

Brian W. Mulligan

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Current position

Graduate Student & Teaching Assistant, University of Texas at Austin,
Austin, TX

Areas of specialization

Supernovae - Computational Hydrodynamics - High Performance Computing

Education

- 2011 B.S. in Physics; University of Minnesota, Twin Cities
2018 Ph.D. in Astrophysics (High velocity features in Type Ia supernovae via interaction with a compact circumstellar shell); University of Texas at Austin (Expected); Advisor: J. Craig Wheeler.

Publications & talks

Journal articles: primary author

- 2018 Mulligan, B. W., & Wheeler, J. C. (2017); “**Deriving abundances from early supernova spectra**”; In Preparation
2018 Mulligan, B. W., & Wheeler, J. C. (2017); “**A Compact Circumstellar Shell as the Source of High-Velocity Features in SN 2011fe**”; *Monthly Notices of the Royal Astronomical Society*, Accepted
2017 Mulligan, B. W., & Wheeler, J. C. (2017); “**High-Velocity Features in Type Ia Supernovae from a Compact Circumstellar Shell**”; *Monthly Notices of the Royal Astronomical Society*, Vol. 467, Iss. 1

Journal articles: other author

- 2018 Mace, Gregory N., Mann, Andrew W., Skiff, Brian A., Sneden, Christopher, Kirkpatrick, Davy, Schneider, Adam C., Kidder, Benjamin, Gosnell, Natalie M., Kim, Hwihyun, *Mulligan, Brian W.*, Prato, L., Jaffe, Daniel (2018); **Wolf 1130: A Nearby Triple System Containing a Cool, Ultramassive White Dwarf**; *The Astrophysical Journal*, Accepted
- 2015 Silverman, J. M., Vinkó, J., Marion, G. H., Wheeler, J. C., Barna, B., Szalai, T., *Mulligan, B. W.*, Filippenko, A. V., (2015); **“High-velocity features of calcium and silicon in the spectra of Type Ia supernovae”**; *Monthly Notices of the Royal Astronomical Society*, Vol 451, Issue 2
- 2011 Daghigh, Ramin G., Green, Michael D., *Mulligan, Brian W.* (2011); **“Asymptotic spectrum of Kerr black holes in the small angular momentum limit”**; *Physical Review D*, Vol. 83, Iss. 4

Posters

- 2015 Mulligan, B. W., & Wheeler, J. C. (2015); **“High velocity features in Type Ia supernovae via interaction with circumstellar shell”**; American Astronomical Society 225th Meeting
- 2015 Silverman, J. M., Vinkó, J., Marion, G. H., Wheeler, J. C., Mulligan, B. W., Filippenko, A. V., (2015); **“High-Velocity Features in the Spectra of Type-Ia Supernovae”**; American Astronomical Society 225th Meeting
- 2014 Mulligan, B. W., & Wheeler, J. C. (2015); **“High velocity lines due to interaction between Type Ia supernova ejecta and a circumstellar shell: 1-D simulations”**; American Astronomical Society 223rd Meeting
- 1993 Myers, J. M.; Mulligan, B. W.; Johnson, M. J.; Hakkila, J.; Meegan, C. A.; **“A Statistical Analysis of the Barium Star Spatial Distribution and Luminosity Function: Preliminary Results”**; American Astronomical Society 184th Meeting

Public Research Talks

- 2017 **“On determining the composition of high velocity material in Type Ia supernovae”**; Astronomy Department Theory Seminar; University of Texas at Austin; 13 Apr 2015
- 2017 **“Simulation of High-Velocity Features of Exploding White Dwarfs”**; Trinity University Physics Seminar; Trinity University, San Antonio, TX; 21 Mar 2017
- 2017 **“Simulation of compact circumstellar shells around Type Ia supernovae and the resulting high-velocity features”**; American Astronomical Society 229th Meeting; Grapevine, TX; 6 Jan 2017
- 2016 **“Deriving abundances from early supernova spectra”**; Astronomy Department Theory Seminar; University of Texas at Austin; 25 Oct 2016

- 2015 **“Type Ia supernovae, circumstellar shells, and high velocity lines: 1-D simulation”**, Astronomy Department Theory Seminar; University of Texas at Austin, Austin, TX; 13 Apr 2015
- 2014 **“Type Ia supernovae, circumstellar shells, and high velocity lines: 1-D simulation”**, Astronomy Department Theory Seminar; University of Texas at Austin, Austin, TX; 6 Oct 2014

Public Popular Talks

- 2018 **“Astronomy in the News”**; Astronomy On Tap ATX; North Door; Austin, TX; 20 Feb 2018
Description: Astronomy on Tap is a free, public event held in an informal setting with a typical attendance of about 250 people. It is meant to give the public a chance to meet and ask questions of professional astrophysicists. Astronomy in the News is a 10 minute segment that discusses several newsworthy results in astronomy and astrophysics from the previous month, giving some background and context for each story.
- 2018 **“Astronomy in the News”**; Astronomy On Tap ATX; North Door; Austin, TX; 24 Jan 2018
- 2017 **“Astronomy in the News”**; Astronomy On Tap ATX; North Door; Austin, TX; 19 Dec 2017
- 2017 **“Astronomy in the News”**; Astronomy On Tap ATX; North Door; Austin, TX; 21 Nov 2017
- 2017 **“Astronomy in the News”**; Astronomy On Tap ATX; North Door; Austin, TX; 17 Oct 2017
- 2017 **“Astronomy in the News”**; Astronomy On Tap ATX; North Door; Austin, TX; 19 Sep 2017
- 2017 **“Astronomy in the News”**; Astronomy On Tap ATX; North Door; Austin, TX; 15 Aug 2017
- 2017 **“Astronomy in the News”**; Astronomy On Tap ATX; North Door; Austin, TX; 18 Jul 2017
- 2017 **“Astronomy in the News”**; Astronomy On Tap ATX; North Door; Austin, TX; 20 Jun 2017
- 2017 **“Astronomy in the News”**; Astronomy On Tap ATX; North Door; Austin, TX; 16 May 2017
- 2017 **“Astronomy in the News”**; Astronomy On Tap ATX; North Door; Austin, TX; 18 Apr 2017
- 2017 **“Astronomy in the News”**; Astronomy On Tap ATX; North Door; Austin, TX; 21 Feb 2017
- 2017 **“Astronomy in the News”**; Astronomy On Tap ATX; North Door; Austin, TX; 17 Jan 2017
- 2016 **“Astronomy in the News”**; Astronomy On Tap ATX; North Door; Austin, TX; 20 Dec 2016
- 2016 **“Astronomy in the News”**; Astronomy On Tap ATX; North Door; Austin, TX; 15 Nov 2016

- 2016 “**Astronomy in the News**”; Astronomy On Tap ATX; North Door; Austin, TX; 18 Oct 2016
- 2016 “**Searching for the rest of the Universe: Dark Matter**”; Astronomy on Tap ATX; North Door; Austin, TX; 20 Sept 2016
Description: A review of searches for particle dark matter, including the most recent results from the LUX experiment. Direct dark matter searches look for interaction between dark matter particles and ordinary matter. The LHC looks for creation of particles of dark matter from high energy proton-proton collisions. None of these searches have successfully found dark matter as a particle. Attendance: 280.
Video: https://www.youtube.com/watch?v=n4bbuMY_NnA&feature=youtu.be
- 2016 “**Astronomy in the News**”; Astronomy On Tap ATX; North Door; Austin, TX; 20 Sept 2016
Video: <https://www.youtube.com/watch?v=aszX-dRsIV0&feature=youtu.be>
- 2016 “**Astronomy in the News**”; Astronomy On Tap ATX; North Door; Austin, TX; 16 Aug 2016
Video: https://www.youtube.com/watch?v=JdcnN4pqfM8&index=9&list=PLdB_Hy0gTQHg9UziyoilQ00Iap62FeEfK
- 2016 “**Astronomy in the News**”; Astronomy On Tap ATX; North Door; Austin, TX; 19 July 2016
Video: https://www.youtube.com/watch?v=30bj149B5h4&list=PLdB_Hy0gTQHg9UziyoilQ00Iap62FeEfK&index=8
- 2016 “**Astronomy in the News**”; Astronomy On Tap ATX; North Door; Austin, TX; 17 May 2016
Video: https://www.youtube.com/watch?v=OUI3wc3X5j4&index=7&list=PLdB_Hy0gTQHg9UziyoilQ00Iap62FeEfK
- 2016 “**Why does my code take a week to run? Optimizing and profiling your code**”; Grad Student/Post-Doc Seminar; UT-Austin; Austin, TX; 4 Mar 2016
Description: A significant fraction of code written by and for astronomers is in an interpreted language such as python or IDL. For large datasets or complex problems, codes may take hours or even several days to execute. This talk discusses common causes of slow downs in serial code, discusses solutions, and introduces profilers as a way to identify causes of more complex speed problems in code. Attendance: 20.
- 2015 “**10000 Years of Calendars**” Astronomy On Tap ATX; Scholz Garden; Austin, TX; 20 Jan 2015
Description: A history of the development of the calendar, discussing types of calendar systems, the development of the early Roman calendar and the subsequent changes that led to the modern calendar, with an emphasis on the astronomical motivations for each change. Attendance: 200.
- 2013 “**Time, Calendars, and the Stars: A little history of time and calendars**”; Monthly Meeting; UT Austin Astronomy Students Association; Austin, TX; 13 Nov 2013
Description: Astronomy Students Association is an organization open to all UT students, including non-science majors. This talk discusses how our calendar

and methods of measuring time came about, with an emphasis on astronomical motivations for each system. Attendance: 50.

2013 **“Weighing galaxies and finding dark matter”**; Star Party; Westgate Outdoor Discovery Center; Round Mountain, TX; 28 Sept 2013

Description: This talk discusses the observations that lead to evidence for dark matter, including galactic rotation curves, gravitational lensing by clusters of galaxies, and x-ray emission from the inter-galactic medium in cluster of galaxies. Some candidates for dark matter are discussed. Attendance: 70.

2013 **“Time, Calendars, and the Stars: A little history of time and calendars”**; Star Party; Westgate Outdoor Discovery Center; Round Mountain, TX; 28 Sept 2013

Description: Westgate Outdoor Discovery Center is located 1 hour west of Austin, TX. The star parties are free and open to the public. This talk discusses how our calendar and methods of measuring time came about, with an emphasis on astronomical motivations for each system. Attendance: 70.

Teaching

Principal Instructor

2014 NSC 001: **Natural Sciences Seminar**; University of Texas at Austin; Fall 2014

Duties: Lesson planning, content development, office hours.

Description: The Natural Sciences Seminar was a course required for all incoming freshmen in the College of Natural Sciences, with an emphasis on useful academic and life skills for college students, including studying, preparing for exams, budgeting, getting the most out of classes and office hours, and preparing a resume.

Class size: 25.

Teaching Assistant

2018 AST 301; **Introduction to Astronomy**; PI: Don Winget; University of Texas at Austin; Spring 2018

Duties: Grading, office hours, exam review, exam writing.

Description: “Introduction to Astronomy” is a course for non-science majors that reviews all areas of astronomy.

2017 AST 152M: **Stellar Astronomy Laboratory**; PI: Chris Sneden ; University of Texas at Austin; Fall 2017

Duties: Lesson planning, content development, grading, office hours.

Description: “Stellar Astronomy Laboratory” is an observational astronomy course for mid- to upper-division astronomy students, meant to be supplemental to the AST 352K class (below), though there are no prerequisites for the

lab. The lab introduces the students to modern astronomical equipment and methods: using a modern telescope and instruments, how a CCD works and associated noise sources, astrometric methods, photometric methods, and using IRAF for data reduction. The TA is fully responsible for labs, including developing and modifying labs, developing a syllabus and grading rubrics, and preparing a short lecture for each week of lab.

Class size: 8.

2017 AST 352K: **Stellar Astronomy**; PI: Chris Sneden; University of Texas at Austin; Fall 2017

Duties: Grading, office hours, exam review, homework help sessions.

Description: “Stellar Astronomy” is a course for mid- to upper-division astronomy students with an emphasis on observational aspects of astronomy, including coordinate systems, photometry (flux measurement, filters, magnitude systems), astrometry (parallax, proper motion), and spectroscopy (redshift, line broadening). The students learn how stellar parameters are derived from the observational data.

Class size: 45.

2017 AST 301; **Introduction to Astronomy**; PI: Rob Robinson; University of Texas at Austin; Spring 2017

Duties: Grading, office hours.

2016 UGS 303: **Popular Astronomy**; PI: Karl Gebhardt; University of Texas at Austin; Fall 2016

Duties: Lesson planning, content development, grading, office hours.

Description: “Popular Astronomy” is a University of Texas Signature Course, intended to help incoming students to the University to transition from smaller classes to larger, lecture format classes. In addition to bi-weekly lecture, the students attend a small group (17 student) discussion each week. Each TA has three discussion sections, for which they prepare content and a lesson plan that are supplemental to the class material.

Class size: 100; Students in discussion: 50 (3 sections of 17).

2016 AST 309N; **The Lives and Deaths of Stars**; PI: J. Craig Wheeler; University of Texas at Austin; Spring 2016

Duties: Grading, office hours.

Description: “The Lives and Deaths of Stars” is a course for non-science majors that reviews the life cycle of stars, with an emphasis on the end phases of massive stars: supernovae, neutron stars, and black holes.

Class size: 150.

2015 AST 152M: **Stellar Astronomy Laboratory**; PI: Chris Sneden ; University of Texas at Austin; Fall 2015

Duties: Lesson planning, content development, grading, office hours.

2015 AST 352K: **Stellar Astronomy**; PI: Chris Sneden; University of Texas at Austin; Fall 2015

Duties: Grading, office hours, exam review, homework help sessions.

Class size: 45.

2015 UGS 303: **Extraterrestrial Life**; PI: Neal Evans; University of Texas at Austin; Spring 2015

- Duties: Lesson planning, content development, grading, office hours, exam review.
- Description: “Extraterrestrial Life” is a University of Texas Signature Course, with an emphasis on understanding the possibility of discovering the existence of life elsewhere in the galaxy through exploring the Drake equation and the individual parameters. Topics include star and planet formation, the greenhouse effect, transition from chemistry to life, evolution, solar system exploration, space travel, and communication.
- Class size: 150; Students in discussion: 50 (3 sections of 17).
- 2014 AST 152M: **Stellar Astronomy Laboratory**; PI: Harriet Dinerstein ; University of Texas at Austin; Fall 2014
- Duties: Lesson planning, content development, grading, office hours.
- Class size: 8.
- 2014 AST 352K: **Stellar Astronomy**; PI: Harriet Dinerstein; University of Texas at Austin; Fall 2014
- Duties: Grading, office hours, exam review, homework help sessions.
- Class size: 45.
- 2014 UGS 303: **Extraterrestrial Life**; PI: Neal Evans; University of Texas at Austin; Spring 2014
- Duties: Lesson planning, content development, grading, office hours, exam review.
- Class size: 150; Students in discussion: 50 (3 sections of 17).
- 2013 AST 152M: **Stellar Astronomy Laboratory**; PI: Harriet Dinerstein ; University of Texas at Austin; Fall 2013
- Duties: Lesson planning, content development, grading, office hours.
- Class size: 8.
- 2013 AST 352K: **Stellar Astronomy**; PI: Harriet Dinerstein; University of Texas at Austin; Fall 2013
- Duties: Grading, office hours, exam review, homework help sessions.
- Class size: 45.
- 2013 UGS 303: **Extraterrestrial Life**; PI: Neal Evans; University of Texas at Austin; Spring 2013
- Class size: 150; Students in discussion: 50 (3 sections of 17).
- 2012 AST 309N; **The Lives and Deaths of Stars**; PI: Harriet Dinerstein; University of Texas at Austin; Fall 2012
- Duties: Grading, office hours, exam review.
- Class size: 150.
- 2012 AST 353; **Astrophysics**; PI: Gregory Shields; University of Texas at Austin; Spring 2012
- Duties: Grading, office hours, exam review, homework help sessions.
- Description: “Astrophysics” is a course for astronomy majors that reviews the physics of stellar interiors, including radiative and heat transfer, thermodynamics, hydrodynamics, nucleosynthesis, and stellar life cycles.
- Class size: 45.
- 2011 AST 1001; **Introductory Astronomy Laboratory**; PI: Department; University of Minnesota, Twin Cities; Spring 2011

Duties: Lesson planning, grading, office hours.

Description: “Introductory Astronomy Laboratory” is a supplemental laboratory to an introductory astronomy lecture for a mix of non-science and science major students. Topics include optics, spectroscopy, Kepler’s laws and orbits, Lunar phases, expansion of the universe.

Class size: 50 (2 sections of 25).

2010 AST 2001: **Introduction to Astrophysics**; PI: Robert Gehrz; University of Minnesota, Twin Cities; Spring 2011

Duties: Grading, office hours, homework help sessions.

Description: “Astrophysics” is a course for astronomy majors that reviews the physics of stellar interiors, including radiative and heat transfer, thermodynamics, hydrodynamics, nucleosynthesis, and stellar life cycles.

Class size: 60

2010 AST 1001; **Introductory Astronomy Laboratory**; PI: Department; University of Minnesota, Twin Cities; Fall 2010

Class size: 50 (2 sections of 25).

2010 AST 2001: **Introduction to Astrophysics**; PI: Robert Gehrz; University of Minnesota, Twin Cities; Fall 2010

Class size: 60

2010 AST 1001; **Introductory Astronomy Laboratory**; PI: Department; University of Minnesota, Twin Cities; Spring 2010

Class size: 25.

2010 AST 2001: **Introduction to Astrophysics**; PI: Robert Gehrz; University of Minnesota, Twin Cities; Spring 2010

Class size: 60

Guest Lectures

2016 AST 309N; *The Lives and Deaths of Stars*; PI: J. Craig Wheeler; University of Texas at Austin; **“The Interiors of Black Holes”**; Spring 2016

Description: Introduction to the properties of space-time within the interiors of Schwarzschild and Kerr black holes.

2015 UGS 303: *Extraterrestrial Life*; PI: Neal Evans; University of Texas at Austin; **“Biological Evolution”**; Spring 2015

Description: Introduction to the phenomenology of biological evolution in terms of speciation, and the driving principles such as selection processes.

2014 AST 352K: *Stellar Astronomy*; PI: Harriet Dinerstein; University of Texas at Austin; **“Core collapse Supernovae”**; Fall 2014

Description: Introduction to the final minutes of a massive star leading to core collapse, and observational details of Type II supernovae within the first months after the explosion.

2012 AST 309N; *The Lives and Deaths of Stars*; PI: Harriet Dinerstein; **“Core Collapse Supernovae”**; University of Texas at Austin; Fall 2012

Description: Introduction to the final minutes of a massive star leading to core collapse, and observational details of Type II supernovae within the first months

after the explosion.

- 2012 AST 309N; *Astrophysics*; PI: Gregory Shields; University of Texas at Austin; **“Introduction to Radiative Transfer”**; Spring 2012
Description: Introduction to the radiative transfer processes including absorption and emission, optical depth, and the radiative transfer equation.
- 2011 AST 307; *Introductory Astronomy*; PI: John Lacy; University of Texas at Austin; **“Weighing galaxies and finding dark matter”**; Spring 2012
Description: Introduction to observational evidence for dark matter, including galactic rotation curves, gravitational lensing by clusters of galaxies, and x-ray emission from the inter-galactic medium in cluster of galaxies.

Other Experience

- 2016- **Founder, CEO, Lead Developer**; Astronaos Software; Austin, TX
Description: **Astronaos Software** develops educational software targeted toward University level education, video games, and provides consulting services for high performance computing.
- 2005-2011 **Senior Software Engineer & Technical Team Lead (Aircraft Systems and Flight Instrumentation Systems)**; Aerosim Technologies; Burnsville, MN
Duties: Project management, team management and administration, software tools development and maintenance, simulation software development and maintenance, graphics development and maintenance.
Description: **Aerosim Technologies (Now part of L3)** develops aircraft simulation software for training of commercial pilots and maintenance crews. The simulations range from a limited subset of the cockpit avionics to simulation of all aircraft systems. The Aircraft Systems and Flight Instrumentation Systems team handles simulation of all aircraft systems except the autopilot and the flight management computer, and is responsible for generating the graphics for the flight instrumentation in the cockpit, that provide aircraft maintenance, status, and flight critical information to the pilots.
Team Size: 3-8.
- 2002-2005 **Senior Software Engineer & Technical Team Lead (Flight Instrumentation Systems)**; Aerosim Technologies; Burnsville, MN
Duties: Team management and administration, simulation software development and maintenance, graphics development and maintenance.
Team Size: 2-3.
- 2001-2002 **Senior Software Engineer (Flight Instrumentation Systems)**; Aerosim Technologies; Burnsville, MN
Duties: Simulation software development and maintenance, graphics development and maintenance.
- 1999-2001 **Software Engineer (Flight Instrumentation Systems, Cockpit Controls)**; Aerosim Technologies; Burnsville, MN
Duties: Simulation software development and maintenance, graphics development and maintenance.

Academic Service

- 2013-2014 **Graduate Student Representative**; Department of Astronomy; University of Texas at Austin; Summer 2013 - Spring 2014
Description: Representative of the graduate student in the Department of Astronomy to the faculty of the department. Responsibilities include organizing graduate student meetings, attending departmental faculty meetings, sitting on the Graduate Student Admissions committee, organizing graduate student recruitment activities.
- 2013-2014 **Graduate Student Assembly Representative**; University of Texas at Austin; Summer 2013 - Spring 2014
Description: Representative of graduate students in the Department of Astronomy for the University-wide graduate student government.
- 2012-2013 **Computing Committee**; Department of Astronomy; University of Texas at Austin; Summer 2012 - Spring 2013
Description: Graduate student member of departmental computing committee, with oversight of departmental computing resources and information technology staff.