

# Carlos J. Vargas

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## Education

- 2017 **Doctor of Philosophy (PH.D.) in Astronomy**, *New Mexico State University*, Las Cruces, NM.  
Dissertation: The Interaction Between In-situ Star Formation and the Matter Residing in Galaxy Halos  
Advisor: Dr. Rene Walterbos
- 2012 – 2015 **Master of Science (M.S.) in Astronomy**, *New Mexico State University*, Las Cruces, NM.  
Advisor: Dr. Rene Walterbos
- 2008 – 2012 **Bachelor of Science (B.S.) in Astrophysics, with Honors**, *Rutgers University*, New Brunswick, NJ.  
Advisor: Dr. Eric Gawiser

## Research Experience

- 2014 – **Star Formation of Edge-on Galaxies and its Relation to Radio Continuum Halos**, *New Mexico State University*, Las Cruces, NM.  
I used  $H\alpha$  and 24 micron infrared imaging to infer star formation properties of the Continuum Halos in Nearby Galaxies – an EVLA Survey (CHANG-ES) galaxies. I then used these data to predict the thermal component of the radio continuum emission in the CHANG-ES wavelength bands. This thermal prediction allows for separation of the thermal component from the non-thermal synchrotron radiation, which can then be studied individually. Through this project, I explored ways to quantify star formation properties in dusty environments, such as in edge-on galaxies.  
Advisor: Dr. Rene Walterbos
- 2016 **Green Bank Telescope Continuum Observations of CHANG-ES Galaxies**, *New Mexico State University*, Las Cruces, NM.  
I was trained and certified as a remote observer on the National Radio Astronomy Observatory (NRAO) Green Bank Telescope (GBT) in Green Bank, WV. I observed numerous CHANG-ES galaxies in L band continuum using the new Versatile GBT Astronomical Spectrometer (VEGAS) backend, as a contribution to the CHANG-ES collaboration.  
Advisors: Dr. Amanda Kepley and Dr. Rene Walterbos
- 2015 – 2017 **Narrowband Apache Point Observatory Observations of 27 Edge-on Galaxies**, *New Mexico State University*, Las Cruces, NM.  
I successfully proposed for, obtained, and reduced deep narrowband  $H\alpha$  imaging for 27 of the CHANG-ES sample galaxies with the Astrophysical Research Consortium (ARC) 3.5m telescope. The observations were taken in 20 half nights of observing.  
Advisor: Dr. Rene Walterbos

- 2012 – 2014 **Extra-planar Atomic Hydrogen in NGC 4559 and Its Relation to Star Formation**, *New Mexico State University*, Las Cruces, NM.  
I used 21 cm atomic hydrogen (HI) data cubes from the Hydrogen Accretion in LOcal Galaxies Survey (HALOGAS) to construct three-dimensional models of the HI emission in a moderately inclined nearby galaxy, NGC 4559. I separated the gas residing above and below the galaxy disk, or extra-planar gas, from the HALOGAS data cube. I then used star formation tracers  $H\alpha$  and the Galaxy Evolution Explorer (GALEX) far ultraviolet (FUV) data to confirm that the bulk of the extra-planar gas originated from within the disk, consistent with star formation processes. This international project involved an extended visit to Dwingeloo, The Netherlands to the Netherlands Institute for Radio Astronomy (ASTRON) to work closely with Dr. George Heald.  
Advisors: Dr. George Heald and Rene Walterbos
- 2011 – 2012 **To Stack or Not To Stack: Spectral Energy Distribution Properties of  $z=2.1$  Lyman Alpha Emitting Galaxies**, *Rutgers University*, New Brunswick, NJ.  
I compared the spectral energy distribution (SED) fitting results from a Markov Chain Monte Carlo (MCMC) code called 'GalMC' for a sample of Lyman Alpha Emitting Galaxies (LAEs) that were stacked, to those of the individual objects themselves. The SEDs used were obtained from the Cosmic Assembly Near Infrared Deep Extragalactic Legacy Survey (CANDELS), the largest Hubble Space Telescope (HST) survey in history. The CANDELS data made a study of stacked versus individual object SEDs at high redshift possible for the first time.  
Advisors: Dr. Eric Gawiser and Dr. Viviana Acquaviva
- 2010 – 2011 **Spectral Energy Distribution Properties of  $z=3.1$  Lyman Alpha Emitting Galaxies**, *Rutgers University*, New Brunswick, NJ.  
I wrote IDL code to identify potential counterpart matches of known LAEs with the CANDELS catalog of HST sources. I then used 'GalMC', to fit the CANDELS SEDs of these LAEs. This analysis made it possible to pinpoint the ages, stellar masses, and dust content of these distant galaxies.  
Advisor: Dr. Eric Gawiser
- Summer 2009 **Characterizing the Radio Frequency Interference Environment Using the Small Radio Telescope**, *Rutgers University*, New Brunswick, NJ.  
I used the Small Radio Telescope (SRT) to explore the radio frequency interference (RFI) environment of the central New Jersey area. This involved analyzing radio telescope data from both an analog and digital receiver. I also became familiar with installing hardware on the telescope itself, and troubleshooting both hardware and software issues.  
Advisor: Dr. Carlton Pryor

## Work Experience

- 2014 – **Graduate Assistant**, *New Mexico State University*, Las Cruces, NM.  
Responsible for active research in astronomy – Funded by the National Science Foundation (NSF) Graduate Research Fellowship Program (GRFP)
- 2012 – 2014 **Teaching Assistant**, *New Mexico State University*, Las Cruces, NM.  
Responsible for teaching the laboratory component of the introductory astronomy course "The Planets" (ASTR 105), teaching ~60 students per semester. Office hours, grading homework and exams were also incorporated.
- 2010 – 2012 **Research Assistant**, *Rutgers University*, New Brunswick, NJ.  
Assisted Dr. Eric Gawiser in various astronomy research projects, including familiarizing myself with a MCMC technique for the fitting of high-redshift galaxy SEDs. Through this work I was also responsible for writing code to identify counterpart objects within two separate catalogs of sources, so individual SEDs could be studied for objects of interest.
- 2008 **Summer Intern**, *Sabert Corporation*, Sayreville, NJ.  
Summer internship assisting human resources

## Honors and Awards

- 2014 **National Science Foundation Graduate Research Fellowship Award**, *The National Science Foundation*.  
The NSF Graduate Research Fellowship Program recognizes and supports outstanding graduate students in NSF-supported science, technology, engineering, and mathematics disciplines who are pursuing research-based Master's and doctoral degrees at accredited United States institutions. This award funded my CHANG-ES related Ph.D. research project.
- 2015 **Zia Award for Outstanding Graduate Student Research**, *New Mexico State University*, Las Cruces, NM.  
The Zia Award recognizes outstanding research and professional development at New Mexico State University Department of Astronomy
- 2008 **James Dickson Carr Scholarship**, *Rutgers University*, New Brunswick, NJ.  
The James Dickson Carr Scholarship is awarded to academically promising under-represented minorities attending Rutgers University.
- 2008 **Sabert Corporation Scholarship**, *Sabert Corporation*, Sayreville, NJ.  
The Sabert Corporation Scholarship is awarded to an academically outstanding graduating high school senior.

## Publications

### Peer-Reviewed Publications

- Submitted* C. J. Vargas, G. Heald, R. A. M. Walterbos, F. Fraternali, M. Patterson, R. Rand. Extra-planar Gas in NGC 4559 and Its Relation to Star Formation. *The Astrophysical Journal*.
- in prep.* C. J. Vargas, S. C. Mora-Partiarroyo, P. Schmidt, Y. Stein, R. A. M. Walterbos, D. Wang, R. Beck, J. Irwin, R. Rand, A. Kepley, F. Tabatabaei, A. Basu. Separation of Thermal Emission from Radio Continuum Observations of Edge-on Galaxies. *The Astrophysical Journal*, *In Preparation*.
- in prep.* R. A. M. Walterbos, C. J. Vargas, J. Irwin, D. Wang et al. H $\alpha$  Observations and Star Formation in CHANG-ES Galaxies. *The Astrophysical Journal*, *In Preparation*.
- 2014 C. J. Vargas, H. Bish, V. Acquaviva, E. Gawiser, S. Finkelstein, R. Ciardullo, M. L. N. Ashby, J. Feldmeier, H. Ferguson et al. To Stack or Not to Stack: Spectral Energy Distribution Properties of Ly $\alpha$ -emitting Galaxies at  $z=2.1$ . *The Astrophysical Journal*, Vol. 783.
- 2012 V. Acquaviva, C. J. Vargas, E. Gawiser, L. Guaita. The Curious Case of Ly $\alpha$  Emitters: Growing Younger from  $z\sim 3$  to  $z\sim 2$ ?. *The Astrophysical Journal*, Vol. 751.
- 2016 J. T. Li, R. Beck, R. J. Dettmar, G. Heald, J. Irwin et al. including C. J. Vargas. CHANG-ES -VI. Probing Supernova Energy Deposition in Spiral Galaxies Through Multiwavelength Relationships. *Monthly Notices of the Royal Astronomical Society*, Vol. 456, pp 1723 – 1783.
- 2011 A. M. Koekemoer, S. M. Faber, H. Ferguson, N. A. Grogin, D. Kocevski, et al. including C. J. Vargas. CANDELS: The Cosmic Assembly Near-infrared Deep Extragalactic Legacy Survey – The Hubble Space Telescope Observations, Imaging Data Products, and Mosaics. *The Astrophysical Journal Supplement Series*, Vol. 197.

### Conference Proceedings and Public Talks

- 2017 C. J. Vargas, S. C. Mora-Partiarroyo, P. Schmidt, R. A. M. Walterbos. Star Formation of Edge-on Galaxies and its Relation to Radio Continuum Halos. *The 229th Meeting of the American Astronomical Society*, Grapevine, TX, January 2017.
- 2016 C. J. Vargas, S. C. Mora-Partiarroyo, P. Schmidt, R. A. M. Walterbos. Thermal Separation in CHANG-ES Galaxies. *CHANG-ES Collaboration Meeting at the University of Wisconsin Madison*, Madison, WI, July 2016.

- 2015 C. J. Vargas, G. Heald, R. A. M. Walterbos, F. Fraternali, M. Paterson. Counter-Rotating and Lagging Extra-planar HI in NGC 4559. *The 225th Meeting of the American Astronomical Society*, Vol. 225, Abstract #227.06, Seattle, WA, January, 2015.
- 2015 C. J. Vargas. Extra-planar Gas and Radio Continuum Emission in Nearby Galaxies. *New Mexico State University Department of Astronomy Dissertation Proposal*, Las Cruces, NM, May, 2015.
- 2015 C. J. Vargas, R. A. M. Walterbos. An Introduction to Thermal/Non-thermal Separation. *CHANG-ES Collaboration Meeting at Max Planck Institute for Radio Astronomy*, Bonn, Germany, July 2015.
- 2014 C. J. Vargas, H. Bish, V. Acquaviva, E. Gawiser, S. Finkelstein, R. Ciardullo. To Stack or Not to Stack: Spectral Energy Distribution Properties of Lyman Alpha Emitting Galaxies at  $z=2.1$ . *The 223rd Meeting of the American Astronomical Society*, Vol. 223, Abstract #310.04, Washington, D.C, January, 2014.
- 2014 C. J. Vargas, G. Heald, R. A. M. Walterbos, F. Fraternali, R. Rand. Extra-planar Gas in the HALOGAS Galaxy NGC 4556. *CHANG-ES Collaboration Meeting at Queen's University*, Kingston, ON, Canada, July, 2014.
- 2014 C. J. Vargas, H. Bish, V. Acquaviva, E. Gawiser, S. Finkelstein, R. Ciardullo. To Stack or Not to Stack: Spectral Energy Distribution Properties of Lyman Alpha Emitting Galaxies at  $z=2.1$ . *Astronomical Society of Las Cruces*, Las Cruces, NM, April, 2014.
- 2014 C. J. Vargas, H. Bish, V. Acquaviva, E. Gawiser, S. Finkelstein, R. Ciardullo. To Stack or Not to Stack: Spectral Energy Distribution Properties of Lyman Alpha Emitting Galaxies at  $z=2.1$ . *29th Annual New Mexico Symposium*, Socorro, NM, January, 2014.
- 2013 C. J. Vargas, H. Bish, V. Acquaviva, E. Gawiser, S. Finkelstein, R. Ciardullo. To Stack or Not to Stack: Spectral Energy Distribution Properties of Lyman Alpha Emitting Galaxies at  $z=2.1$ . *The 221st Meeting of the American Astronomical Society*, Vol. 221, Abstract #112.08, Long Beach, CA, January, 2013.
- 2012 C. J. Vargas. To Stack or Not to Stack: Spectral Energy Distribution Properties of High-Redshift Lyman Alpha Emitting Galaxies. *Honors Thesis Colloquium, Rutgers University Physics and Astronomy Department*, Piscataway, NJ, May, 2012.
- 2012 C. J. Vargas, V. Acquaviva, E. Gawiser, K. Lai. Exploring the Photometric Properties of  $z=3.1$  Lyman Alpha Emitting Galaxies. *The 219th Meeting of the American Astronomical Society*, Vol. 219, Abstract #340.11, Austin, TX, January, 2012.
- 2011 C. J. Vargas, V. Acquaviva, E. Gawiser, K. Lai. Exploring the Photometric Properties of  $z=3.1$  Lyman Alpha Emitting Galaxies. *Tri-State Astronomy Conference at the City University of New York*, New York City, NY, October, 2011.

## Meeting Attendance

- planned* 2017 **The 229th Meeting of the American Astronomical Society**, Grapevine, TX, January 3–7, 2017.  
*dissertation talk*
- 2016 **CHANG-ES Collaboration Meeting at the University of Wisconsin Madison**, Madison, WI, July 18–22, 2016.  
*public talk*
- 2015 **The 225th Meeting of the American Astronomical Society**, Seattle, WA, January 4–8, 2015.  
*oral presentation*
- 2015 **CHANG-ES Collaboration Meeting at Max Planck Institute for Radio Astronomy**, Bonn, Germany, July 13–17, 2015.  
*oral presentation*

- 2014 **The 223rd Meeting of the American Astronomical Society**, *Washington, D.C.*, January 5–9, 2014.  
*oral presentation*
- 2014 **4th VLA Data Reduction Workshop**, *Socorro, NM*, October 27–31, 2014.
- 2014 **14th Synthesis Imaging Workshop**, *Socorro, NM*, May 13–20, 2014.
- 2014 **CHANG-ES Collaboration Meeting at Queen’s University**, *Kingston, ON, Canada*, July 21–25, 2014.  
*oral presentation*
- 2014 **29th Annual New Mexico Symposium**, *Socorro, NM*, January 17, 2014.  
*oral presentation*
- 2013 **The 221st Meeting of the American Astronomical Society**, *Long Beach, CA*, January 6–10, 2013.  
*oral presentation*
- 2012 **The 219th Meeting of the American Astronomical Society**, *Austin, TX*, January 8–12, 2012.  
*poster presentation*
- 2011 **Tri-State Astronomy Conference at the City University of New York**, *New York City, NY*, October 2011.  
*poster presentation*

## Technical Skills

Programming Languages	<b>Python</b>	<i>proficient</i>
	<b>IDL</b>	<i>proficient</i>
	<b>Matlab</b>	<i>proficient</i>
	<b>ΛT<sub>E</sub>X</b>	<i>proficient</i>
	<b>HTML</b>	<i>experienced</i>
	<b>SQL</b>	<i>experienced</i>
	<b>C/C++</b>	<i>experienced</i>
	<b>Fortran</b>	<i>experienced</i>
Operating Systems	<b>Unix</b>	<i>proficient</i>
	<b>Linux</b>	<i>proficient</i>
	<b>Mac OSX</b>	<i>proficient</i>
	<b>Microsoft Windows</b>	<i>proficient</i>
Tools & Technologies	<b>Git</b>	<i>proficient</i>
	<b>Microsoft Office</b>	<i>proficient</i>
	<b>OpenOffice</b>	<i>proficient</i>
	<b>PyRAF/IRAF</b>	<i>proficient</i>
	<b>TiRiFiC</b>	<i>proficient</i>
	<b>KARMA</b>	<i>proficient</i>
	<b>CASA</b>	<i>proficient</i>
<b>GIPSY</b>	<i>proficient</i>	

	<b>ASTRID</b>	<i>proficient</i>
	<b>MIRIAD</b>	<i>experienced</i>
Observing	<b>Apache Point Observatory Astrophysical Research Consortium 3.5-m</b>	<i>proficient</i>
	<b>National Radio Astronomy Observatory Green Bank Telescope</b>	<i>proficient</i>
	<b>NMSU Tombaugh Observatory 12" Meade &amp; 11" Celestron (for public outreach)</b>	<i>proficient</i>
Engineering	<b>Digital Signal Processing</b>	<i>proficient</i>
	<b>Interferometry</b>	<i>proficient</i>
	<b>Adaptive Phased Arrays</b>	<i>proficient</i>
	<b>Optics</b>	<i>proficient</i>
	<b>Radio Receivers</b>	<i>experienced</i>
	<b>Radar</b>	<i>experienced</i>

## Public Outreach

- 2012 – 2017 **Campus Observatory Open House, NMSU: Las Cruces, NM.**  
At least once each academic year, I participated in an event at Tombaugh Observatory on NMSU's campus to operate telescopes and show astronomical objects to the public.
- 2016 **After School Science, University Hills Elementary School: Las Cruces, NM, November 2, 2016.**  
I taught elementary school students about meteorites, impact craters, and showed them how to safely view the sun through a solar telescope.
- 2016 **Hillrise Elementary School Career Day, Hillrise Elementary School: Las Cruces, NM, October 21, 2016.**  
I taught elementary school students about meteorites, impact craters, and showed them how to safely view the sun through a solar telescope.
- 2016 **Enrich the Kids, Hillrise Elementary School: Las Cruces, NM, July 6, 2016.**  
I taught elementary school students about meteorites and answered many questions about the possibilities of extraterrestrial life in the universe.
- 2016 **Farmer's Market Astronomy, Museum of Nature and Science: Las Cruces, NM, February 20, 2016.**  
I set up solar telescopes outside of the Museum of Nature and Science during the weekly Farmer's Market and showed citizens the Sun while answering astronomy-related questions.
- 2015 **SEMAA After School Program, Tombaugh Observatory: Las Cruces, NM, December 3, 2015.**  
I taught a group of visiting children about the scale of the Solar System through interactive activities.
- 2015 **Library Moon Viewing, Thomas Branigan Memorial Library: Las Cruces, NM, September 24, 2015.**  
I set up telescopes near Thomas Branigan Memorial Library to observe the Moon with elementary school classes.
- 2015 **Science Fair, Sierra Middle School: Las Cruces, NM, February 9, 2015.**  
I acted as a judge for a middle school science fair, focusing on physical science and engineering projects.
- 2015 **Sky Safari, Tombaugh Observatory: Las Cruces, NM, January 24, 2015.**  
I taught the general public about astronomy, while providing telescope direction at Tombaugh Observatory.
- 2014 **Partial Solar Eclipse, Mesilla Valley Mall: Las Cruces, NM, October 23, 2014.**  
I helped teach the general public about solar eclipses, while providing people with solar viewing glasses for the partial solar eclipse.
- 2014 **Astronomical Society of Las Cruces Speaker, Dona Ana Community College: Las Cruces, NM, April 25, 2014.**  
I gave a presentation to ~30 members of the Astronomical Society of Las Cruces focusing on current astronomy breakthroughs.

- 2014 **Farmer's Market Astronomy**, *Museum of Nature and Science: Las Cruces, NM*, September 27, 2014.  
I set up solar telescopes outside of the Museum of Nature and Science during the weekly Farmer's Market and showed citizens the Sun while answering astronomy-related questions.
- 2014 **Farmer's Market Astronomy**, *Museum of Nature and Science: Las Cruces, NM*, March 29, 2014.  
I set up solar telescopes outside of the Museum of Nature and Science during the weekly Farmer's Market and showed citizens the Sun while answering astronomy-related questions.
- 2014 **Science Fair**, *Sierra Middle School: Las Cruces, NM*, February 6, 2014.  
I acted as a judge for a middle school science fair, focusing on physical science and engineering projects.
- 2013 **Sky Safari**, *Tombaugh Observatory: Las Cruces, NM*, September 7, 2013.  
I taught the general public about astronomy, while providing telescope direction at Tombaugh Observatory.
- 2013 **Special Sky Safari**, *Chihuahuan Desert Nature Park: Las Cruces, NM*, July 22, 2013.  
I taught the general public about astronomy at a science night event at the Chihuahuan Desert Nature Park.
- 2013 **Star Party**, *Dark sky site: Las Cruces, NM*, June 22, 2013.  
I provided assistance at a star party for a school class.
- 2013 **Sky Safari**, *Tombaugh Observatory: Las Cruces, NM*, May 18, 2013.  
I taught the general public about astronomy, while providing telescope direction at Tombaugh Observatory.
- 2013 **Zia Middle School Campus Field Trip**, *Tombaugh Observatory: Las Cruces, NM*, April 19, 2013.  
I taught groups of middle school students about meteorites while also observing the Sun through solar telescopes.
- 2013 **4th Grade Campus Field Trip**, *Tombaugh Observatory: Las Cruces, NM*, April 17, 2013.  
I taught groups of elementary school students about the Sun while observing it through a solar telescope.
- 2013 **Elementary School Open House**, *Booker T. Washington Elementary School: Las Cruces, NM*, February 21, 2013.  
I set up a stand at the elementary school open house to teach children and parents about astronomy. We also viewed the moon through a telescope.
- 2013 **Tombaugh Day**, *Tombaugh Elementary School: Las Cruces, NM*, February 9, 2013.  
I taught students about various aspects of astronomy in honor of Clyde Tombaugh, the discoverer of Pluto.
- 2012 **SEMAA Campus Visits**, *Tombaugh Observatory: Las Cruces, NM*, November 29, 2012.  
I taught groups of elementary school students about meteorites while also observing the Sun through solar telescopes.

## Press Releases

- 2015 **CHANG-ES Press Release**, *D-Configuration Public Data Release*, October 13, 2015, I wrote the initial drafts of the D-Configuration Public Data Release Press Release, which was circulated through the National Radio Astronomy Observatory and various other science news platforms..  
<https://public.nrao.edu/news/pressreleases/galaxy-halos>

## Referees

**Professor René Walterbos**, *Dissertation Advisor, New Mexico State University.*

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**Dr. George Heald**, *Collaborator, ASTRON/CSIRO.*

[George.Heald@csiro.au](mailto:George.Heald@csiro.au); +61-8-6436-8758

**Professor Nancy Chanover**, *Instructor, New Mexico State University.*

[nchanove@nmsu.edu](mailto:nchanove@nmsu.edu); +1-575-646-2567