L. Jonathan Dursi

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RESEARCH INTERESTS

Type Ia supernovae, galaxy clusters, protoplanetary disks, and compact objects, particularly as examples of astrophysical turbulence, mixing, fluid instabilities, and nuclear burning and combustion. Computational astrophysics methods generally; computational hydrodynamics, MHD, novel algorithms, and large-scale computing.

CITIZENSHIP

Canada, USA

POSITION

Senior Research Associate, Canadian Institute for Theoretical Astrophysics, University of Toronto.

PREVIOUS POSITIONS

Postdoctoral Fellow, Canadian Institute for Theoretical Astrophysics, University of Toronto, Sep 2004–Aug 2007.

Research Associate, The University of Chicago, Dept. of Astronomy & Astrophysics, Jan 2004–Aug 2004.

Visitor, Max-Plank Institut für Astrophysik, Apr 2001.

Guest Research Faculty, Argonne National Laboratory, Math and Computer Science Division, Sept 2000–Aug 2004

Visitor, Sandia National Laboratories, Combustion Research Facility, Summer 2000.

Visitor, Lawrence Livermore National Laboratory ISCR, Summer 1998.

EDUCATION

Ph.D., The University of Chicago, Astronomy & Astrophysics, Jan 2004.
Thesis: **Astrophysical Flame Stability**. Supervisor: R. Rosner.

M.Sc., Queen's University, Physics, Sept 1996. Supervisor: L. Widrow.

B.Sc., St. Mary's University, Physics, Computer Science, May 1994. Supervisor: D. Clarke.

TEACHING EXPERIENCE

Supervising of Students

With N. Murray: graduate student L. Mudryk, 2005-7.

Undergraduate students D. Doucette, C. Hiratsuka, summer 2005.

Undergraduate student K. Robinson, summer 2003.

With M. Zingale: undergraduate student J. ZuHone, summer 2001.

Teaching

Creating curriculum and teaching in Summer School on Parallel Computation to be held by CITA, Jul 2008.

Teaching AST222, Galactic and Extragalactic Astronomy, University of Toronto, Jan-Apr 2008.

Created curriculum and taught science course 'Search for Life in the Universe', School of the Art Institute of Chicago, Jan-May 2004.

TAing

Introduction to Programming in Java, Jan–Mar 2002.

Project development in C, Sept–Dec 2001.

Introduction to Programming in C, Jul–Aug 2001.

Led lab sections, Sep 1994–May 1995 and Sep 1997–Apr 1998.

AWARDS

Jeffrey L. Bishop Fellowship in Dynamics, CITA, 2006-2007.

University of Chicago Astronomy Department D. McMinn Award for Teaching Outside of the University, May 2001.

Gordon Bell Award in High Performance Computing, Special Category, Nov 2000.

Krell Institute Computational Science Graduate Fellowship, Sept 1999 – Sept 2003.

Queen's University Reinhardt Fellowship, Sept 1995 – Sept 1996.

Government of Canada NSERC Graduate Fellowship, Sept 1994 – Sept 1996.

Government of Canada Canada Scholarship, Sept 1990 – May 1994.

RECENT RESEARCH WORK

CITA, Aug 2004–Present

Beginning work with J. Sievers, CITA, to use graphics processing units to simulate multidimensional PDE problems and perform data analysis.

Exploring collaboration with S. Morris, Physics, U. Toronto, to compare theory, simulation, and experiment of rising reacting bubbles.

With R. Rafikov, Princeton, analyzing gravitational instability in accretion disks.

Considering magnetic draping in galaxy clusters with C. Pfrommer, CITA.

Examining instability and path to ignition for Type Ia supernovae, working with F. X. Timmes, LANL, and undergraduate students D. Doucette and C. Hiratsuka, SMU/CITA.

Investigating early stage propagation of buoyant reactive flame 'bubbles' in Type Ia supernovae using analytics and computation on the ORNL Jaguar supercomputer, with M. Zingale, SUNY SB.

University of Chicago/Argonne National Lab FLASH Center, 1998 – 2004

Worked with a very large team to develop the FLASH code, a general purpose AMR reactive hydrodynamics code; to test it against experiments and theory. Applications included examining behaviour of flame/flow reaction, and influence of magnetic fields; considering the problem buoyant flows and simmering convection.

Developed numerical techniques for these problems including for accurately studying flows in nearly static stratified atmospheres and examining usefulness of 'time subcycling' technique for explicit solvers in AMR codes.

Max-Plank Institut für Astrophysik, Apr 2001

With E. Müller, considered necessary boundary conditions for minimizing transients in stratified atmospheres with Godunov-type hydrodynamical codes.

Visitor, Sandia National Laboratories, Combustion Research Facility, Summer 2000

With A. Kerstein, S. Wunsch, examined generalizing the turbulence model ODT to combustion in a stratified medium.

Lawrence Livermore National Laboratory, Summer 1998

Worked with G. Dimonte, LLNL, to analyze data from Rayleigh-Taylor fluid instability experiments and examine growth of mixing zone.

SERVICE

Co-chair Organizing committee, Parallel Scientific Computing Summer School

Member Compute/Calcul Canada TECC Benchmark Working Group, 2007 -

Member CITA Computer Committee 2007-

Member CITA Web Committee 2006-

Panelist NSF Review panel

Referee IBM Journal of Research and Development, 2007-

Referee The Astrophysical Journal, 2004-

Referee Canadian Journal of Physics, 2007-

Refereed Publications

L. J. Dursi, C. Pfrommer. *Draping of Cluster Magnetic Fields over Bullets and Bubbles: Morphology and Dynamic Effects*, ApJ In Press.

L. J. Dursi. *Bubble Wrap for Bullets: The Stability Imparted by a Thin Magnetized Layer*, ApJ 670:221–230, Nov 2007.

M. Zingale, **L. J. Dursi**. *Propagation of the First Flames in Type Ia Supernovae*, ApJ 656:333–346, Feb 2007 .

L. J. Dursi, F. X. Timmes. *Local Ignition in Carbon/Oxygen White Dwarfs – I: One-zone Ignition and Spherical Shock Ignition of Detonations*, ApJ , 641:1071–1086, April 2006.

A. Alexakis, A. C. Calder, **L. J. Dursi**, R. Rosner, J. W. Truran, B. Fryxell, M. Zingale, F. X. Timmes, P. Ricker, and K. Olson, *On the Nonlinear Evolution of Wind-Driven Gravity Waves*, Physics of Fluids, 16:3256–3268, Sept 2004.

L. J. Dursi, *The Effect of Magnetic Fields on the Linear Stability of Flames*, ApJ, 606:1039–1056, May 2004.

Guy Dimonte, et. al, *A Comparitive Study of the Turbulent Rayleigh-Taylor Instability using High-Resolution Three Dimensional Simulations: The Alpha-Group collaboration*. Physics of Fluids, 16:1668–1693, May 2004.

A. Alexakis, A. C. Calder, A. Heger, E. F. Brown, **L. J. Dursi**, J. W. Truran, R. Rosner, D. Q. Lamb, F. X. Timmes, B. Fryxell, M. Zingale, P. M. Ricker, and K. Olson. *On Heavy Element Enrichment in Classical Novae*. ApJ, 602:931–937, Feb 2004.

K. Robinson, **L. J. Dursi**, P. M. Ricker, R. Rosner, A. C. Calder, M. Zingale, J. W. Truran, T. Linde, A. Caceres, B. Fryxell, , K. Olson, K. Riley, A. Siegel, and N. Vladimirova. *Morphology of Rising Hydrodynamic and Magnetohydrodynamic Bubbles from Numerical Simulations*. ApJ, 601(2):621–643, February 2004.

L. J. Dursi, M. Zingale, A. C. Calder, B. Fryxell, F. X. T. Timmes, N. Vladimirova, R. Rosner, A. Caceres, D. Q. Lamb, K. Olson, P. M. Ricker, K. Riley, A. Siegel, and J. W. Truran. *The Response of Model and Astrophysical Thermonuclear Flames to Curvature and Stretch*. ApJ, 595(2):955–979, October 2003.

A. C. Calder, **L. J. Dursi**, B. Fryxell, T. Plewa, V. G. Wiers, T. Dupont, H. F. Robey, R. P. Drake, B. A. Remmington, G. Dimonte, J. Hayes, J. M. Stone, P. M. Ricker, F. X. Timmes, M. Zingale, and K. Olson. *Issues with Validating an Astrophysical Simulation Code*. CiSE, 6(5):10–20, September 2004.

M. Zingale, **L. J. Dursi**, J. ZuHone, A. C. Calder, B. Fryxell, T. Plewa, J. W. Truran, A. Caceres, K. Olson, P. Ricker, K. Riley, R. Rosner, A. Siegel, F. X. Timmes, and N. Vladimirova. *Mapping Initial Hydrostatic Models in Godunov Codes*. ApJSS, 143(2):539–566, December 2002.

A. C. Calder, B. Fryxell, T. Plewa, R. Rosner, **L. J. Dursi**, V. G. Weirs, T. Dupont, H. F. Robey, J. O. Kane, B. A. Remington, R. P. Drake, G. Dimonte, M. Zingale, F. X. Timmes, K. Olson, P. Ricker, P. MacNeice, and H. M. Tufo. *On Validating an Astrophysical Simulation Code*. ApJSS, 143:201–229, November 2002.

B. Fryxell, M. Zingale, F. X. Timmes, D. Q. Lamb, K. Olson, A. C. Calder, **L. J. Dursi**, P. Ricker, R. Rosner, J. W. Truran, P. MacNeice, and H. Tufo. *Numerical Simulations of Thermonuclear Flashes on Neutron Stars*. Nuclear Physics A, 688:172–176, May 2001.

M. Zingale, F. X. Timmes, B. Fryxell, D. Q. Lamb, K. Olson, A. C. Calder, **L. J. Dursi**, P. Ricker, R. Rosner, P. MacNeice, and H. M. Tufo. *Helium Detonations on Neutron Stars*. ApJSS, 133:195–220, March 2001.

F. X. Timmes, M. Zingale, K. Olson, B. Fryxell, P. Ricker, A. C. Calder, **L. J. Dursi**, H. Tufo, P. MacNeice, J. W. Truran, and R. Rosner. *On the Cellular Structure of Carbon Detonations*. ApJ, 543:938–954, November 2000.

A. C. Calder, B. C. Curtis, **L. J. Dursi**, B. Fryxell, G. Henry, P. MacNeice, K. Olson, P. Ricker, R. Rosner, F. X. Timmes, H. M. Tufo, J. W. Truran, and M. Zingale. *High-Performance Reactive Fluid Flow Simulations Using Adpative Mesh Refinement on Thousands of Processors*. In Proceedings of Supercomputing 2000, 2000.

R Rosner, A. Calder, **L. J. Dursi**, B. Fryxell, D. Q. Lamb, J. C. Niemeyer, K. Olson, P. Ricker, F. X. Timmes, J. W. Truran, H. Tufo, Y.-N. Young, M. Zingale, E. Lusk, and R. Stevens. *Flash Code: Studying Astrophysical Thermonuclear Flashes*. CiSE, 2(2):33–41, March 2000.

X. Shi, L. M. Widrow, and **L. J. Dursi**, *Measuring Hubble's Constant in our Inhomogeneous universe*. MNRAS, 281:565–578, July 1996.

Selected Recent Contributed Publications

L. J. Dursi, M. Zingale. *Efficiency Gains from Time Refinement on AMR Meshes and Explicit Timestepping*. In Adaptive Mesh Refinement - Theory and Applications., Springer-Verlag, 2005.

L. J. Dursi, A. C. Calder, A. Alexakis, J. W. Truran, M. Zingale, B. Fryxell, P. Ricker, F. X. Timmes, and K. Olson. *Onset of Convection on a Pre-Runaway White Dwarf*. In Classical Nova Explosions: International Conference on Classical Nova Explosions. American Institute of Physics, 2002

A. C. Calder, A. Alexakis, **L. J. Dursi**, R. Rosner, J. W. Truran, B. Fryxell, P. Ricker, M. Zingale, K. Olson, F. X. Timmes, and P. MacNeice. *Mixing by Non-linear Gravity Wave Breaking on a White Dwarf Surface*. In Classical Nova Explosions: International Conference on Classical Nova Explosions. American Institute of Physics, 2002

M. Zingale, J. C. Niemeyer, F. X. Timmes, **L. J. Dursi**, A. C. Calder, B. Fryxell, D. Q. Lamb, P. MacNeice, K. Olson, P. M. Ricker, R. Rosner, J. W. Truran, and H. M. Tufo. *Quenching Processes in Flame-Vortex Interactions*. In 20th Texas Symposium on relativistic astrophysics, pages 490+, 2001.

A. C. Calder, B. Fryxell, R. Rosner, **L. J. Dursi**, K. Olson, P. M. Ricker, F. X. Timmes, M. Zingale, P. MacNeice, and H. M. Tufo. *Simulations of Astrophysical Fluid Instabilities*. In 20th Texas Symposium on relativistic astrophysics, pages 484+, 2001.

A. C. Calder, B. Fryxell, R. Rosner, J. Kane, B. A. Remington, H. Robey, P. Keiter, R. P. Drake, J. Knauer, **L. J. Dursi**, K. Olson, P. M. Ricker, F. X. Timmes, M. Zingale, H. Tufo, and P. MacNeice. *Astrophysically Relevant Instabilities at a Decelerating Interface*. In American Physical Society, 42nd Annual Meeting of the APS Division of Plasma Physics pages 1078P+, October 2000.