

# Miguel F. Morales

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## PROFESSIONAL HISTORY

Assistant Professor, University of Washington, Seattle, WA (starting 2008)  
Research Scientist, MIT Kavli Institute, Cambridge, MA (2006–Present)  
Postdoctoral Fellow, Harvard-Smithsonian Institute for Theory and Computation, Cambridge (2005–2006)  
Research Scientist, MIT Kavli Institute, Cambridge, MA (2004–2005)  
Postdoctoral Associate, MIT Center for Space Research, Cambridge, MA (2002–2004)  
High School Physics Teacher, University School of Milwaukee, Milwaukee, WI (1993–1996)

## EDUCATION

Ph.D. in Physics, University of California, Santa Cruz, CA (2002)  
Bachelor of Arts in Physics, Swarthmore College, Swarthmore, PA (1993)

## RESEARCH INTERESTS

My research interests are in experimental astrophysics and cosmology. I develop observational techniques and instrumentation for emerging cosmology observations, including:

**Epoch of Reionization Observations.** Leading the US-Australian Epoch of Reionization (EOR) power spectrum observing team, using the Mileura Widefield Array (MWA). Created symmetry-based analysis that underpins 21 cm EOR power spectrum observations, and quantified instrumental sensitivity of the first generation EOR observatories.

**New Radio Cosmology Signatures.** Developed four new radio cosmology signatures: the EOR power spectrum, the radio-transient dispersion vs. redshift signature, radio weak lensing observations free of ellipticity noise, and unresolved radio acoustic oscillation surveys for enhanced dark energy observations.

**Construction of MWA.** Core member of the instrument design and construction team. Optimized the MWA for EOR power spectrum observations. Co-designer of the realtime calibration and analysis pipeline.

**GASE & Radio Transient Surveys.** Constructing GRB All-sky Spectrometer Experiment (GASE, pronounced “gaze”) to search for predicted prompt 30 MHz emission from GRB blast waves and enable dispersion-based cosmology measurements. Leading member of MWA All-Sky Monitor transient survey.

## STUDENTS

Judd Bowman (now Hubble Fellow)  
Michael Matejek (2<sup>nd</sup> year graduate student)  
Adam Belay (current undergraduate student)

## DISTINCTIONS

**Diversity Magazine Emerging Scholar.** Selected for inaugural list of ten minority scholars making an impact in their respective fields. Magazine devoted to issues of equality in higher education. (2006)

**First Mellon 100+ PhDs.** Member of first 100 PhDs from the Mellon Minority Fellowship program, which is designed to increase minority representation in academia.

**NASA Graduate Student Research Program Fellowship.** National Fellowship awarded to graduate students performing original and promising research. (2000–2002)

**Chancellor's Award for Teaching Excellence.** A campus-wide award at the University of California, Santa Cruz given to teaching assistants who have demonstrated excellence in teaching. (1999)

**GAANN Fellowship.** Federal fellowship given to graduate students in areas of national need. (1998–2000)

**Cota-Robles Fellowship.** Graduate fellowship given to promising graduate students. (1996–1998)

**Mellon Minority Undergraduate Research Fellowship.** National fellowship given to distinguished minority students considering a career in academia. (1991–1993)

**N. Harvey Collisson Scholarship.** Awarded annually to a Swarthmore student showing academic promise. (1990–1993)

**Member of American Astronomical Society, URSI, HEAD, & Sigma Xi**

TEACHING  
EXPERIENCE

**Head Physics TA,** University of California, Santa Cruz, CA. Trained and supervised approximately 25 Physics Department teaching assistants per year. Greatly expanded the instruction and supervision of physics teaching assistants and instituted a peer mentoring program. (1998–2001)

**Adjunct Physics Professor,** temporary appointment, Cabrillo College, Santa Cruz, CA. Taught conceptual physics using a combination of lecture, group inquiry, and individual student research at this top-ranked community college. (2000)

**Discussion Leader and Laboratory TA,** University of California, Santa Cruz, CA. Led discussion sections and laboratories for a variety of introductory physics courses. Received Chancellor's Award for Teaching Excellence. (1997–2000)

**Workshop Leader and Tutor,** MESA program at Cabrillo College, Santa Cruz, CA. Led physics excellence workshops and provided drop-in tutoring for the Math Engineering and Science Achievement (MESA) program for underrepresented and disadvantaged students. (1998–1999)

**Extensive Air Shower Animations.** Developed computer visualizations of extensive air showers which are widely used for particle astrophysics education. (1999)

**Physics Teacher,** University School of Milwaukee, Milwaukee, WI. Taught physics, chemistry and astronomy at prestigious private high school. Developed several new classes and restructured the science department's course sequence. (1993–1996)

PROFESSIONAL  
SERVICE

**Convened MIT EOR Workshop.** International workshop to help direct theoretical and observational progress in the field. Served as first opportunity for many leading theorists and radio observers to meet. (July 2004)

**Pelletier Lecturer.** Annual lectureship at Allegheny College. (October 2006)

**Public Lectures.** Frequent public speaker, including at the Skyscrapers astronomy club in Rhode Island and Jefferson Unitarian Church in Colorado during 2006.

**Journal Reviews.** Frequent reviewer for leading journals, particularly on EOR science.

**Community Outreach.** Advised students in Tufts introductory astronomy class on their presentations to K–12 classrooms in the Boston area. (Spring 2006)

RECENT  
LECTURES

“GLAST and Low Frequency Radio Observations,” Boston Area GLAST Workshop, Cambridge, Massachusetts (June 2007)

“Observing the Epoch of Reionization,” Seminar at Yale, New Haven, Connecticut (March 2007)

“Observing the Epoch of Reionization,” Seminar at University of Pennsylvania, Philadelphia, Pennsylvania (February 2007)

“Observing the Epoch of Reionization,” ACKS Seminar at KIPAC, Stanford, California (February 2007)

“Observing the Epoch of Reionization,” TAC Seminar at Berkeley, Berkeley, California (January 2007)

“Observing the Epoch of Reionization,” Colloquium at University of Washington, Seattle, Washington (January 2007)

“Radio Observations of the Epoch of Reionization,” Colloquium at Columbia, New York, New York (November 2006)

“Peering Through the Primeval Hydrogen Fog with Radio Light,” Pelletier Lecture, Allegheny College, Meadville, Pennsylvania (October 2006)

“Radio Cosmology at MIT,” Colloquium at MIT, Cambridge, Massachusetts (October 2006)

“Sensitivity of EOR Observations,” COSMO 06, Lake Tahoe, California (September 2006)

“Radio Observations of the Epoch of Reionization,” Colloquium at Caltech, Pasadena, California (May 2006)

“Radio Observations of the Epoch of Reionization,” Colloquium at Ohio University, Athens, Ohio (March 2006)

“Radio Observations of the Epoch of Reionization,” Colloquium at Calpoly, San Luis Obispo, California (February 2006)

“Radio Observations of the Epoch of Reionization,” Colloquium at University of Chicago, Chicago, Illinois (February 2006)

RECENT  
LECTURES  
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“Radio Observations of the Epoch of Reionization,” Colloquium at University of Colorado at Boulder, Boulder, Colorado (February 2006)

“Radio Observations of the Epoch of Reionization,” Colloquium at UC Berkeley, Berkeley, California (January 2006)

“Sensitivity of EOR Observations,” Cosmological Probes of Baryons and Dark Matter, Aspen, Colorado (January 2006)

“Designing the MWA–LFD,” URSI, Boulder, Colorado (January 2006)

“Statistical EOR Detection and Foreground Subtraction,” Reionizing the Universe, Groningen, Netherlands (June 2005)

“Statistical EOR Detection and the Mileura Widefield Array,” invited talk at the First Light Workshop, UC Irvine, California (May 2005)

“Design and Science of the Mileura Widefield Array,” Colloquium, NRAO, Charlottesville, Virginia (February 2005)

“Cosmology and Transient Observations with Widefield Radio Telescopes,” Colloquium, Reed College, Oregon (February 2005)

“The Formation of Galaxies and Cosmic Structure,” invited introductory talk and session chair for Epoch of Reionization Session, National Academy of Science Frontiers of Science Meeting, Bangalore, India (January 2005)

“The Design and Science of the Mileura Widefield Array,” Colloquium, NRAO, New Mexico (December 2004)

“Cosmology and Transient Detection with Widefield Radio Measurements,” Colloquium, Los Alamos National Laboratory, New Mexico (December 2004)

“Radio Transients with the MWA Demonstrator,” Science with Low Frequency Observations, Melbourne University, Melbourne, Australia (November 2004)

“Observing the Epoch of Reionization with Widefield Radio Measurements,” Physics Department Colloquium, University of California, Santa Cruz, California (October 2004)

“Mileura Widefield Array Demonstrator,” invited talk at Science with Wavelengths on Human Scales: A Celebration of Bill Erickson’s 74th Birthday and Low Frequency Radio Science, Santa Fe, New Mexico (September 2004)

“Probing the Dark Ages: HI and the Epoch of Reionization Signal,” invited talk at SKA 2004, Penticton, Canada (July 2004)

Convened MIT Epoch of Reionization Workshop and chaired Future Directions panel, Cambridge, MIT, Massachusetts (July 2004)

“Toward Epoch of Reionization Measurements with Wide Field LOFAR Observations,” URSI 2004, Boulder, Colorado (January 2004)

“The LOFAR Wide Field Correlator,” URSI 2004, Boulder, Colorado (January 2004)

# Bibliography

REFEREED  
PAPERS

- Wyithe, J. S. B., & Morales, M. F. 2007, “Biased reionization and non-Gaussianity in redshifted 21-cm intensity maps of the reionization epoch,” *MNRAS* **379** (4), 1647
- Bowman, J. D., Morales, M. F., & Hewitt, J. N. 2007, “Constraints on Fundamental Cosmological Parameters with Upcoming Redshifted 21 cm Observations,” *ApJ* **661**, 1
- Bowman, J. D. et al. 2007, “Field Deployment of Prototype Antenna Tiles for the Mileura Widefield Array—Low Frequency Demonstrator,” *AJ* **133** (4), 1505
- Morales, M. F. 2006, “A Technique for Weak Lensing with Velocity Maps: Eliminating Ellipticity Noise in HI Radio Observations,” *ApJL* **650**, L21
- Morales, M. F., Bowman, J. D., & Hewitt, J. N. 2006, “Improving Foreground Subtraction in Statistical Observations of 21 cm Emission from the Epoch of Reionization,” *ApJ* **648**, 767
- Bowman, J. D., Morales, M. F., & Hewitt, J. N. 2005, “The Sensitivity of First Generation Epoch of Reionization Observatories and Their Potential for Differentiating Theoretical Power Spectra,” *ApJ* **638**, 20
- Atkins, R. et al. 2005, “Evidence for TeV Gamma-Ray Emission from a Region of the Galactic Plane,” *PRL* **95**, 251103
- Atkins, R. et al. 2005, “Constraints on Very High Energy Gamma-Ray Emission from Gamma-Ray Bursts,” *ApJ* **630**, 996
- Morales, M. F. 2005, “Power Spectrum Sensitivity and the Design of Epoch of Reionization Observatories,” *ApJ* **619**, 678
- Morales, M. F., & Hewitt, J. N. 2004, “Towards Epoch of Reionization Measurements with Wide Field Radio Observations,” *ApJ* **615**, 7
- Atkins, R. et al. 2004, “Search For Very High Energy Gamma Rays From WIMP Annihilations Near The Sun With The Milagro Detector,” *PRD* **70**, 083516
- Atkins, R. et al. 2004, “TeV Gamma Ray Survey of the Northern Hemisphere Using the Milagro Observatory,” *ApJ* **608**, 680
- †Atkins, R. et al. 2004, “Limits on Very High Energy Emission from Gamma-Ray Bursts with the Milagro Observatory,” *ApJL* **604**, L25
- Morales, M. F., Williams, D. A., & DeYoung, T. 2003, “An Advanced Analysis Technique for Transient Searches in Wide-Field Gamma-Ray Observatories,” *Astroparticle Physics* **20**, 485
- Atkins, R. et al. 2003, “Observation of TeV Gamma Rays from the Crab Nebula with Milagro Using a New Background Rejection Technique,” *ApJ* **595**, 803
- Falcone, A. et al. 2003, “Observation of GeV Solar Energetic Particles from the 1997 November 6 Event Using Milagrito,” *ApJ* **588**, 557
- Atkins, R. et al. 2003, “The High-Energy Gamma-Ray Fluence and Energy Spectrum of GRB 970417a from Observations with Milagrito,” *ApJ* **583**, 824

†Collaboration paper with M. F. Morales as primary author

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Wang, K. et al. 2001, "A Survey of the Northern Sky for TeV Point Sources," *ApJ* **558**, 477

Atkins, R. et al. 2000, "Evidence for TeV Emission from GRB 970417a," *ApJ Letters* **533**, L119

Atkins, R. et al. 1999, "TeV Observations of Markarian 501 with the Milagro Water Cerenkov Detector," *ApJ Letters* **525**, L25

WHITE PAPERS  
& OTHER  
PUBLICATIONS

Morales, M. F. et al. 2006, "A Mathematical Description of the MWA-LFD Processing Pipeline," MWA-LFD white paper

Morales, M. F. 2006, "Notation For Representing Blocking and Data Order in Digital Signal Processing," MWA-LFD white paper

Bunton, J., Cappallo, R., & Morales, M. F. 2005, "LFD-NTD Commonality in Correlators, Receivers and Beamformers," MWA-LFD white paper

Morales, M. F. et al. 2005, "Statistical EOR Detection and the Mileura Widefield Array," UC Irvine First Light Workshop, *New Astronomy Review* **50**, 173

Morales, M. F. et al. 2005, "The GRB All-sky Spectrometer Experiment (GASE)," Science with Wavelengths on Human Scales, *ASP Conference Series* **345**, 512

Morales, M. F. 2005, "Design Principles of the Mileura Widefield Array-Low Frequency Demonstrator (MWA-LFD)," Science with Wavelengths on Human Scales, *ASP Conference Series* **345**, 452

Morales, M. F. et al. 2004, "Design of the All-Sky Monitor Analysis," MIT-Haystack white paper, <http://www.haystack.mit.edu/ast/arrays/mwa/LFD/documents.html>, 14

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Morales, M. F. 2003, "Discovery Mode Search Techniques for Gamma-Ray Telescopes," Gamma-Ray Burst and Afterglow Astronomy 2001, *AIP Conference Proceedings*, **662**, 535

Morales, M. F. 2003, "Rapid Notification of TeV Transients with the Milagro Telescope," Gamma-Ray Burst and Afterglow Astronomy 2001, *AIP Conference Proceedings*, **662**, 532

Morales, M. F. 2002, "A Search for TeV Gamma-Ray Burst Emission with the Milagro Observatory," Ph.D. Thesis, University of California, Santa Cruz astro-ph/0308100

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PUBLICATIONS  
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Morales, M. F., Norris, J. P. & Bonnell, J. T. 2000, "Refinements of the GRB Luminosity–Pulse Lag Relationship," HEAD 2000, Honolulu, Hawaii, *Bulletin of the American Astronomical Society* **32**

Morales, M. F. 2000, "Computer Animation of Extensive Air Showers Interacting with the Milagro Water Cherenkov Detector," Proc. 1999 TeV Workshop, Snowbird, Utah, *AIP* **516**, animations available at <http://scipp.ucsc.edu/milagro/Animations/AnimationIntro.html>