

Donald E. Willcox / Curriculum Vitæ

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Present Position:

2014– Graduate research assistant, Department of Physics and Astronomy, Stony Brook University

advisor: Dr. Alan C. Calder

Research Interests:

I am interested in combining multidimensional fluid dynamics algorithms with realistic descriptions of microscopic physics to study multi-scale, multi-physics astrophysical processes such as thermonuclear supernovae explosions and pre-ignition convection in Chandrasekhar-mass white dwarfs (WD). One of my long-term goals is to clarify the nature of Chandrasekhar-mass WD progenitors for Type Ia Supernovae with explosion simulations starting from 3-dimensional, low-Mach number simulations of the convective Urca process during the simmering phase up to ignition. These are computationally challenging problems, and in addition to developing the science simulations, I also work on porting the associated numerical algorithms to GPU hardware for current and planned supercomputers.

Education:

Stony Brook University – Stony Brook, NY, USA

Ph.D. Candidate in Physics and Astronomy (Expected Summer 2018)
GPA: 3.68

LeTourneau University – Longview, TX, USA

B.S., Engineering Physics, May 2011
B.S., Electrical Engineering, May 2011
Minors: Mathematics, Applied Sciences
GPA: 3.92

Fellowships / Awards:

2011– Turner Fellow, Stony Brook University Center for Inclusive Education

- 2010 Internship with the Research Internships in Science and Engineering program of the German Academic Exchange Service (DAAD)
 host: A. Knue, Georg-August Universität, Göttingen, Germany
- 2007-2011 Heritage Scholarship, LeTourneau University

Large Computer Time Allocations:

- 2018 Senior Investigator on a NERSC 2018 Allocation, *Three-dimensional studies of white dwarf and neutron star systems* (20.8 M MPP hours)
- 2018 Co-Investigator on an INCITE 2018 award at OLCF, *Approaching Exascale Models of Astrophysical Explosions* (40 Mh)

Community Outreach:

- 11/03/2017 Public talk in the Astronomy Open Night Series, Stony Brook University, *Saturn in 13 Years: the Cassini-Huygens Mission*

Teaching Experience:

Stony Brook University

- Spring 2017 *WISE Computational Astrophysics*
 Co-instructor for a computational astrophysics course for the Women In Science and Engineering program.
- Summer 2015 *IACS Computes!*
 Teaching assistant for a Python programming workshop for high school students by the Institute for Advanced Computational Sciences.
- Spring 2014 *Astronomy*
 Teaching assistant for an undergraduate astronomy course.
- Spring 2013 *Modern Physics*
 Instructor for an undergraduate laboratory on relativity and quantum mechanics.
- Summer 2012 *Introduction to Calculus II*
 Instructor for a 3-week course on integral calculus for incoming freshman students.
- 2012 *Introductory Physics*
 Instructor for undergraduate laboratory on electricity and magnetism.

LeTourneau University

- Fall, 2008-2010 *Electricity and Magnetism*
 Weekly recitation instructor for undergraduates.
- Spring 2010 *Classical Mechanics*
 Weekly recitation instructor for undergraduates.

Professional Development:

- 2017 Participated in GPU Hackathon at Brookhaven National Laboratory.
- 2016 Participated in GPU Hackathon hosted by the Oak Ridge Leadership Computing Facility.
- 2015 Participated in GPU Hackathon hosted by the Oak Ridge Leadership Computing Facility.
- 2015 Attended the Argonne Training Program on Extreme-Scale Computing (ATPESC).
- 2014 Attended the MESA Summer School for simulating massive stars, accreting white dwarfs, stellar mixing processes and more at UC Santa Barbara.
- 2014 Attended the JINA TALENT Course on Nuclear Theory for Astrophysics at Michigan State University.

Software Projects:

- ongoing Core developer of the **StarKiller Microphysics** code, a collection of publicly-available astrophysical microphysics routines and network integrators, <https://github.com/starkiller-astro/Microphysics>
- ongoing Co-developer of **pynucastro**, a publicly-available Python interface to the JINA Reaclib nuclear reaction rate database for rate visualization and ODE right hand side generation, <https://github.com/pynucastro/pynucastro>
- ongoing Co-creator of the **StarSTRUQ** github organization for publicly-available code implementing uncertainty quantification algorithms useful for stellar evolution calculations, <https://github.com/StarSTRUQ>

Donald E. Willcox / Publications and Talks

Refereed Publications:

4. *On the Quantification of Incertitude in Astrophysical Simulation Codes*,
M. M. Hoffman, D. E. Willcox, M. P. Katz, S. Ferson, F. D. Swesty, & A. C. Calder
Manuscript in preparation.
3. *Meeting the Challenges of Modeling Astrophysical Thermonuclear Explosions: Castro, Maestro, and the AMReX Astrophysics Suite*,
M. Zingale, A. S. Almgren, M. G. Barrios Sazo, V. E. Beckner, J. B. Bell, B. Friesen, A. M. Jacobs, M. P. Katz, C. M. Malone, A. J. Nonaka, D. E. Willcox, & W. Zhang
2017, submitted to the Proceedings of the AstroNum 2017 conference, St. Malo, France.
2. *Cosmic Chandlery with Thermonuclear Supernovae*,
A. C. Calder, B. K. Krueger, A. P. Jackson, D. E. Willcox, B. J. Miles, & D. M. Townsley
2017, Journal of Physics: Conference Series, 837, 012005.
1. *Type Ia Supernova Explosions From Hybrid Carbon-Oxygen-Neon White Dwarf Progenitors*,
D. E. Willcox, D. M. Townsley, A. C. Calder, P. Denissenkov, & F. Herwig
2016, ApJ, 832, 13.

Meeting Talks / Invited Talks / Seminars:

- 11/15/2017 Seminar for the Student Seminar Series, Institute for Advanced Computational Sciences, Stony Brook University, *Stellar Explosion Mechanics: Properties and Physical Processes in White Dwarf Interiors*
- 10/05/2017 Talk at the Interdisciplinary Theoretical and Computational Physical Science meeting, Tokyo Institute of Technology, Japan, *The Dynamics and Origins of Thermonuclear (Type Ia) Supernovae*
- 09/29/2017 Talk at NY Area Computational Hydro Workshop, Flatiron Institute/CCA, *A Brief Tour of the AMReX Astrophysics Suite of Codes*
- 06/28/2017 Seminar for the Research Café Series, Center for Inclusive Education, Stony Brook University, *White Dwarfs as Type Ia Supernovae Progenitors*
- 06/16/2017 Invited talk at Current Challenges in the Physics of White Dwarf Stars, Santa Fe, NM, *Simulations of Various White Dwarf Progenitor Models for Type Ia Supernovae*
- 06/14/2017 Invited astrophysics seminar at Los Alamos National Laboratory, NM, *Status of Recent Work for Type Ia Supernovae Progenitors: Hybrid C-O-Ne White Dwarfs, the Convective Urca Process, and Accelerated Reaction Networks*
- 02/05/2017 Talk at JINA-CEE Frontiers in Nuclear Astrophysics: Junior Researchers Workshop, Michigan State University, *Elucidating the Convective Urca Process in Pre-Supernova White Dwarfs Using Three-Dimensional Simulations*

Conference Posters:

9. *Three Dimensional Simulations of the Convective Urca Process in White Dwarf Progenitors of Type Ia Supernovae*,
D. E. Willcox, D. M. Townsley, M. Zingale, & A. C. Calder
2017, Current Challenges in the Physics of White Dwarf Stars, Santa Fe, NM, June 12-16, 2017.
8. *Elucidating the Convective Urca Process in Pre-Supernova White Dwarfs Using Three-Dimensional Simulations*,
D. E. Willcox, D. M. Townsley, M. Zingale, & A. C. Calder
2017, JINA-CEE Frontiers in Nuclear Astrophysics Meeting, February 7-9, 2017.
7. *Three-Dimensional Simulations of the Convective Urca Process in Pre-Supernova White Dwarfs*,
D. E. Willcox, D. M. Townsley, M. Zingale, & A. C. Calder
2017, American Astronomical Society Meeting 229, 244.05
6. *On the Quantification of Incertitude in Astrophysical Simulation Codes*,
M. M. Hoffman, M. P. Katz, D. E. Willcox, S. Ferson, F. D. Swesty, & A. C. Calder
2017, American Astronomical Society Meeting 229, 154.27
5. *Thermonuclear Supernova Explosions From Hybrid White Dwarf Progenitors*,
D. E. Willcox, D. M. Townsley, A. C. Calder, P. Denissenkov, & F. Herwig
2016, American Astronomical Society Meeting 227, 237.17
4. *A Comparison of Type Ia Supernovae with C-O and Hybrid C-O-Ne White Dwarf Progenitors*,
D. E. Willcox, D. M. Townsley, A. C. Calder, P. Denissenkov, & F. Herwig
2015, F.O.E. Fifty-One Erg International Workshop, North Carolina State University, NC.
3. *A Study of Steady-State Detonation Structures for Hybrid C, O, Ne White Dwarf Models*,
D. E. Willcox, D. M. Townsley, & A. C. Calder
2014, International Conference: "Type Ia Supernovae: Progenitors, Explosions, and Cosmology," University of Chicago, IL.
2. *Imaging Molecular Structure With High Harmonics*,
D. E. Willcox, M. A. Reber, Y. Chen, K. Halder, & T. Allison
2013, Chemistry Research Day, Stony Brook University, NY.
1. *Cavity-Enhanced Transient Absorption Spectroscopy*,
M. A. Reber, Y. Chen, D. E. Willcox, & T. Allison
2013, Chemistry Research Day, Stony Brook University, NY.

Conference Proceedings:

3. *Implementation of Digital Radio Mondiale receiver - Part II*,
D. E. Willcox, J. Kim, & J. Wineman
2011, IEEE 43rd Southeastern Symposium on System Theory, Auburn, AL, March 2011.
2. *Implementation of Digital Radio Mondiale Receiver - Part I*,
D. E. Willcox, J. Kim, C. Loewen, & J. Wineman
2010, IEEE 42nd Southeastern Symposium on System Theory, Tyler, TX, March 2010.
1. *Diversity Receiver for Digital Radio Mondiale - a multi-year design project*,
P. Leiffer, J. Kim, R. W. Graff, & D. E. Willcox
2010, ASEE 2010 Annual Conference & Exposition, Louisville, KY, June 2010.