

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

Publications:

60+ refereed publications and conference proceedings, h-index = 19 (ISI)

Honors / Awards:

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| 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: <i>Multidimensional Modeling of Astrophysical Thermonuclear Explosions</i> |
| 2000 | Gordon Bell Award in High Performance Computing, Special Category for a paper entitled <i>High-Performance Reactive Fluid Flow Simulations Using Adaptive Mesh Refinement on Thousands of Processors</i> , 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) |

Research Grants/Contracts as Principal Investigator:

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| 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 |

Research Grants/Contracts as Co-Investigator:

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| 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:

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| 2015–16 | PI on an INCITE 2015 award for the OLCF Cray XK7 titan machine entitled <i>Approaching Exascale Models of Astrophysical Explosions</i> (2015: 50 Mh) | |
| 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 for a proposal entitled <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 for a proposal entitled <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 for a proposal entitled <i>Petascale Simulations of Type Ia Supernovae</i> (50 Mh) | |
| 2010 | PI on a TeraGrid allocation on the Kraken machine for a proposal entitled <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 for a proposal entitled <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 for a proposal entitled <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 entitled <i>Ignition and Flame Propagation in Type Ia Supernovae</i> . (3 Mh) | |

Stony Brook Physics and Astronomy Teaching Experience:

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| <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) |
| <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) |
| <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) |
| <i>Stars</i> (PHY 521) | A graduate-level introduction to the physical processes inside stars. (F 2013) |
| <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, and parallel programming, with examples in python. (S 2013) |
| <i>Python for Scientific Computing</i> (grad special topics) | A one-hour weekly graduate seminar 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) |

Other Teaching Experience:

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| 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:

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| 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:

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| 2013–14 | Undergraduate Astronomy Coordinator, Dept. of Physics and Astronomy |
| 2014– | Department Chair Search Committee, Dept. of Physics and Astronomy |
| 2014– | Three-year Reappointment Committee for Astronomy colleague, Dept. of Physics and Astronomy |
| 2013– | Tenure Committee for Astronomy colleague, Dept. of Physics and Astronomy |
| 2013– | Astronomy Open Nights coordinator, Dept. of Physics and Astronomy |
| 2011–12, 2013– | Strategic Advising Committee, Dept. of Physics and Astronomy |
| 2013–14 | Astronomy Faculty Search Committee, Dept. of Physics and Astronomy |
| 2013 | Ad-hoc Committee for High-Energy Physics Hire, Dept. Physics and Astronomy |
| 2007–12 | 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 |
| 2007–09 | Graduate Advising Committee, Dept. of Physics and Astronomy |
| 2006–09 | University Senate Committee on Computing and Communications (chair: Feb. 2008 – May 2009) |
| 2008 | Department Chair Search Committee, Dept. of Physics and Astronomy |
| 2007–08 | Astronomy Faculty Search Committee, Dept. of Physics and Astronomy |
| 2006–07 | Graduate Admission Committee, Dept. of Physics and Astronomy |
| 2006–07 | NYCCS Faculty Search Committee (Dept. level), Dept. of Physics and Astronomy |

Professional Service:

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| 2014– | Elected to the OLCF User Group Executive Board (Vice chair: 2014–15; Chair: 2015–16) |
| 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>Journal of Computational Physics</i> , and <i>Nuclear Physics A</i> |

Professional Service (cont.):

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| 2006– | Annual <i>Astronomy Open Night</i> public outreach talks, Stony Brook (Open Night coordinator from Fall 2013–) |
| 2014 | External reviewer for NSF PRAC |
| 2013 | Served on a NASA ATP grant review panel |
| 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. |
| 2011 | External reviewer for DOE Office of Nuclear Physics |
| 2007 | External reviewer for NASA Astrophysics Theory and Fundamental Physics Program |
| 2006 | Served on NSF Astronomy and Astrophysics Program review panel |

Meeting Organization:

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

Astrophysical Software / Other Projects:

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| ongoing | Creator of the Open Astrophysics Bookshelf github organization http://open-astrophysics-bookshelf.github.io/ and author of the open text <i>Computational Hydrodynamics for Astrophysics</i> |
| ongoing | Co-developer of the publicly-available low Mach number hydrodynamics code <i>Maestro</i> , http://bender.astro.sunysb.edu/Maestro/ |
| ongoing | Co-developer of the publicly-available compressible hydrodynamics code <i>Castro</i> , 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 |

Astrophysical Software / Other Projects (cont.):

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 Astronomical Society
 Member of the American Physical Society

Students Advised:

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| graduate | Chris Malone (Stony Brook, PhD 2011, thesis: <i>Multidimensional Simulations of Convection Preceding a Type Ia X-ray Bursts</i>) Adam Jacobs (Stony Brook, current student, working on Maestro simulations of sub-Chandrasekhar mass SNe Ia) Max Katz (Stony Brook, current student, working on Castro simulations of white dwarf mergers) |
| undergraduate | 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