

# Michael Zingale / Curriculum Vitæ

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## Present Position:

Jan. 2012– *Associate Professor of Physics and Astronomy, Stony Brook University, Stony Brook, NY*

## Research Interests:

I am interested in developing and applying computational hydrodynamics algorithms to problems in nuclear astrophysics. A large part of this work is the development of low Mach number hydrodynamics algorithms suited toward long-time evolution in astrophysical flows. The low Mach number simulation code *Maestro* (developed together with collaborators at LBNL) has been applied to a variety of problems to model convection in stellar environments, including Type Ia supernovae, X-ray bursts, novae, and massive star evolution. *Maestro* is publicly available.

## Education:

2000      Ph.D. in Astronomy and Astrophysics, University of Chicago  
*thesis:* *Helium Detonations on Neutron Stars*  
*advisor:* Dr. J. W. Truran

1998      M.S. in Astronomy and Astrophysics, University of Chicago

1996      B.S. in Physics and Astronomy, University of Rochester, Magna Cum Laude  
*thesis:* *Magnetohydrodynamical Wave Support of Molecular Clouds*  
Minor in Mathematics, University of Rochester

## Academic Appointments:

2014–      *Affiliate, Institute for Advanced Computational Science, Stony Brook University, Stony Brook, NY*

2006–2011      *Assistant Professor of Physics and Astronomy, Stony Brook University*

2001–2005      *Postdoctoral Researcher, SciDAC Supernova Science Center, University of California, Santa Cruz. Worked on simulations of turbulent thermonuclear flames in Type Ia supernova. Initiated a collaboration with Lawrence Berkeley Lab to apply low Mach number hydrodynamics methods to astrophysical flames. advisor: Dr. S. E. Woosley*

2000–2001      *Research Associate, Center for Astrophysical Thermonuclear Flashes, University of Chicago. One of the developers of the FLASH Code. Research focused on flame simulations in Type Ia supernovae. advisor: Dr. J. W. Truran*

1997–2000 Graduate student researcher, Center for Astrophysical Thermonuclear Flashes and Department of Astronomy and Astrophysics, University of Chicago. One of the developers of the FLASH Code. *advisor:* Dr. J. W. Truran

### Honors / Awards:

2015–2016 Scialog Fellow for *Scialog: Time Domain Astrophysics: Stars and Explosions*

2006 Presidential Early Career Award in Science and Engineering (PECASE). Nomination through DOE NNSA.

2006 DOE Office of Nuclear Physics Outstanding Junior Investigator (OJI) Award for a proposal entitled: *Multidimensional Modeling of Astrophysical Thermonuclear Explosions*

2000 Gordon Bell Award in High Performance Computing, Special Category for a paper entitled *High-Performance Reactive Fluid Flow Simulations Using Adaptive Mesh Refinement on Thousands of Processors*, Calder et al. 2000. (SC 2000 conference)

2000 Carl Sagan Award for Excellence in Teaching (Dept. of Astronomy & Astrophysics, University of Chicago)

1997 Gregor Wentzel graduate teaching award (Dept. of Physics, University of Chicago)

1996 Stoddard Prize in physics for senior thesis (University of Rochester)

1996 Flagg Award for highest GPA in physics (University of Rochester)

1996 Inducted into Phi Beta Kappa honor society (University of Rochester)

1994 Inducted into Sigma Pi Sigma physics honor society (University of Rochester)

### Publications:

60+ refereed publications and conference proceedings, h-index = 20 (ISI)

### Research Grants/Contracts as Principal Investigator:

2011–2013	Department of Energy, Office of Nuclear Physics (2.5-year renewal), <i>Multidimensional Modeling of Astrophysical Thermonuclear Explosions</i> , DOE DE-FG02-06ER41448	\$253,000
2010–2011	Contract with Lawrence Livermore National Laboratory, <i>Multidimensional Modeling of Nova with Realistic Nuclear Physics</i> , 2010: B589924; 2011: B593287	\$99,768
2009–2011	Department of Energy, Office of Nuclear Physics Outstanding Junior Investigator Award (2-year renewal), <i>Multidimensional Modeling of Astrophysical Thermonuclear Explosions</i> , DOE DE-FG02-06ER41448	\$186,000
2007–2009	Contract with Lawrence Livermore National Laboratory, <i>Verification and Validation of Radiation Hydrodynamics for Astrophysical Applications</i> , 2007: B568673; 2008: B574691; 2009 B582735	\$150,000

2006–2009	Department of Energy, Office of Nuclear Physics Outstanding Junior Investigator Award, <i>Multidimensional Modeling of Astrophysical Thermonuclear Explosions</i> , DOE DE-FG02-06ER41448	\$255,000
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#### Research Grants/Contracts as Co-Investigator:

2015–2018	Department of Energy, Office of Nuclear Physics <i>Research in Nuclear Astrophysics: Supernovae, Compact Objects, and Algorithms</i> , DOE DE-FG02-87ER40317, PI: James Lattimer, Co-Is: Alan Calder, Michael Zingale	\$1,100,000
2013–2015	Department of Energy, Office of Nuclear Physics <i>Research in Nuclear Astrophysics: Supernovae, Compact Objects, and Algorithms</i> , DOE DE-FG02-87ER40317, PI: James Lattimer, Co-Is: Alan Calder, Michael Zingale	\$640,000
2012–2015	NSF, <i>White Dwarf Mergers as Progenitors of Type Ia Supernovae</i> , AST-1211563, PI: Alan Calder, Co-Is: Doug Swesty, Michael Zingale	\$437,643

#### Large Computer Time Allocations:

2017	PI on a NERSC 2017 allocation, <i>Three-dimensional studies of white dwarf and neutron star systems</i> (5 M MPP hours)	
2017	PI on an INCITE 2017 award for the OLCF Cray XKT titan machine, <i>Approaching Exascale Models of Astrophysical Explosions</i> (45 Mh)	
2016	PI on a NERSC 2016 allocation, <i>Three-dimensional studies of neutron star systems</i> (4.6 M MPP hours)	
2015–2016	PI on an INCITE 2015 award for the OLCF Cray XK7 titan machine, <i>Approaching Exascale Models of Astrophysical Explosions</i> (2015: 50 Mh, 2016: 55 Mh)	
2011–2015	Co-I on NSF PRAC for NCSA/Blue Waters, <i>Type Ia Supernovae</i> (9.1 M node hours)	
2015	PI on a NERSC 2015 allocation, <i>Three-dimensional studies of convection in X-ray bursts</i> (5.9 M MPP hours)	
2014	PI on a NERSC 2014 allocation, <i>Three-dimensional studies of convection in X-ray bursts</i> (14 M MPP hours)	
2014	Co-I on a NERSC 2014 allocation, <i>Type Ia Supernovae and X-Ray Bursts</i> (9 M MPP hours)	
2012–2014	Co-I on an INCITE 2012 award for the OLCF Cray XT5, <i>Petascale Simulations of Type Ia Supernovae</i> (2012: 46 Mh; 2013: 55 Mh; 2014: 50 Mh)	
2013	PI on XSEDE allocation on Kraken/NICS, <i>CASTRO Simulations of Merging White Dwarfs</i> (4.1 Mh)	
2013	Co-I on a NERSC 2013 allocation, <i>Type Ia Supernovae and X-ray Bursts</i> (3.5 M MPP hours)	
2011	Co-I on a TeraGrid allocation on the Kraken machine, <i>Thermonuclear Bursts on the Surfaces of Compact Astrophysical Objects</i> (2.1 Mh, Oct. 2011)	

2011	Co-I on an INCITE 2011 award for the Cray XT5/ORNL machine, <i>Petascale Simulations of Type Ia Supernovae</i> (50 Mh)
2010	PI on a TeraGrid allocation on the Kraken machine, <i>Thermonuclear Bursts on the Surfaces of Compact Astrophysical Objects</i> (1 Mh; Oct. 2010)
2010	Co-I on an INCITE 2010 award for the Cray XT5/ORNL, <i>Multidimensional Models of Type Ia Supernovae from Ignition to Observables</i> (5 Mh initially + 20 Mh supplement)
2007–2009	Co-Investigator on an INCITE 2007 award for the Cray XT3/ORNL, <i>First Principles Models of Type Ia Supernovae</i> . (2007: 4 Mh; 2008: 3.5 Mh; 2009: 3 Mh)
2006	Co-Principal Investigator on the Leadership Computing Facility (ORNL) allocation, <i>Ignition and Flame Propagation in Type Ia Supernovae</i> . (3 Mh)

### **Stony Brook Physics and Astronomy Teaching Experience:**

<i>Astronomy Today</i> (AST 100)	A one-credit undergraduate seminar on current astronomy topics, where students lead the discussion on current topics. (F 2010, F 2011, F 2014, F 2015)
<i>Introduction to the Solar System</i> (AST 105)	An overview of solar system topics (solar system dynamics, Kepler's laws, planetary processes, exoplanets, . . .) for non-majors. (F 2007, F 2008, F 2009, F 2011, S 2014, S 2015)
<i>Astronomy</i> (AST 203)	A calculus-based introduction to astronomy and astrophysics for majors, covering the basics of radiation, spectra, binary stars, stellar evolution, ISM, clusters, galaxies, and cosmology. (S 2007, S 2008, S 2009, S 2010, S 2011, S 2012, S 2017)
<i>Introduction to Planetary Sciences</i> (AST 205)	A calculus-based introduction to the solar system for majors covering basic solar system motion, planetary processes, exoplanets, and solar system formation. (F 2010, F 2014, F 2016)
<i>Stars</i> (PHY 521)	A graduate-level introduction to the physical processes inside stars, stellar structure and atmospheres, and stellar explosions. (F 2013, F 2015)
<i>Python for Scientific Computing</i> (PHY 546; formerly grad special topics)	A one-hour weekly graduate seminar that I created that introduces python and a variety of libraries (NumPy, matplotlib, SciPy, SymPy) for numerical analysis, visualization, and data processing, as well as basic software engineering practices (git/github, debugging, testing). (S 2014, S 2015, S 2016, S 2017)
<i>The Application of Simulation in Astrophysics</i> (grad special topics)	Develop the equations of hydrodynamics, instabilities common in astrophysics, and discuss numerical methods for solving the Euler equations (finite-volume methods, Riemann solvers, etc.) (S 2006)

<i>Numerical Methods for (Astro)Physics</i> (grad special topics)	A practical introduction to good development practices, order-of-accuracy, numerical differentiation, integration, interpolation, ODEs, root finding, solving hyperbolic, elliptical, and parabolic PDEs, computational fluid dynamics, and parallel programming, with examples in python. (S 2013, S 2016)
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### Other Teaching Experience:

Summer 2001	<i>University of Chicago / Department of Computer Science:</i> Teaching assistant for the Introduction to Programming in C class in the Computer Science Professional Masters Program at the University of Chicago.
1997–1998	<i>Center of Astronomical Research in Antarctica (CARA) outreach program:</i> Developed and taught thermodynamics, E&M, and mechanics experiments to grade 7–12 Chicago school students. Awarded the Carl Sagan teaching award.
1996–1997	<i>Introductory Physics Teaching Assistant (University of Chicago):</i> Taught weekly discussion and laboratory sections. Awarded the Gregor Wentzel teaching award.

### Professional Development:

2001	Finite Volume Upwind and Centered Methods for Hyperbolic Conservation Laws (Barcelona, Spain)
1999	NASA Summer School for High Performance Computational Earth and Space Sciences

### Stony Brook University Service:

2011–2012, 2013–	Strategic Advising Committee, Dept. of Physics and Astronomy
2006–2007, 2016–2017	Graduate Admission Committee, Dept. of Physics and Astronomy
2016–2017	Examine the Graduate Exam Committee, Dept. of Physics and Astronomy
2013–2016	Astronomy Open Nights coordinator, Dept. of Physics and Astronomy
2008, 2014–2015	Department Chair Search Committee, Dept. of Physics and Astronomy
2014–2015	Three-year Reappointment Committee for Astronomy colleague, Dept. of Physics and Astronomy
2013–2014	Undergraduate Astronomy Coordinator, Dept. of Physics and Astronomy
2013–2014	Tenure Committee for Astronomy colleague, Dept. of Physics and Astronomy
2013–2014	Astronomy Faculty Search Committee, Dept. of Physics and Astronomy
2013	Ad-hoc Committee for High-Energy Physics Hire, Dept. Physics and Astronomy

2007–2012	Colloquium Committee, Dept. of Physics and Astronomy (chair: Fall 2008, Fall 2009, Fall 2010, Fall 2011)
2011	CESAME/Physics and Astronomy joint hire committee, Dept. of Physics and Astronomy
2010	Teaching Learning Technology (TLT) Advisory Committee
2009	Long Range Planning Committee, Dept. of Physics and Astronomy
2007–2009	Graduate Advising Committee, Dept. of Physics and Astronomy
2006–2009	University Senate Committee on Computing and Communications (chair: Feb. 2008 – May 2009)
2007–2008	Astronomy Faculty Search Committee, Dept. of Physics and Astronomy
2006–2007	NYCCS Faculty Search Committee (Dept. level), Dept. of Physics and Astronomy

### Professional Service:

2016–	Elected to the NERSC User’s Group Executive Committee (NUGEX)
2014–	Elected to the OLCF User Group Executive Board (Vice chair: 2014–2015; Chair: 2015–2016)
ongoing	Referee for the <i>Astrophysical Journal</i> , <i>Astronomy and Astrophysics</i> , <i>Nature</i> , <i>Monthly Notices of the Royal Astronomical Society</i> , <i>Computing in Science and Engineering</i> , <i>Journal of Computational Physics</i> , and <i>Nuclear Physics A</i>
2006–	Annual <i>Astronomy Open Night</i> public outreach talks, Stony Brook (Open Night coordinator from Fall 2013–)
2016	Reviewer for Deutsche Forschungsgemeinschaft
2013, 2016	Served on a NASA ATP grant review panel
2011, 2014, 2016	External reviewer for DOE Office of Nuclear Physics
2014, 2016	External reviewer for NSF PRAC
2013	External reviewer for NSF Office of Cyber Infrastructure
2012	Reviewer for the Great Lakes Consortium for Petascale Computation (2012) proposals for the NCSA Blue Waters machine.
2007	External reviewer for NASA Astrophysics Theory and Fundamental Physics Program
2006	Served on NSF Astronomy and Astrophysics Program review panel

### Meeting Organization:

2016–2017	Member of the Program Committee for the <i>13th International Workshop on OpenMP (IWOMP) 2017</i> (Stony Brook, NY 2017)
2016	Co-organizer of the second <i>New York Area Computational Astrophysics meeting</i> (American Museum of Natural History, April 2016)

- 2015      Scientific organizing committee for the workshop *GNASH: The anomalous metal-poor stars and convective-reactive nuclear astrophysics* (U. Victoria, Victoria, BC)
- 2015      Co-organizer of the *New York Area Computational Astrophysics meeting* (Farmingdale State College, April 2015)
- 2014–2015      Organizing committee for the 2015 *Oak Ridge Leadership Computing Facility User Meeting*
- 2012–2013      Local organizing committee for the *National Nuclear Physics Summer School* (NNPSS 2013).
- 2012      Co-convenor of *Thermonuclear explosions: Type Ias, Novae, and X-ray bursts* working group at *Nuclear Astrophysics Town Meeting* (Detroit, MI)

### **Astrophysical Software / Other Projects:**

- ongoing      Creator of the Open Astrophysics Bookshelf github organization <http://open-astrophysics-bookshelf.github.io/> and author of the open text *Computational Hydrodynamics for Astrophysics*
- ongoing      Co-developer of the publicly-available low Mach number hydrodynamics code *Maestro*, <http://bender.astro.sunysb.edu/Maestro/>
- ongoing      Co-developer of the publicly-available compressible hydrodynamics code *Castro*, <https://ccse.lbl.gov/Downloads/downloadCASTRO.html>
- ongoing      Developed and distribute many simple teaching codes (advection, Eulerian compressible and incompressible hydro solvers, multigrid, etc., with accompanying notes and exercises), <http://www.astro.sunysb.edu/mzingale/software/>
- ongoing      Created a library of astronomy animations introducing basic concepts (e.g. Kepler's laws, blackbody radiation, waves, binary star/exoplanet dynamics, etc.) as well as more advanced concepts (e.g. entropy in convection), <http://www.astro.sunysb.edu/mzingale/software/astro/>, also available on youtube, <http://www.youtube.com/user/michaelzingale>
- ongoing      Contributor to the astrophysics visualization package *yt*
- 1997–2002      Original member of the FLASH Code development team

### **Guest Appointments:**

- 2000–2003      Guest Appointment at Argonne National Laboratory / Mathematics and Computer Science Division
- April 2001      Guest at the Max-Planck-Institut für Astrophysik

### **Professional Societies:**

Member of the American Association of Physics Teachers  
 Member of the American Astronomical Society  
 Member of the American Physical Society

**Students Advised:**

PhDs graduated	Chris Malone (Stony Brook, PhD 2011, thesis: <i>Multidimensional Simulations of Convection Preceding a Type Ia X-ray Bursts</i> )
	Max Katz (Stony Brook, PhD 2016, thesis: <i>White Dwarf Mergers on Adaptive Meshes</i> )
	Adam Jacobs (Stony Brook, PhD 2016, thesis: <i>The Explosive Possibilities of Little Dwarfs: Low-Mach Number Modeling of Thin Helium Shells on Sub-Chandrasekhar Mass White Dwarfs</i> )
current grad students	Maria Guadalupe Barrios Sazo (Stony Brook, current student, working on Castro radiation hydrodynamics simulations of black widow pulsars)
undergraduate (long term)	Max Katz (REU student at Stony Brook, summer 2010, worked on generating initial models with the MESA code)
	Adam Siegel (Stony Brook, BS 2011, worked on flame modeling)
	Ryan Orvedahl (Stony Brook, BS 2013, worked on Maestro algorithm issues and particle analysis)

**References:**

references available upon request