

# David Garrison

## Education

### **Ph.D. Physics, Pennsylvania State University**

Department of Physics, 1997-2002

Dissertation: “Testing Binary Black Hole Codes in Strong Field Regimes”

Dissertation Committee: Jorge Pullin, Pablo Laguna, Abhay Ashtekar, Stein Sigurdsson.

### **B.S. Physics, Massachusetts Institute of Technology**

Undergraduate studies, 1993-1997

Major in Physics, Minor in Earth Atmospheric & Planetary Science, and Concentration in Political Science.

Undergraduate Thesis: Gravitational Lensing of Extended Radio Sources

## Notable Achievements

- Founded the Physics program at UHCL (BS, MS, Collaborative PhD)
- Developed the Collaborative UHCL-UH Physics PhD Program through agreement with the UH Physics Department
- Established the UHCL Physics guest lecture series and Distinguished lecture series
- Developed the Professional Science Masters of Physics: Technical Management sub-plan
- Developed the undergraduate Engineering Physics and Computational Physics sub-plans
- Developed an advisory board for the UHCL Physics program
- Helped develop the UHCL Computational Physics Laboratory, Physics Teaching Laboratory and Plasma Physics Laboratory
- PI of a multi-university unfunded FAA Center of Excellence in Commercial Space Transportation. The proposal involved 125 participants and was completed in less than one month.
- Co-founded UHCL’s Center for Faculty Development
- Appeared on an episode of “The Universe” on the History Channel.
- Interviewed several times on Television, Radio and the World Wide Web.
- Interviewed for HistoryMakers - ScienceMakers series

## Honors, Grants and Fellowships

- 2018-19 UHCL Faculty Fellowship Award
- UHCL Faculty Development Fund Award Total, \$24,913
- UHCL Faculty Research Support Fund Awards Total, \$24,916
- NSF SSTEM Co-I, 2013, \$592,468
- HistoryMakers – ScienceMaker, 2012
- Institute for Space Systems Operations Grant, 2010, \$66,800
- Fort Zumwalt North Hall of Fame Inductee, 2009
- Institute for Space Systems Operations Mini-Grant, 2006, \$7,077
- Institute for Space Systems Operations Mini-Grant, 2005, \$6,666
- Council of Graduate Schools PSM implementation grant, 2005-2007, \$25,000
- NASA Faculty Fellowship Program at JSC, 2004, \$12,000
- Institute for Space Systems Operations Post-Doctoral Aerospace Grant, 2004, \$20,000
- Council of Graduate Schools Professional Science M.S. planning grant, 2004, \$6,000
- NASA GSRP Fellowship, 2001-2002, \$27,000

- Academic Computing Fellowship, 2001-2002, \$15,000
- Sloan Scholar, 1998-2002
- Bayer Fellowship, 1997-1998, \$3,000
- Minority Scholars Award, 1997-1998
- MIT Class of 1961 Clarke E. Swannack Scholarship Recipient, 1995-1997
- University Club Scholarship Recipient, 1993-1997
- National Merit Scholarship Commended Student, 1993

### **Teaching/Administrative Experience**

**Associate Dean for the College of Science and Engineering & Professor of Physics**, University of Houston-Clear Lake (Joint Faculty appointment with the University of Houston as Professor of Physics)-2019-Present

The Interim Associate Dean serves as the administrator reporting to the Dean for the college and assists in planning, executing, and monitoring the school's activities. In coordination with the department chairs, program chairs, and others at the college, the interim associate dean directs all activities related to the day to day operations of the college.

**Director of Graduate Programs for the College of Science and Engineering & Professor of Physics**, University of Houston-Clear Lake (Joint Faculty appointment with the University of Houston as Professor of Physics)- 2014-2019

The Graduate Program Director serves as the administrator reporting to the associate dean for the college and assists the dean and associate dean in planning, executing, and monitoring the school's activities. In coordination with the division heads, program chairs, and where appropriate, others at the college, the Graduate Program Director coordinates all activities related to graduate programs and processes through the several primary responsibilities.

**Physics Program Chair & Associate Professor of Physics**, University of Houston-Clear Lake (Joint Faculty appointment with the University of Houston as Associate Professor of Physics) –2003-2015

Founded and developed the UHCL Physics program (BS, MS, Collaborative PhD, PSM Physics sub-plan in Technical Management and the BS Engineering Physics sub-plan). Presently teaching undergraduate and graduate level physics and astronomy courses. Classical Mechanics, Electrodynamics, Fundamentals of Spacetime, General Relativity, Modern Physics Research, Methods in Computational Physics, Research Project and Seminar, Mathematica for Physics and Mathematical Methods in Physics I & II. Other duties include: advising and mentoring students, community outreach, running the UHCL Physics seminar series, promoting the physics and space science programs, managing adjunct faculty, developing the school's undergraduate and graduate physics curriculum, managing a research program in theoretical and computational physics and developing the educational and research relationships between UHCL, UH and the Johnson Space Center.

**Visiting Assistant Professor and Interim Chair of Physical Sciences**, University of Houston-Clear Lake –2002-2003

Taught graduate and undergraduate level physics courses. Classical Mechanics, Electrodynamics, Special Relativity, Research Methods in Space Science, Research Project & Seminar and Mathematical Methods in Physics I & II. Other duties included: advising and mentoring students, community outreach, promoting the physics and space science programs, managing adjunct faculty, developing the school's physics curriculum, developing a Master's degree in physics program, starting a physics research program and improving the relationship between UHCL and the Johnson Space Center.

**Teaching Assistant**, Pennsylvania State University --1998-2000

Taught recitations and labs for several introductory level physics classes. Courses include virtually every course in Penn State's Algebra and Calculus based Physics Curriculum. Examples include: Physics 202 - Calculus based physics for engineers focusing on electrostatics taught using traditional recitations and lectures; Physics 203 - Calculus based physics for engineers focusing on thermodynamics and modern physics taught using traditional recitations and lectures; Physics 212 - Calculus based physics for engineers focusing on electrostatics taught using dynamic physics, a combination of group learning in recitations and

labs as well as traditional lectures; Physics 215 - Algebra based physics for pre-med students focusing on classical mechanics and thermodynamics taught using traditional recitations and lectures.

**Writer**, Thinkwell --2001

Helped develop interactive Physics CD's that included video lectures and tests. I wrote practice tests and answer keys for each unit.

**Instructor**, Kaplan --1999-2001

Prepared Students for the Physics section of the MCAT Medical School Admissions exam using a series of lectures. Each lecture lasted for three hours; the first was on classical mechanics, the second was on electrostatics and thermodynamics and the last was on magnetism and modern physics. These lectures focused on reviewing the material as well as test taking techniques and confidence building.

**Teaching Assistant**, Washington University --1994

Assisted Prof. Ogilvie of Washington University in developing and preparing the curriculum for Computational Physics for Washington University Juniors, Seniors and first year Graduate Students. My work included setting up computers, installing software and networking, developing and testing homework projects and writing elements of the curriculum. Matlab, Fortran and Maple were used.

**Physics Tutor**, --1994-2002

Individually tutored several students in basic and advanced undergraduate level math and physics courses. Examples include: 8.01 and 8.02 at MIT; Physics 201, Physics 202, Physics 203, Physics 204, Physics 211, Physics 212, Physics 213, Physics 214, Physics 215, Physics 237, Physics 265, Physics 400 and Physics 419 at Penn State.

## **Research Experience**

**Professor**, University of Houston-Clear Lake --2018-Present

Various research projects both independently and in collaboration with NASA JSC. Research topics include numerical relativity, cosmology, computational physics and relativistic plasma physics. My focus is on studying the early universe using numerical simulations.

**Associate Professor**, University of Houston-Clear Lake --2008-2018

Various research projects both independently and in collaboration with NASA JSC. Research topics include numerical relativity, cosmology, computational physics and plasma physics. My focus is on studying the early universe using numerical simulations.

**Assistant Professor**, University of Houston-Clear Lake --2003-2008

Various research projects both independently and in collaboration with NASA JSC. Some research topics include numerical relativity and cosmology as well as collaboration with the Advanced Space Propulsion Laboratory's VASMIR project for the development of a Plasma rocket engine.

**Visiting Assistant Professor**, University of Houston-Clear Lake --2002-2003

Various research projects both independently and in collaboration with NASA JSC. Work included numerical relativity and cosmology as well as collaboration with the Advanced Space Propulsion Laboratory's VASMIR project for the development of a Plasma rocket engine.

**Research Assistant**, Pennsylvania State University --1998-2002

Working with Prof. Jorge Pullin and Prof. Pablo Laguna on several projects in an effort to develop numerical codes to solve the problem of the 3D spiraling coalescence of two black holes. This project is done in Penn State's Center for Gravitational Physics and Geometry in order to realize the top candidate for a gravitational wave source that may be detected by LIGO. Most of my work is based on developing a method of testing the stability of the numerical codes using periodic cosmological systems, which lack singularities. Using these codes I induced constraint violating and gauge modes in unstable codes and identified early clues to their instability. Additional projects included a study of gravitational gradient noise in gravity wave detectors, applying causal differencing to our evolution methods and the development

of black hole spectroscopy, a method of using data from gravitational wave detectors to determine the mass and angular momentum of a black hole.

**B.S. Physics Thesis Project**, Massachusetts Institute of Technology -- 1996-1997

Worked with Prof. Jacqueline Hewitt simulating the gravitational lensing of observed images to determine the conditions under which a gravitational lens is detectable. I used Monte Carlo techniques and an unlensed radio image of Cygnus-A to generate statistical data on the luminosity ratios of lensed radio lobes. Next I compared the results to the natural range of luminosity ratios of unlensed radio lobes caused by varying the orientation of the radio lobes with respect to the observer. I then attempted to show whether or not gravitational lenses could be detected by simply looking at the luminosity ratios of the radio lobes. This knowledge could lead to new techniques in the detection of dark matter.

**Research Assistant**, Washington University --1995

Worked with Prof. Ogilvie and Prof. Will of Washington University on several projects in theoretical Physics such as variable calculations and computer simulations, which provided me with an introduction to General Relativity and gauge theory. Many of the simulations used Unix based visualization packages although some of the work was based on using symbolic manipulators to plot analytic functions.

**Research Assistant**, Massachusetts Institute of Technology --1995

Worked with Prof. David Pritchard on a project to measure the mass of ions more precisely than ever before. The data gained from this experiment will be used to develop a new atomic standard for the kilogram, and is accurate enough to find the “rest mass” of both gamma waves and atomic bonds. Much of my work included building electronics and analyzing data.

**Research Assistant**, Massachusetts Institute of Technology -- 1994

Worked in the Undergraduate Research Opportunity Program (UROP) with Prof. John King to develop an ultrasonic whistle capable of producing high frequency sounds (25 kHz) at 145 dB of intensity. Based on a Hartman Whistle, I machined several models myself using a metal lathe and brass stock and tested them using high frequency microphones.

### Selected Publications

1. The Universe’s Earliest Moments by David Garrison, Sky and Telescope Magazine, September 2021, 22-27 (2021).
2. Numerical Analysis of the Magnetogenesis from early universe phase transitions by David Garrison, *Astronomische Nachrichten*, ASNA342, Issue 1-2, 75-80, <http://dx.doi.org/10.1002/asna.202113884> (2021).
3. Numerical Analysis of Magnetogenesis’ Primordial Mechanism by David Garrison, *Astronomische Nachrichten*, ASNA302, 16404290, 10.1002/asna.201913627, <http://dx.doi.org/10.1002/asna.201913627> (2019).
4. Relativistic Magnetohydrodynamic Turbulence in the Early Universe by David Garrison, *Proceedings of the 10<sup>th</sup> Chaotic Modeling and Simulation International Conference*, *International Journal of Nonlinear Science*, 102017, 493-498 (2017).
5. Extracting Gravitational Waves Induced by Plasma Turbulence in the Early Universe through an Averaging Process by David Garrison and Christopher Rameriz, arXiv:1503.04764, *Classical and Quantum Gravity* 34, 145008 (2017).
6. Using Gravitational Waves to put limits on Primordial Magnetic Fields by David Garrison, arXiv: [1608.01005](https://arxiv.org/abs/1608.01005), *GJSFR-A Volume 17, Issue 1* (2017).
7. Invariants in Relativistic MHD Turbulence by David Garrison and Phu Nguyen, *Journal of Modern Physics*, 7, 281-289. doi: [10.4236/jmp.2016.73028](https://doi.org/10.4236/jmp.2016.73028), arXiv:1501.06068
8. Gauge Field Turbulence as a Cause of Inflation in Chern-Simons Modified Gravity by David Garrison, to appear in the *Proceedings of the 7<sup>th</sup> Chaotic Modeling and Simulation International Conference*.

9. Numerical Relativity as a tool for studying the Early Universe by David Garrison, Journal of Gravity, vol. 2014, Article ID 407197, 11 pages, 2014. doi:10.1155/2014/407197, gr-qc/1207.7097
10. A Numerical Simulation of Chern-Simons Inflation by David Garrison and Christopher Underwood, Advances in Astronomy, Volume 2013, 207218, hep-th/1208.2660.
11. What Every Successful Physics Graduate Student Should Know by David Garrison, Smashwords, 2013
12. TESTING BINARY BLACK HOLE CODES IN STRONG FIELD REGIMES: UNDERSTANDING NUMERICAL INSTABILITIES THROUGH COMPUTATIONAL EXPERIMENTS by David Garrison, LAP Lambert Academic Publishing, 2011
13. Numerical Cosmology: Building a dynamical universe by David Garrison, AIP Conf. Proc., 2010 - Volume 1280, pp. 65-69.
14. Gravitational Waves and the Evolution of the Universe by David Garrison, AIP Conf. Proc., 2009 -- Volume 1140, pp. 42-45.
15. Did Gravitational Waves Affect the Evolution of the Universe? by David Garrison, gr-qc/808.1764.
16. Numerical analysis of simplified Relic-Birefringent gravitational waves by David Garrison and Rafael de la Torre, Classical and Quantum Gravity 24 (2007) 5889
17. Serving Nontraditional Graduate Students by David Garrison, Physics Today, January 2007
18. Development of a Comprehensive Physics Program at a non-traditional upper-level undergraduate and graduate small university by David Garrison, APS Forum On Education Spring 2006 Newsletter
19. Testing Binary Black Hole codes with Cosmological Spacetimes by David Garrison, Proceedings of the Tenth Marcel Grossman Meeting on General Relativity, 2006
20. Gravity Gradients in LIGO: a proposal for Data Analysis by David Garrison and Gabriela Gonzalez, Proceedings of the Tenth Marcel Grossman Meeting on General Relativity, 2006
21. Black Hole Spectroscopy: testing general relativity through gravitational-wave observations by Olaf Dreyer, Lee Finn, Ramon Lopez-Aleman, Badri Krishnan, Bernard J. Kelly, David Garrison, Classical and Quantum Gravity 21 (2004) 787-803
22. Causal Differencing in ADM and Conformal ADM Formulations: A Comparison in Spherical Symmetry. by Luis Lehner, Mijan Huq, David Garrison. 2000. Physical Review D. Volume 62, 084016
23. Notes on causal differencing in ADM/CADM formulations: a 1D comparison by Luis Lehner, Mijan Huq, David Garrison, gr-qc/0004065
24. Accurate Mass Spectrometry of Trapped Ions by M. Bradley, F. Palmer, D. Garrison, L. Ilich, S. Rusinkiewicz & D.E. Pritchard, Hyperfine Interactions 108, 227-238 (1997)

### **Selected Presentations and Posters**

1. Virtual: 2020 International Workshop on Astronomy and Relativistic Astrophysics (IWARA2020) – September 17, 2020 – Invited talk on Computer Simulations of the Early Universe
2. Virtual: 2020 April Meeting of the American Physical Society – April 17, 2020 – Contributed talk on Computer Simulations of the Early Universe
3. Providence, RI: 2019 Meeting of the National Society of Black Physicists (NSBP) – November 15, 2019 – Contributed talk on Computer Simulations of the Early Universe
4. Chania, GR: 12<sup>th</sup> Chaotic Modeling and Simulation International Conference – June 20, 2019 – Contributed talk on The Spontaneous Development of Magnetic Fields in the Early Universe from Relativistic MHD Turbulence
5. Houston, TX: Texas Section of the American Physical Society Meeting (TSAPS) – October 19,

- 2018 – Invited talk on Numerical Analysis of the Biermann Battery Mechanism of Magnetogenesis for Relativistic MHD Turbulence
6. Ollantaytambo, Peru: 8<sup>th</sup> International Workshop on Astronomy and Relativistic Astrophysics (IWARA2018) – September 9, 2018 – Invited talk on Numerical Analysis of the Biermann Battery Mechanism of Magnetogenesis for Relativistic MHD Turbulence
  7. Barcelona, Spain: 10<sup>th</sup> Chaotic Modeling and Simulation International Conference – May 31, 2017 – Relativistic Magnetohydrodynamic Turbulence in the Early Universe
  8. Berkley, CA: Sustainable Pathways Workshop – December 7, 2016 – Poster on Gravitational Waves induced by Plasma Turbulence in the Early Universe
  9. New York, NY: 21<sup>st</sup> General Relativity International Conference – July 11, 2016 – Poster on Numerical Simulations of Cosmological Gravitational Waves from MHD Turbulence.
  10. Commerce, TX – March 26, 2015 – Invited talk on Characterization of Gravitational Waves from Primordial Relativistic Turbulence.
  11. Lisbon, Portugal: 7<sup>th</sup> Chaotic Modeling and Simulation International Conference – June 7, 2014 – Gauge Field Turbulence as a Cause of Inflation in Chern-Simons Modified Gravity.
  12. Houston, TX: University of Houston – April 4, 2014 - Invited talk on Numerical Relativity as a tool for studying the Early Universe.
  13. Houston, TX: Rice University – October 23, 2013 – Invited talk on Numerical Relativity as a tool for studying the Early Universe.
  14. Houston, TX: WALIPP TSU Preparatory Academy – September 27, 2013 – Back to School with the History Makers.
  15. Houston, TX: North Houston Astronomy Club – March 22, 2013 – Invited talk on Numerical Cosmology
  16. Austin, TX: National Society of Black Physicists – September 24, 2011 – Invited Talk – Spectral Methods in General Relativistic MHD Simulations
  17. Houston, TX: Houston Astronomical Society – September 2, 2011 – Invited Talk – Gravitational Radiation from the Early Universe
  18. Houston, TX: United Space School – July 26, 2011 – Invited talk about the Physics Program at UHCL
  19. Pittsburgh, PA: Carnegie Mellon University – April 15, 2011 – Invited talk on Numerical Simulations of Gravitational Waves from Primordial Turbulence
  20. Houston, TX: Johnson Space Center – February 16, 2011 – Invited talk on African-American Scientists and Engineers: Standing on the Shoulders of Giants
  21. Houston, TX: Foundation for International Space Education – July 27, 2010 – Invited talk about the Physics Program at UHCL
  22. Houston, TX: JSC Astronomical Society – November 13, 2009 – Invited talk - Gravitational Wave Astronomy 101
  23. Houston, TX: Annual Banquet of the Houston Astronomical Society – October 10, 2009 – Keynote Address – Gravitational Wave Astronomy 101
  24. Tampa, FL: University of South Florida – September 26, 2008 – Invited talk on Numerical Cosmology – Building a Dynamical Universe
  25. Washington, DC: National Society of Black Physicists – February 22, 2008 – Invited talk on Gravitational Waves and the Evolution of the Universe
  26. Houston, TX: University of Houston Clear Lake – November 29, 2007 – Invited talk on Numerical Cosmology for Poets

27. Houston, TX: University of Houston – October 9, 2007 – Invited talk on Cosmic Structure Formation via Gravitational Radiation
28. Eugene, OR: University of Oregon – May 11, 2006 – Invited talk on Cosmic Structure Formation via Gravitational Radiation
29. Orlando, FL: National Society of Black Physicists – February 19, 2005 – Invited talk on Computational Electromagnetism
30. Grinnell, IA: Grinnell College – May 4, 2004 – Invited talk on Gravitational Wave Physics.
31. Rio de Janeiro, Brazil: Tenth Marcel Grossmann Meeting on General Relativity – July 21, 2003 – Talk on Testing Binary Black Hole Codes with Cosmological Spacetimes, July 25, 2003 – Talk on Gravitational Gradient Noise.
32. Atlanta, GA: National Society of Black Physicists – February 13, 2003– Invited talk on Gravitational Wave Physics.
33. Paris, France: UNESCO - July 22, 2002 - Poster on Testing Numerical Relativity Codes in Strong Field Regimes.
34. Houston, TX: Texas Southern University – February 11, 2002 – Invited talk on Gravitational Wave Research.

### **References**

1. George Abbey Jr – Member of the UHCL Physics Program, Advisory Committee. - gwsajr@gmail.com
2. Jarad Squire – Member of the UHCL Physics Program, Advisory Committee - jared.squire@adastrarocket.com
3. Israel Galvan – President of GHG Corp - israel.galvan@ghg.com
4. Chris Ward – Past President of UHCL Faculty Senate – WardChris@UHCL.edu
5. Kia Yendell – CSE Director of Academic Advising - Yendell@UHCL.edu
6. Lee Morin – Astronaut, UHCL Physics Program Alumni - lee.m.morin@nasa.gov
7. John Shebali – Retired JSC Civil Servant - jshebali@gmu.edu
8. Neal Lane – Senior Fellow Baker Institute, Former Chief Science Advisor to President Bill Clinton - neal@rice.edu
9. Steven Hawley – Professor University of Kansas, Former Director of ARES at NASA JSC – sawhley@ku.edu
10. Jim Clarage –Professor of Physics at University of St. Thomas - claragj@stthom.edu

### **Skills**

Experience with: Macintosh, UNIX, LINUX, Windows, and DOS operating systems; Networking systems including Internet Web Servers; Mathematics software such as Maple, Matlab, and Mathematica; R, C, C++, Visual Basic, Perl, HTML, Java, JSP, ASP, SQL, and Fortran programming languages.

### **Activities & Organizations**

Member-At-Large of TSAPS Executive Committee – 2022 – Present  
 Editorial Board Member for the Journal of Astronomy and Space Science – 2022 - Present  
 Co-Founder and Owner of Belle Transformations Medical Spa – 2020 - Present  
 Academic Editor for the International Astronomy and Astrophysics Research Journal – 2018-Present

AUM Clean Energy Group, Investment Board – 2013-2014  
Space Center Houston, Educational Advisory Board Member – 2012-Present  
Latin Deaf Services, Inc., Advisory Board Member – 2011-Present  
UHCL Faculty Senate – 2007-2009, 2012-2016  
UHCL Faculty Senate Executive Committee - 2008-2009, 2012-2016  
UHCL Faculty Senate President Elect, President, Past President, President – 2012-2016  
UHCL University Council – 2008-2009, 2012-2016  
UHCL Academic Council – 2008-2009, 2012-2016  
UHCL Faculty Senate Research Committee – 2007-2009 – Chair -- 2008-2009  
UHCL Planning and Budget Committee – 2007-2009  
UHCL Black Students Association – Advisor – 2005-2007  
Organized UHCL Physics and Space Science Guest Lecture Series – 2003-Present  
UHCL Physics Club – Co-advisor – 2002-Present  
American Association of Physics Teachers -- 2002-2003  
National Society of Black Physicists -- 2002-Present  
American Physical Society -- 1994-Present  
Kappa Sigma Fraternity –1993-Present -- Social Chair – 1995-1996  
MIT Varsity Football Team -- 1993, 1994 & 1996  
National Society of Black Engineers --1993-1997  
Black Student Union, Society of Physics Students --1993-1997  
Helped organize 1997 National Conference for Black Physics Students -- 1997  
National Honor Society -- 1989-1993  
Jazz Band improvisational soloist --1989-1993