

# Michael Zingale / Curriculum Vitæ

Department of Physics and Astronomy, Stony Brook University, Stony Brook, NY 11794-3800

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## Present Position

Sept. 2021– *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 code MAESTROeX and the compressible (magneto-, radiation-) hydrodynamics code Castro. Both codes are freely available on github, use adaptive mesh refinement, and hybrid parallelism techniques to run at scale on today's supercomputers. I apply these codes to studies of X-ray bursts, different progenitor models of Type Ia supernovae, and convection in stars. Importantly, all of the code, input files, workflow scripts needed to reproduce the science done in my research group is available in our github repos.

## 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

- 2021–      *Astronomy Undergraduate Advisor, Stony Brook University*
- 2014–      *Affiliate, Institute for Advanced Computational Science, Stony Brook University*
- 2012–2021      *Associate Professor of Physics and Astronomy, Stony Brook University*
- 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

- 2022 *Outstanding Faculty Award*, Stony Brook University, Department of Physics and Astronomy
- 2019 *Godfrey Excellence in Teaching Award*, Stony Brook University, College of Arts and Sciences
- 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

80+ refereed publications and conference proceedings

### Research Grants/Contracts as Principal Investigator

- |           |   |             |
|-----------|---|-------------|
| 2021–2024 | Department of Energy, Office of Nuclear Physics, <i>Research in Nuclear Astrophysics: Supernovae, Compact Objects, and Algorithms</i> , DOE DE-FG02-87ER40317, Co-Is: Alan Calder, James Lattimer | \$1,095,000 |
| 2020–2022 | Contract with Lawrence Berkeley National Laboratory (part of the DOE ECP Exastar project), contract # 7418390, Co-I: Alan Calder  | \$580,951   |

2018–2019	Contract with Lawrence Berkeley National Laboratory (part of the DOE ECP Exastar project), contract # 7418390, Co-I: Alan Calder	\$144,588
2017–2022	Department of Energy, Office of Nuclear Physics & Office of Advanced Scientific Computing Research, <i>Towards Exascale Astrophysics of Mergers and Supernovae (TEAMS)</i> (SBU subcontract through MSU, multi-institution collaboration, DE-SC0017955), Co-Is: Alan Calder, James Lattimer	\$616,000
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>Multi-dimensional 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

2019–2022	National Science Foundation, <i>REU Site: Broadening undergraduate research participation in Physics and Astronomy at Stony Brook University</i> , PI: Matthew Dawber, Co-Is: Navid Vafael-Najafabadi, Michael Zingale	\$273,308
2018–2021	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	\$1,140,000
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, *White Dwarf Mergers as Progenitors of Type Ia Supernovae*, AST-1211563, PI: Alan Calder, Co-Is: Doug Swesty, Michael Zingale \$437,643

### Large Computer Time Allocations

2022 PI on a NERSC 2022 allocation, *Three-dimensional studies of white dwarfs, massive stars, and neutron star systems* (80k CPU node-hours; 100k GPU node-hours)

2021–2022 PI on an INCITE 2021 award *Approaching Exascale Models of Astrophysical Explosions* (2021: 700 k node hours on OLCF summit; 2022: 590 k node hours on OLCF summit, 100 k node hours on ALCF polaris)

2020 PI on a NERSC 2021 allocation, *Three-dimensional studies of white dwarfs, massive stars, and neutron star systems* (30 M MPP hours)

2019 PI on a NERSC 2020 allocation, *Three-dimensional studies of white dwarfs, massive stars, and neutron star systems* (30 M MPP hours)

2019–2020 PI on an INCITE 2019 award for at OLCF, *Approaching Exascale Models of Astrophysical Explosions* (2019: 1.5 M node hours on titan, 105 k node hours on summit; 2020: 300 k node hours on summit)

2019 PI on a NERSC 2019 allocation, *Three-dimensional studies of white dwarfs, massive stars, and neutron star systems* (27.5 M MPP hours)

2018 PI on a NERSC 2018 allocation, *Three-dimensional studies of white dwarf and neutron star systems* (20.85 M MPP hours)

2018 PI on an INCITE 2018 award for at OLCF, *Approaching Exascale Models of Astrophysical Explosions* (40 M hours)

2017 PI on a NERSC 2017 allocation, *Three-dimensional studies of white dwarf and neutron star systems* (5 M MPP hours)

2017 PI on an INCITE 2017 award for the OLCF Cray XKT titan machine, *Approaching Exascale Models of Astrophysical Explosions* (45 M hours)

2016 PI on a NERSC 2016 allocation, *Three-dimensional studies of neutron star systems* (4.6 M MPP hours)

2015–2016 PI on an INCITE 2015 award for the OLCF Cray XK7 titan machine, *Approaching Exascale Models of Astrophysical Explosions* (2015: 50 M hours, 2016: 55 M hours)

2011–2015 Co-I on NSF PRAC for NCSA/Blue Waters, *Type Ia Supernovae* (9.1 M node hours)

2015 PI on a NERSC 2015 allocation, *Three-dimensional studies of convection in X-ray bursts* (5.9 M MPP hours)

2014 PI on a NERSC 2014 allocation, *Three-dimensional studies of convection in X-ray bursts* (14 M MPP hours)

2014 Co-I on a NERSC 2014 allocation, *Type Ia Supernovae and X-Ray Bursts* (9 M MPP hours)

2012–2014 Co-I on an INCITE 2012 award for the OLCF Cray XT5, *Petascale Simulations of Type Ia Supernovae* (2012: 46 M hours; 2013: 55 M hours; 2014: 50 M hours)

2013	PI on XSEDE allocation on Kraken/NICS, <i>CASTRO Simulations of Merging White Dwarfs</i> (4.1 M hours)
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 M hours, 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 M hours)
2010	PI on a TeraGrid allocation on the Kraken machine, <i>Thermonuclear Bursts on the Surfaces of Compact Astrophysical Objects</i> (1 M hours; 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 M hours initially + 20 M hours 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 M hours; 2008: 3.5 M hours; 2009: 3 M hours)
2006	Co-Principal Investigator on the Leadership Computing Facility (ORNL) allocation, <i>Ignition and Flame Propagation in Type Ia Supernovae</i> . (3 M hours)

### **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, F 2020)
<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, S 2019)
<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 and Radiation</i> (AST 341)	An overview on stellar physics for undergraduate astronomy majors. (F 2018, F 2020)
<i>Computational Methods in Physics and Astrophysics I</i> (PHY 504)	An introduction to the Unix command line, version control, C++, data structures, and scientific programming. (S 2022)

<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, F2021)
<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, S 2018, S 2022)
<i>Computational Methods in Physics and Astrophysics II</i> (PHY 604; formerly grad special topics)	A practical introduction to good development practices, order-of-accuracy, numerical differentiation, integration, interpolation, ODEs, root finding, fitting, FFTs, Monte Carlo, solving hyperbolic, elliptical, and parabolic PDEs, computational fluid dynamics, and parallel programming, with examples in python. (S 2013, S 2016, F 2017)
<i>Astrophysical Fluids and Plasmas</i> (grad special topics)	An introduction to hydrodynamics, fluid instabilities, applications to astrophysics, and an introduction to MHD. (S 2018, S 2021)
<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)

### Other Teaching Experience

Fall 2020	Instructor for Software Carpentry training event at Institute for Advanced Computational Science, Stony Brook, NY (taught: bash, git)
Summer 2020	Developed and led the Physics and Astronomy REU <i>Python Tutorial</i> of introductory tutorials and exercises over the 10 week program ( <a href="https://github.com/sbu-phy-ast-reu/reu-python-tutorial">https://github.com/sbu-phy-ast-reu/reu-python-tutorial</a> ).
Feb 2019	Instructor for Software Carpentry training event at Institute for Advanced Computational Science, Stony Brook, NY (taught: python, git).
Summer 2017	Developed and led the <i>Python Boot Camp</i> week-long tutorial for the IACS Data + Compute = Discovery Research Experience for Undergraduates program ( <a href="https://sbu-python-summer.github.io/">https://sbu-python-summer.github.io/</a> )
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 *Introductory Physics Teaching Assistant (University of Chicago):*  
 Taught weekly discussion and laboratory sections. Awarded the Gregor Wentzel teaching award.

### Professional Development

2018 Software Carpentry instructor certification  
 2001 student at Finite Volume Upwind and Centered Methods for Hyperbolic Conservation Laws (Barcelona, Spain)  
 1999 student at NASA Summer School for High Performance Computational Earth and Space Sciences

### Stony Brook Physics and Astronomy Service

2020– Astronomy Director of Undergraduate Studies  
 2020– Undergraduate Curriculum Committee, Dept. of Physics and Astronomy  
 2017– Undergraduate Research Committee, Dept. of Physics and Astronomy  
 2021 Promotion Committee for Astronomy colleague, Dept. of Physics and Astronomy  
 2018–2021 Diversity Committee, Dept. of Physics and Astronomy (chair: 2019, 2021)  
 2019 Three-year Reappointment Committee for Physics colleague, Dept. of Physics and Astronomy (chair)  
 2011–2012, Strategic Advising Committee, Dept. of Physics and Astronomy  
 2013–2019  
 2017 Tenure Committee for Astronomy colleague, Dept. of Physics and Astronomy  
 2006–2007, Graduate Admission Committee, Dept. of Physics and Astronomy  
 2016–2017  
 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– Department Chair Search Committee, Dept. of Physics and Astronomy  
 2015  
 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

2009	Long Range Planning Committee, Dept. of Physics and Astronomy
2007–2009	Graduate Advising Committee, Dept. of Physics and Astronomy
2007–2008	Astronomy Faculty Search Committee, Dept. of Physics and Astronomy
2006–2007	NYCCS Faculty Search Committee (Dept. level), Dept. of Physics and Astronomy

### **Stony Brook University Service**

2010	Teaching Learning Technology (TLT) Advisory Committee
2006–2009	University Senate Committee on Computing and Communications (chair: Feb. 2008 – May 2009)

### **Professional Service**

2020–	Associate Editor for <i>Living Reviews in Computational Astrophysics</i>
2014–	OLCF User Group Executive Board (Elected to 3 year term 2014, re-elected in 2017; re-elected in 2020; Vice chair: 2014–2015, 2018–2019; Chair: 2015–2016, 2019–2020)
ongoing	Referee for <i>Astronomy and Astrophysics</i> , the <i>Astrophysical Journal</i> , <i>Communications in Applied Mathematics and Computational Science</i> , <i>Computing in Science and Engineering</i> , <i>Journal of Computational Physics</i> , <i>Journal of Open Source Software</i> , <i>Journal of Open Source Education</i> , <i>Monthly Notices of the Royal Astronomical Society</i> , <i>Nature</i> , <i>Nuclear Physics A</i> , and <i>Physical Review Letters</i>
2021	Served on a NASA Open Source Tools, Frameworks, and Libraries review panel
2020	External review committee member for Operational Assessment of the Oak Ridge Leadership Computing Facility (OLCF) (April 21–22, 2020)
2006–	Annual <i>Astronomy Open Night</i> public outreach talks, Stony Brook (Open Night coordinator from Fall 2013–Fall 2016)
2019	Reviewer for UK Science & Technology Facilities Council
2016–2019	Elected to the NERSC User’s Group Executive Committee (NUGEX)
2018	Reviewer for UK DiRAC HPC Facility
2018	Reviewer for Pazy Foundation / Israeli University Planning and Budgeting Committee and the Israeli Atomic Energy Commission (IAEC)
2016	Reviewer for Deutsche Forschungsgemeinschaft
2013, 2016	Served on a NASA ATP grant review panel
2011, 2014, 2016, 2018, 2020, 2022	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

- 2022 Organizer of the *Physics and Astrophysics of Common Envelopes* meeting (Los Alamos National Laboratory, May 2022)
- 2022 Co-chair of the Physics and Astronomy track of the SciPy 2022 meeting (July 2022)
- 2022 Program Committee for *Physics Domain* of the 2022 *Platform for Advanced Scientific Computing* (PASC) conference (Basel, June 2022)
- 2022 Organizer of APS April meeting DCOMP/DAP Invited Session *Frontiers in Computational Stellar Astrophysics* (NYC, April 2022)
- 2021 Co-chair of the Physics and Astronomy track of the SciPy 2021 meeting (virtual, July 2021)
- 2021 Co-organizer of a SIAM CSE 2021 mini-symposium *Performance Portability in Astrophysics Simulation Codes* (virtual, Feb. 2021)
- 2020 Co-chair of the Astronomy and Astrophysics track of the SciPy 2020 meeting (virtual, July 2020)
- 2020 Co-organizer of the *yAC: yt at CCA* meeting (Flatiron Institute / Center for Computational Astrophysics, March 2020)
- 2019 Scientific Organizing Committee, 2019 Compressible Convection Conference (Newcastle, UK, Sept. 2019)
- 2018–2019 Member of the SC19 Reproducibility Challenge track committee
- 2017 Co-organizer of the third *New York Area Computational Astrophysics meeting* (Flatiron Institute / Center for Computational Astrophysics, Sept. 2017)
- 2016–2017 Member of the Program Committee for the *13th International Workshop on OpenMP (IWOMP) 2017* (Stony Brook, NY 2017)
- 2016 Co-organizer of the second *New York Area Computational Astrophysics meeting* (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-convener of *Thermonuclear explosions: Type Ias, Novae, and X-ray bursts* working group at *Nuclear Astrophysics Town Meeting* (Detroit, MI)

**Community Astrophysical Software / Other Projects**

- ongoing Co-developer of the publicly-available low Mach number hydrodynamics code MAESTROeX, <https://amrex-astro.github.io/MAESTROeX/>
- ongoing Co-developer of the publicly-available compressible (radiation-, magneto-) hydrodynamics code Castro, <https://amrex-astro.github.io/Castro/>
- ongoing Creator and co-developer of the publicly-available teaching and prototyping hydrodynamics code pyro, <https://github.com/python-hydro/pyro2/>
- ongoing Creator / co-developer of the pynucastro library, <https://github.com/pynucastro/pynucastro>
- ongoing Creator of the Open Astrophysics Bookshelf github organization <http://open-astrophysics-bookshelf.github.io/> and author of the open text *Introduction to Computational Astrophysical Hydrodynamics*
- 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://zingale.github.io/astro\\_animations/](http://zingale.github.io/astro_animations/), also available on youtube, <http://www.youtube.com/user/michaelzingale>
- ongoing Contributor to and *project member* of the volumetric visualization package yt
- 2020– Ombudsperson for the TARDIS Monte Carlo radiative transfer code (<https://tardis-sn.github.io/tardis/team.html>)
- 1997–2002 Original member of the FLASH Code development team

**Guest/Visiting Appointments**

- 2019–2020 Visiting Scholar at the Flatiron Institute / Center for Computational Astrophysics
- 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  
 Member of the Society for Applied and Industrial Mathematics

**Students Advised**

- PhDs advised Chris Malone (Stony Brook, PhD 2011, thesis: *Multidimensional Simulations of Convection Preceding a Type Ia X-ray Bursts*)

	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> )
	Maria Guadalupe Barrios Sazo (Stony Brook, PhD 2020, thesis: <i>Studies toward the modeling of White Dwarf Mergers and Magnetohydrodynamics</i> )
	Xinlong Li (Stony Brook, PhD 2021, thesis: <i>3-d Simulation of Convection in an Electron-capture O-Ne Core</i> )
Masters students advised	Mu-Hung Chang (Stony Brook, MA 2017, thesis: <i>Application of Spectral Deferred Correction for 1-D Astrophysical Detonation</i> )
	Hengrui Zhan (Stony Brook, MA 2019, thesis: <i>Implementation of an Improved Multipole Expansion Method</i> )
postdocs advised	Alice Harpole (current postdoc, working on Maestro rotation support, GPU acceleration, algorithm development, massive star evolution).
current grad students	Eric Johnson
	Alexander Smith Clark
undergrad honors theses	Kiran Eiden (Stony Brook, BS 05/2020, thesis <i>Propagation of Thermonuclear Flame Fronts in Type I X-ray Bursts</i> )
	Abigail Bishop (Stony Brook, BS 05/2019, thesis <i>Expanding the Modeling of Type Ia Supernovae</i> )
	Luke Nolan (Stony Brook, BS 05/2016, thesis <i>Flame Wave Propagation on the Surface of Neutron Stars During Type I X-Ray Bursts</i> )

## References

references available upon request

# Michael Zingale / Publications and Talks

## Refereed Publications

63. *Neural Networks for Nuclear Reactions in MAESTROeX*,  
D. Fan, D. E. Willcox, C. DeGrendele, M. Zingale, & A. Nonaka 2022, submitted to ApJ
62. *An Improved Method for Coupling Hydrodynamics with Astrophysical Reaction Networks*,  
M. Zingale, M. P. Katz, A. Nonaka, & M. Rasmussen 2022, accepted to ApJ
61. *Dynamics of Laterally Propagating Flames in X-ray Bursts. II. Realistic Burning & Rotation*,  
A. Harpole, N. M. Ford, K. Eiden, M. Zingale, A. D. Willcox, Y. Cavecchi, & M. P. Katz, 2021,  
ApJ, 912, 36
60. *CASTRO: A Massively Parallel Compressible Astrophysics Simulation Code*,  
A. Almgren, M. Barrios Sazo, J. Bell, A. Harpole, M. Katz, J. Sexton, D. Willcox, W. Zhang, &  
M. Zingale, 2020, Journal of Open Source Software, 5, 54, 2513
59. *Preparing Nuclear Astrophysics for the Exascale*,  
M. Katz, A. Almgren, M. Barrios Sazo, K. Eiden, K. Gott, A. Harpole, J. Sexton, D. Willcox,  
W. Zhang, & M. Zingale, 2020, accepted to SC20
58. *Dynamics of Laterally Propagating Flames in X-ray Bursts. I. Burning Front Structure*,  
K. Eiden, M. Zingale, A. Harpole, D. Willcox, Y. Cavecchi, & M. P. Katz, 2020, ApJ, 894, 6
57. *The Castro AMR Simulation Code: Current and Future Developments*,  
M. Zingale, A. S. Almgren, M. Barrios Sazo, J. B. Bell, K. Eiden, A. Harpole, M. P. Katz,  
A. J. Nonaka, D. E. Willcox, & W. Zhang, 2020, Journal of Physics: Conference Series, 1623,  
012021, 14th Int. Conf. on Numerical Modeling of Space Plasma Flows: ASTRONUM-2019  
1-5 July 2019, Paris, France
56. *Modelling low Mach number stellar hydrodynamics with MAESTROeX*  
A. Harpole, D. Fan, M. P. Katz, A. J. Nonaka, D. E. Willcox, & M. Zingale, 2020, Journal of  
Physics: Conference Series, 1623, 012015, 14th Int. Conf. on Numerical Modeling of Space  
Plasma Flows: ASTRONUM-2019 1-5 July 2019, Paris, France
55. *MAESTROeX: A Massively Parallel Low Mach Number Astrophysical Solver*,  
D. Fan, A. Nonaka, A. S. Almgren, A. Harpole, & M. Zingale, 2019, ApJ, 887, 212
54. *Improved Coupling of Hydrodynamics and Nuclear Reactions via Spectral Deferred Corrections*,  
M. Zingale, M. P. Katz, J. B. Bell, M. L. Minion, A. J. Nonaka, & W. Zhang, 2019, ApJ, 886, 105
53. *MAESTROeX: A Massively Parallel Low Mach Number Astrophysical Solver*,  
D. Fan, A. Nonaka, A. Almgren, D. Willcox, A. Harpole, & M. Zingale, 2019, Journal of Open  
Source Software, 4, 43, 1757
52. *AMReX: a framework for block-structured adaptive mesh refinement*,  
W. Zhang, A. Almgren, V. Beckner, J. Bell, J. Blaschke, C. Chan, M. Day, B. Friesen, K. Gott,  
D. Graves, M. P. Katz, A. Myers, T. Nguyen, A. Nonaka, M. Rosso, S. Williams, & M. Zingale,  
2019, Journal of Open Source Software, 4, 37, 1370

51. *Numerical Stability of Detonations in White Dwarf Simulations*,  
M. P. Katz & M. Zingale, 2019, ApJ, 874, 169
50. *pyro: a framework for hydrodynamics explorations and prototyping*,  
A. Harpole, M. Zingale, I. Hawke, & T. Chegini, 2019, Journal of Open Source Software, 4,  
34, 1265
49. *Toward Resolved Simulations of Burning Fronts in Thermonuclear X-ray Bursts*,  
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### Invited Lectures / Seminars / Colloquia

- 07/28/2022 Universiti Malaya (Kuala Lumpur, Malaysia), Department of Physics Colloquium, *Modeling Astrophysical Thermonuclear Explosions*
- 05/20/2022 FastMath seminar, *Algorithmic Improvements for Coupling Hydrodynamics and Reactions in Astrophysical Flows*
- 05/04/2022 Invited speaker in the AMReX Breakout Session of the 2022 ECP Annual Meeting, *Castro Developments for Exascale Platforms*
- 03/16/2022 Invited Focus Session Speaker in *Extreme-Scale Computational Science Discovery in Fluid Dynamics and Related Disciplines*, APS March Meeting, *The Challenges of Modeling Astrophysical Reactive Flows*
- 11/17/2021 Invited panelist for KITP Transport in Stars workshop on convection (KITP, Santa Barbara, CA)
- 10/19/2021 Astronomy Society of Ireland Colloquium, *The Challenges of Modeling Astrophysical Reactive Flows*
- 10/18/2021 Michigan State University, Department of Computational Mathematics, Science and Engineering Colloquium, *The Challenges of Modeling Astrophysical Reactive Flows*
- 03/02/2021 Invited talk in the *Computational Methods in Explosive Nuclear Astrophysics* session at the SIAM Computational Science and Engineering 2021 meeting, *Modeling Astrophysical Reacting Flows*
- 01/30/2020 Princeton University, Department of Astrophysical Sciences Thunch talk, *Modeling Stellar Explosions*
- 01/09/2020 Invited presentation at Texas Advanced Computing Center *Workshop on Future Directions in Extreme Scale Computing for Scientific Grand Challenges on Challenges in Modeling Astrophysical Thermonuclear Explosions*
- 11/06/2019 Stony Brook University, Department of Physics and Astronomy Colloquium, *Modeling Thermonuclear X-ray Bursts*
- 07/05/2019 Invited talk at AstroNum 2019–14th International Conference on Numerical Modeling of Space Plasma Flows, Paris, France, *Improved Coupling of Hydrodynamics and Nuclear Burning in Astrophysical Flows using SDC*
- 02/26/2019 Invited talk in the *Spectral Deferred Correction Methods for Temporal Integration* session at the SIAM Computational Science and Engineering 2019 meeting, *Improved Coupling of Hydrodynamics and Nuclear Burning in Astrophysical Flows using SDC*

- 10/12/2018 Flatiron Institute Center for Computational Astrophysics Colloquium, *Algorithmic Demands for Modeling X-ray Bursts and Type Ia Supernovae*
- 08/23/2018 Talk at the TEAMS Collaboration meeting, *StarKiller Microphysics*
- 06/26/2018 Invited talk at AstroNum 2018—13th International Conference on Numerical Modeling of Space Plasma Flows, Panama City, Florida, *Modeling X-ray Bursts with the AMReX Astrophysics Suite*
- 08/10/2017 Seminar at LLNL High Energy Density Science Center, LLNL, *Modeling Stellar Explosions with the AMReX Astrophysics Suite*
- 07/27/2017 Seminar at Computational Science Initiative, BNL, *The AMReX Astrophysics Suite: Simulating the Stars at the Exascale*
- 06/30/2017 Invited talk at AstroNum 2017—12th International Conference on Numerical Modeling of Space Plasma Flows, St. Malo, France, *Computational Challenges of Modeling X-ray Bursts and Type Ia Supernovae*
- 06/02/2017 Invited participant / overview talk at Stellar Hydro Days, University of Victoria, *Modeling Stellar Convection and Explosions with Maestro, Castro, and the BoxLib/AMReX Astrophysics Suite*
- 04/05/2017 Astronomy Seminar at Michigan State University, *Computational Challenges of Modeling X-ray Bursts and Type Ia Supernovae*
- 02/23/2017 Seminar at Stony Brook Institute for Advanced Computational Science, *Computational Challenges of Modeling X-ray Bursts and Type Ia Supernovae*
- 06/15/2016 Case study talk at DOE Nuclear Physics / ASCR Exascale Requirements Review, Gaithersburg, MD, *Thermonuclear Transients*
- 04/29/2016 Seminar at Oak Ridge National Laboratory, *Modeling Stellar Explosions with Maestro, Castro, and the BoxLib Astrophysics Suite*
- 03/17/2016 Talk at the *18th Workshop on Nuclear Astrophysics*, Ringberg Castle, Tegernsee, Germany, *Models of convection in X-ray bursts and pre-SNe Ia white dwarfs*
- 02/26/2016 Seminar at the U. S. Naval Research Laboratory, *Computational Challenges of Modeling X-ray Bursts and Type Ia Supernovae*
- 08/02/2015 Invited talk at the *International Colloquium on the Dynamics of Explosions and Reactive Systems (ICDERS)*, Leeds, UK, *Understanding Ignition in Type Ia Supernovae*
- 06/22/2015 Invited talk at the *OLCF User's Meeting*, ORNL, Oak Ridge, TN, *Computation Challenges of Modeling Astrophysical Explosions*
- 06/03/2015 Invited talk at the *Fifty One Ergs* meeting, NCSU, *Modeling the Early Phases of Type Ia Supernovae*
- 05/24/2015 "Setting the Stage" talk on *Stellar Hydrodynamics* at the JINA GNASH: *The anomalous metal-poor stars and convective-reactive nuclear astrophysics workshop*, Victoria, BC, Canada, <http://jina-cee.phys.uvic.ca/gnash-workshop/talks-and-contributions/monday/setting-the-stage>
- 04/08/2015 Seminar at U Mass Dartmouth, *Algorithmic Developments for Modeling Stellar Explosions*

- 01/15/2015 CCS-2 Seminar at Los Alamos National Laboratory, *The Challenges of Modeling Type Ia Supernovae and X-ray Bursts*
- 09/15/2014 Invited talk at the *Type Ia Supernovae: progenitors, explosions, and cosmology* conference, Chicago, IL, *Modeling the Early Phases of SNe Ia*, <https://kicp-workshops.uchicago.edu/sn2014/presentations.php>
- 04/30/2014 Invited presentation at *Large Scale Computing and Storage Requirements for Nuclear Physics (NP): Target 2017* meeting, *Convection in X-ray Bursts*
- 02/28/2014 Astronomy Seminar at the Center for Cosmology and Particle Physics, New York University, *Modeling Convective Burning in Type Ia Supernovae and X-ray Bursts*
- 09/27/2013 Nuclear Theory Seminar at Brookhaven National Lab, *Modeling Convective Burning in Type Ia Supernovae and X-ray Bursts*
- 07/09/2013 Seminar at the Flash Center, University of Chicago, *Modeling Convective Burning in Type Ia Supernovae and X-ray Bursts*
- 10/10/2012 Astro Computation working group at *2012 Nuclear Astrophysics Town Meeting, Thermonuclear Driven Events*
- 04/04/2012 Nuclear Astrophysics Seminar at Ohio University entitled *The Challenges of Modeling Explosive Phenomena*
- 07/28/2010 Invited talk at the Lorentz Center Workshop on *X-ray Bursts and Burst Oscillations* entitled *The Algorithmic Challenges of Multidimensional Models of X-ray Bursts*, <http://www.lorentzcenter.nl/lc/web/2010/408/info.php?wsid=408>
- 05/13/2010 Joint NRAO / UVa Dept. of Astronomy Colloquium (Charlottesville, VA) entitled *Modeling Convection and Ignition in Type Ia Supernovae*
- 03/31/2010 Center for the Study of Cosmic Evolution Seminar, Dept. of Physics and Astronomy, Michigan State University (E. Lansing, MI), entitled: *Modeling Convection and Ignition in Type Ia Supernovae*
- 05/12/2009 Astronomy Seminar at the American Museum of Natural History (New York, NY), entitled: *Modeling Convection and Ignition in Type Ia Supernovae*
- 09/30/2008 Astronomy Seminar at the Institute for Advanced Studies (Princeton, NJ), entitled: *New Methods for Modeling Type Ia Supernovae*
- 07/15/2008 Invited Poster at the *SciDAC 2008* conference (Seattle, WA), entitled: *Astrophysical Applications of the Maestro Code* (with co-authors: A. S. Almgren, J. B. Bell, C. M. Malone, & A. J. Nonaka)
- 04/06/2007 Astronomy Seminar at Rutgers University (New Brunswick, NJ), entitled: *The Challenges of Modeling Type Ia Supernova*
- 10/31/2006 Astronomy Colloquia at McGill University (Montreal, CA), entitled: *Understanding Type Ia Supernovae*
- 06/27/2006 Invited talk at the *SciDAC 2006* conference (Denver, CO), entitled: *The Challenges of Modeling Type Ia Supernovae*
- 10/03/2005 T-13 Seminar, Los Alamos National Laboratory, entitled: *Simulations of Thermonuclear Flames in Type Ia Supernovae*

- 06/26/2005 Invited poster at the *SciDAC 2005* conference (San Francisco, CA), *The Physics of Thermonuclear Flames in Type Ia Supernovae*
- 03/01/2005 Astronomy Seminar at SUNY Stony Brook, *Flame Instabilities in Type Ia Supernovae*
- 02/23/2005 N Division Seminar, Lawrence Livermore National Laboratory, *Flame Instabilities in Type Ia Supernovae*
- 12/17/2003 Astrophysics Seminar, Institute for Advanced Study, Princeton, NJ, *Flame Instabilities in Type Ia Supernovae*

### Popular Press Features

*How Stars Explode*, Forbes.com, Oct. 1, 2009

(<http://www.forbes.com/2009/09/30/supernovae-universe-science-technology-breakthroughs-stars.html>)

*Unveiled: The First Full 3-D Model of a Star Going Supernova*, Popular Science Online, Sept. 24, 2009

(<http://www.popsci.com/military-aviation-amp-space/article/2009-09/first-3-d-models-white-dwarf-supernova>)

*Flash Upon a Neutron Star*, American Scientist, Sept.–Oct. 2000, vol. 88, no. 5, p. 400.

### Popular Press Mentions

*Stars Go Kaboom, Spilling Cosmic Secrets*, Science News, 2009, Vol. 176, #4 (Aug. 15, 2009)

(see also [http://www.sciencenews.org/view/feature/id/46029/title/Stars\\_go\\_kaboom,\\_spilling\\_cosmic\\_secrets](http://www.sciencenews.org/view/feature/id/46029/title/Stars_go_kaboom,_spilling_cosmic_secrets))

*Supernova explosion simulated in exquisite detail*, New Scientist Online, July 2006

(<http://www.newscientist.com/article/dn9604-supernova-explosion-simulated-in-exquisite-detail.html>)

*Life-or-Death Question: How Supernovas Happen?* NY Times, Nov. 9, 2004.

Physics Today cover, Feb. 2002.