on the precision cosmology from galaxy clustering” The Mass Profiles of Galaxy Clusters, Madonna di Campiglio, Italy	Mar. 2013
“Toward A Complete Satellite Galaxy Population in Dark Matter Simulations” Cosmology with X-ray and Sunyaev-Zeldovich Effect Observations of Galaxy Clusters, Huntsville	Sept. 2011
“Dark Energy Constraints from Optical Galaxy Clusters: the Impact of Observational and Theoretical Uncertainties” From Massive Galaxy Formation to Dark Energy, IPMU, Japan	June 2010
“Dark Energy Studies with Galaxy Clusters: The Efficacy of Self-Calibration and Follow-up Observations” The 24th Texas Symposium on Relativistic Astrophysics, Vancouver	Dec. 2008
“Dark Energy Studies with Galaxy Clusters: The Systematics and Efficacy of Self-Calibration” Santa Fe Cosmology Summer Workshop	July 2008

Outreach and Services

Outreach Activities

Science Literacy Night, Norma Coombs Elementary School, Pasadena (science demonstrations for K-5th grade students and their families)	Feb. 2016
Skype conference with a class of 1st graders in Knollwood Elementary Salisbury, NC (discussing the Sun, the Moon, and the Earth)	Nov. 2015
Caltech Explorers Club (developing and demonstrating the course Our Galaxy the Milky Way at the Polytechnic School in Pasadena)	Feb. 2015
Solar eclipse viewing, McKinley School in Pasadena (demonstrating and explaining concepts in the school-wide event)	Oct. 2014
Michigan Physics Olympiad, University of Michigan (annual one-day event of scientific experiments for area high schools)	May 2014
Presentation “Preparing for a Talk About Your Research” (sharing my experience of public speech in Professor Judy Dyers Oral Presentation class, English Language Institute of University of Michigan)	Feb. 2013
The Science Bus, The East Palo Alto Charter School (weekly science demonstrations for 4th and 5th graders in a low-income part of the San Francisco Bay Area)	Fall 2008
SLAC Kids Day (astrophysics demonstrations for the children of SLAC employees)	Aug. 2008
Menlo School Visit, SLAC (astrophysics demonstrations for 9th graders visiting SLAC)	May 2008

Volunteering and Organizing Activities

Research Statement Workshop, Caltech Postdoctoral Association	Nov. 2015
Michigan Center of Theoretical Physics Workshop	Sept. 2013
Stanford Physics Open House	Apr. 2008
The SLAC Public Lecture Series	Oct. 2007
The First International GLAST Symposium, Stanford University	Feb. 2007

Journal Review Activities

Astroparticle Physics
Astrophysical Journal
Monthly Notices of the Royal Astronomical Society

Teaching and Mentoring Experiences

Co-supervisions of Students

Mike Mills (N-body simulation, UM undergrad with Evrard)	2012-2013
Alan Coleman (data visualization, UM undergrad with Evrard)	Winter 2012
Vishaal Kalwani (data visualization, UM undergrad with Evrard)	2011-2012
Blythe Moreland (N-body simulation, UM undergrad with Wechsler)	Summer 2011
Adam Bouland (Fisher matrix, Yale undergrad with Wechsler)	Summer 2009

Teaching Assistantships in Stanford

Physics 161: Introduction to Extragalactic Astrophysics and Cosmology (physics majors)	2009, 2010, 2011
Physics 362: Advanced Extragalactic Astrophysics and Cosmology (graduate students in astrophysics)	2008, 2010
Physics 21: Mechanics (biology and pre-medical majors)	2006
Physics 43: Electricity and Magnetism (engineering majors)	2006
Physics 120: Intermediate Electricity and Magnetism (physics majors)	2006

Communication and Pedagogical Training

Language and Orientation Tutoring Program, Stanford University (semester-long tutoring on writing and oral presentation)	Summer 2010, 2011
Communication Strategies in Professional Life English for Foreign Students, Stanford University	Spring 2010
Voice and Articulation Intensive for Nonnative English Speakers Center for Teaching and Learning, Stanford University	Winter 2010
I-RITE/I-SPEAK (intensive presentation training) Center for Teaching and Learning, Stanford University	Sept. 2008
English in Action (English conversation and cultural exchange) The Bechtel International Center, Stanford University	2007-2011
Speaking and Teaching in English English for Foreign Students, Stanford University	Summer 2006
Teaching of Physics Seminar Physics Department, Stanford University	Winter 2006

References

Dr. Olivier Doré

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