

R Paul Drake *Curriculum Vitae*

**Name:** R Paul Drake

**Business Address:** 2455 Hayward St., Univ. of Mich., Ann Arbor MI 48109-2143  
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**Positions:** **Henry Smith Carhart Professor of Space Science,  
Professor, Applied Physics; Professor, Physics, University of Michigan  
Director, Center for Laser Experimental Astrophysics  
Visiting Senior Scientist, Laboratory for Laser Energetics,  
University of Rochester**

**Education:** B.A. *magna cum laude* 1975, Vanderbilt Univ., Nashville, Tennessee  
Majors: Philosophy (with Honors) and Physics  
Thesis title: "An Aristotelian Account of Causality"  
Ph.D. 1979 (M.S. 1977), both in Physics  
The Johns Hopkins University, Baltimore, Maryland  
Specialty: Plasma Spectroscopy, Thesis title: "Extreme Ultraviolet  
Diagnosis of a Neutral-Beam-Heated Mirror Machine"  
Advisor: H. Warren Moos  
Professional Ski Instructors of America  
Associate Certification for Alpine Ski Instruction, 1983

**Honors & Awards:** Fellow of the American Physical Society, 1989  
Phi Beta Kappa, Vanderbilt University, 1975  
Distinguished Lecturer in Plasma Physics, APS/DPP 2003  
Outstanding Undergraduate Research Mentorship UROP 2003  
Departmental Research Excellence Award, 2009  
Dist. Faculty Achievement Award, Rackham Graduate School, 2013  
Ted Kennedy Family Faculty Team Excellence Award, 2014

**Publications:** > 230 refereed, > 270 citable,  
Published first textbook in High-Energy-Density Physics

**General Interests:** Skiing, water sports, rowing, music, philosophy, economics, history

**Professional Associations:** American Physical Society  
American Geophysical Union  
American Astronomical Society

**Listed:** American Men and Women of Science,  
Men of Achievement,  
Dictionary of International Biography,  
Who's Who in the World and other Who's Who volumes

### ***Research and Biography:***

Professor R. Paul Drake has played a leading role in the development of two new, related fields of inquiry – High-Energy-Density Physics (HEDP) and High-Energy-Density Laboratory Astrophysics (HEDLA).

Dr. Drake's doctoral thesis was based on plasma spectroscopy measurements that overturned the common belief that a magnetic confinement device known as a "mirror machine" cannot confine impurity ions. Following this, Drake moved in 1979 into magnetic fusion confinement research at the Lawrence Livermore National Laboratory (LLNL), where he unified confinement theory and stability theory to explain the observed plasma confinement in a device called the Tandem Mirror Experiment. He switched into laser fusion research in 1982 and led early experiments on a laser known as Novette. During the next few years he conducted groundbreaking studies of the Stimulated Raman Scattering instability and related mechanisms in laser-produced plasmas, producing results that are still being cited, shown in textbooks, and taught in classes. This led in 1989 to his selection as a Fellow of the American Physical Society. He was also responsible during the mid-1980's for leading the activation for experiments of the highest-energy laser in the world at the time, known as Nova.

In 1989 Drake was chosen to lead the newly formed Plasma Physics Research Institute, whose purpose was to promote and accomplish joint scientific work involving LLNL and the University of California. He became an Associate Professor at U.C. Davis (and was promoted to Full Professor in 1991). During the next few years he turned his attention to the use of laser-fusion facilities for experiments to accomplish fundamental, discovery-driven research. As of 1989, this was occurring nationally only at one facility through one small grant program. Among other accomplishments, he was the first to identify the importance of a mechanism known as Langmuir Decay in the saturation of Stimulated Raman Scattering, a result that was at first very widely disbelieved but was eventually shown to be correct.

During the early 1990s Drake turned his attention specifically to the use of laser fusion tools and facilities to address issues in astrophysics, which is part of what is now known as High Energy Density Laboratory Astrophysics (HEDLA). This was at the time a completely new area. He is recognized as a founder of this field, along with the other three authors of the 1999 paper in *Science* describing it. In early work in this area, he invented an experimental system for the laboratory study of astrophysically relevant plasma effects driven by high-Mach-number flows. This design has been used since by groups in Japan and Europe to study such systems. He devised what is now the standard method of producing hydrodynamic jets using lasers, worked with a Michigan undergraduate student to develop an experimental design, and helped foster the development of an independent research team that is still pursuing this topic. He published a paper in 2000 providing the first scaling analysis of the requirements of laser experiments to study astrophysically relevant diffusive particle acceleration in collisionless shocks.

His primary focus since 1996, when he came to Michigan, has been in the areas of hydrodynamics and radiation hydrodynamics with applications to astrophysics. He led a long-term, multi-institution effort to explore the phenomena responsible for the mixing of stellar layers during supernovae, publishing in 2004 a paper demonstrating enhanced mixing under certain conditions. His group at Michigan and national and international collaborators continue to pursue this area. At Michigan he directed the 13 M\$/yr Space Physics Research Laboratory from 1998 –2002

Drake devised and led, beginning in 1999, the first astrophysically relevant experiments to produce radiative shocks, and has published papers on the theory of these shocks. These experiments have continued and evolved, which has led to a number of papers by his group members, and have been the subject of five Ph.D. theses at Michigan. He also collaborated extensively with a group in France that has pursued similar experiments. This set the stage for the successful establishment, in 2008, of the 5-year, 17 M\$ Center for Radiative Shock Hydrodynamics at Michigan.

Professor Drake has graduated Ph.D. students working in laser-plasma interactions, radiation hydrodynamics, waves in the solar wind, and astrophysical flows. He has published papers in experiments, theory, and simulation. Having worked in several areas of HEDP, he was motivated to teach and write in this area. He began offering a graduate course at Michigan in this area and in alternate years he teaches an intense, two-week summer school in this subject, which has been attended by graduate students and young scientists from the US, Europe, and Asia. He authored the first graduate textbook in HEDP, entitled *High-Energy-Density Physics*, and published by Springer in English in 2006 and in Chinese in 2013. In addition to his book, he has produced more than 230 refereed journal publications and more than 270 total citable publications. He was invited to review HEDP in a plenary lecture as part of the 50<sup>th</sup> anniversary celebration of the Division of Plasma Physics of the American Physical Society, in November 2008 and to write an article on HEDP that was published in *Physics Today* in June, 2010.

During the early 1990s Prof. Drake became a national advocate for university research in HEDP, which at the time was nearly nonexistent. Both his advocacy and his demonstration that such research was possible, at a number of laser facilities, contributed to the national context that led to the establishment of the “Science Use of Nova” program at LLNL and to the initiation of broader national support for university research in HEDP in the mid 1990s. His national role in this area continued. He was invited to speak before the Committee that published the National Academies Press report, *Connecting Quarks with the Cosmos: Eleven Science Questions for the New* in 2003, which advocated increased research in HEDP because of its connections to astrophysics. He was invited to speak before the Committee that published the National Academies Press Report *High Energy Density Physics: The X-Games of Contemporary Science* in 2002. These two NRC reports led to the formation by OSTP of a National Task Force on High Energy Density Physics, which invited him to speak and produced a report entitled *Frontiers for Discovery in High Energy Density Physics* in 2004. This in turn led to the formation of an Interagency Working Group to determine how the U.S. government should proceed in stewarding the field of HEDP. Drake was one of three scientists invited

in Nov. 2006 to meet with members of this task force regarding the connection of HEDP and Laboratory Astrophysics. The outcome of the Interagency Working Group was the formation of a joint program between the DOE Office of Science and the DOE National Nuclear Security Agency to steward the growth of HEDP as a fundamental discipline. Drake was a member of the first workshop to identify fundamental scientific elements of this program, the High-Energy-Density Laboratory Plasmas workshop, convened by the DOE Under Secretary of Science in 2007, and of the Federal Advisory Committee Subpanel to provide advice regarding the structure of this program in 2008. He was a chapter lead on a subsequent, similar report focused on the National Ignition Facility.

Through the work described above, Prof. Drake is also recognized as a founder of the area of High-Energy-Density Laboratory Astrophysics. He has been active in advocacy for and service to this new area. In the mid-1990s he was a founding member of the executive committee of the Topical Group on Plasma Astrophysics of the American Physical Society. He served as the fifth chair of the Topical Group in 2001. He has been a long-term organizer and has been chair of the HEDLA Conference, noted for its promotion of interdisciplinary research combining laboratory scientists with astrophysicists. He has spoken for the NRC Plasma Science Committee on issues of laboratory astrophysics. He was a member of the Laboratory Astrophysics Working Group of the American Astronomical Society, formed in 2007, and whose activities led the American Astronomical Society to establish in 2014 the Laboratory Astrophysics Division, for which he now serves as Treasurer.

Drake has made a sustained national and international impact in other ways as well. He has collaborated on experiments in France and Canada. He is frequently invited to survey HEDLA or HEDP for international audiences. He has served on the “jury” for five French Ph.D. candidates. The BBC documentary entitled *Hyperspace* and the Discovery Channel documentary *How the Universe Works* each includes a segment shot featuring him and his team’s experiments, filmed at a major laser facility.

***Experience:***

Director, Center for Radiative Shock Hydrodynamics,  
University of Michigan, 2008-2014

Director, Space Physics Research Laboratory,  
College of Engineering, Univ. of Michigan 1998-2002

Visiting Professor, University of Michigan, 1996-1998  
Atmospheric, Oceanic and Space Sciences,  
Nuclear Engineering and Radiological Sciences

Director, Plasma Physics Research Institute,  
Lawrence Livermore National Laboratory, 1989-1996

Adjunct Professor, Atmospheric, Oceanic and  
Space Sciences, University of Michigan 1996

Visiting Scientist, Applied Science Department  
College of William & Mary, 1995-1996

Professor,  
Department of Applied Science,  
University of California Davis, 1991-1993

Associate Professor,  
Department of Applied Science,  
University of California Davis, 1989-1991

Group Leader for Plasma Physics  
Nova Experiments Program,  
Lawrence Livermore National Laboratory,  
Livermore, CA, 1985-1989

Physicist, Laser Fusion Program,  
Lawrence Livermore National Laboratory,  
Livermore, CA, 1982-1985

Physicist, Magnetic Fusion Program,  
Lawrence Livermore National Laboratory,  
Livermore, CA, 1979-1982

Teaching Assistant and Research Assistant  
Department of Physics, Johns Hopkins Univ.,  
Baltimore, MD, 1975-1979

**Teaching:** Plasma Physics (1992, 1993)  
Statistical Mechanics (1990, 1991)  
Laser-Plasma Interactions (1988, 1996)  
Mechanics - Dynamics (1997)  
Space Plasma Physics (1998, 1999, 2000, 2004, 2005)  
Nuclear Energy (1998)  
Space Science (2000, 2001)  
High Energy Density Physics (2003, 2004, 2005, 2009, 2011, 2013)  
Graduate Fluid Dynamics (2006 twice, 2007, 2008, 2009,  
2011, 2012, 2013, 2014)  
Rocket Science (2007)

**Advising/Training:**

Korbie K. Dannenberg (2005)  
Bradley Seaford  
Melanie A. Blackburn

**3 M.S. Students:**

**24 Ph.D. Students** (actual or estimated graduation)

Keith S. Bradley 1992 ± (Staff Member, LLNL)  
Kevin L. Baker 1995 ± (Staff Member, LLNL)  
Steven H. Bekhor 2002 (unknown)  
Timothy B. Smith 2003 (Research Scientist, Michigan)  
Paul Kominsky 2007 (Lecturer, Michigan)  
Amy B. Reighard 2007 (Scientist, Naval Surface Warfare Center)  
Carolyn C. Kuranz 2009 (Research Scientist, Michigan)  
Eric C. Harding 2010 (Staff scientist, SNL)  
Forrest Doss 2011 (Staff scientist, LANL)  
Tony Visco 2012 (Staff scientist, Alliant Techsystems)  
Channing Huntington 2012 (Staff Scientist, LLNL)  
Jason Chou 2012 (Programmer)  
Christine Krauland 2013 (Postdoctoral Fellow, UC Davis)  
Eliseo Gamboa 2013 (Postdoctoral Fellow, SLAC)  
Carlos DiStefano 2014  
Rachel Young 2016  
Wesley Wan 2016  
Michael MacDonald 2017  
Jeff Fein 2016  
Joshua Davis 2017  
Alexander Rasmus 2017  
Patrick Belancourt 2018  
Robert Van derVort 2019  
Joseph Levesque 2019

## **6 Post Doctoral Fellows**

Steven H. Batha (Staff member, LANL)  
Bruno S. Bauer (Professor, U. Nevada Reno)  
James J. Carroll III (Professor, Eastern Michigan)  
Paul A. Keiter (Staff Member, LANL)  
Guy Malamud (Negev, Israel)  
Mario Manuel (current)

## **International Thesis Committees**

Doctoral: Laurent Boireau, Tomasso Vinci, Emeric Falize, Xavier Ribeyre, Bruno Albertazzi  
Habilitation a Diriger des Recherches: Alexis Casner, Marina Olazabal-Loume

## **Many undergraduate research students**

2013-2014 Eric Aleman, Katrina Bartek, Sarah Bonhard, Thomas Bouranis, Adam Cowherd, Megan Darby, Hannah Fetner, Mrigank Gupta, Joshua Hall, Dennis Kanarsky, Tyler Kane, Graham Keep, Heath Lefevre, Arielle Maxner, Nicholas McKay, Omair Kawoosa, Arwa Raza, Grant Renny, Daniel Pflug, Sam Polson, Johnny Posada, Joe Spurlin, Caitlin Taylor, Nicholas Tomke, Nadia Dubovitsky, Brent Ritter, Molly Force

2012-2013 Christopher Arnett, Britney Blankenship, Sarah Bonhard, Phillip Bonofiglo, Thomas Bournais, Emma Boyd, Adam Cowherd, Megan Darby, Molly Flynn, Joshua Hall, Nathan Janes, David Kaczala, Heath Lefevre, Grant Renney, David Rinaldi, Joe Spurlin, Caitlin Taylor, Nicholas Tomke, Caleb Zerger

2011-2012 Britney Blakenship, Philip Bonofiglo, Emma Boyd, Colin Cornwall, Andrew DeZeeuw, Molly Flynn, Nathan James, Jimmy Johnson, David Kaczala, Kathleen Kiker, Heath Lefevre, Meghan Osterman, Grant Renny, Chris Ruiz, Whitney Smith, Andrew Swain, Guy Wilson

2010-2011 Philip Bonofiglo, Britney Blakenship, Adam Budde, Colin Cornwall, Philip Falgoust, Kelsey Gasior, Zach Gzicki, Samsul Hoque, Alex Jaeckel, Jimmy Johnson, David Kaczala, Heath Lefevre, Megan McCarthy, Scott Perry, Nico Rombes, Whitney Smith, Paul Stewart, Andrew Swain

2009-2010 Dave Bernthal, Philip Bonofiglo, Britney Blakenship, Adam Budde, Nicholas Clift, Colin Cornwall, Joe Ditmar, Matt Forsythe, Kelsey Gasior, Diana Goulding, Matt Gudorf, Namitha Jassem, Emily Lichko, Ray Mahaffy, Megan McCarthy, Eduardo Mucino, Scott Perry, Paul Stewart, Andrew Swain, Joshua Wehrly

2008-09 Dave Bernthal, Britney Blakenship, Adam Budde, Paul Darnell, Joe Ditmar, Dara Fischer, Matt Forsythe, Nilton Gjeci, Diana Goulding, Namitha Jassem, Justine Lazo, Wai Lee Chan, Kevin Lin, Mariano Lowenstern, Marissa Mantey, Melina Michelen, Eduardo Mucino, Scott Perry, Paul Stewart, Andrew Swain, Marie Ternes

2007-08 Nilton Gjечи, Smantha Yap, Namitha Jassem, Scott Perry, Marie Ternes, Mariano Lowenstern, Eduardo Mucino, Matthew Pistone, Joe Ditmar, Adam Budde, Brittany Worley, Diana Goulding, Donna Marion, Matthew Forsyth, Antonia Hubbard

2006-07 Tiffany Thompson, Jessica Human, James Schultz, Nilton Gjечи, Mariano Lowenstern, Eduardo Mucino, Donna Marion, Christine Krauland, Duncan Campbell, Joe Ditmar, Stephen Martin, Clarice Lee, Adrienne Martz, Gurlovleen Rathore, Trisha Donajkowski, Sebastien Lounis, Jasmine Santana, Edward Wagner, Tyler Brown, Andrew Olson

2005-06 Christine Krauland, Sebastien, Lounis, Dan Austin, Donna Marion, Mariano Lowenstern, Eduardo Mucino, Trisha Donajkowski, Gurlovleen Rathore, Taufig Karim, Jasmine Santana, Kai Ravariere, Kyle Hubbard

2004-05 Devon Lafferty, Mark Taylor, Donna Marion, Christine Krauland, Doug Kremer, Mike Grosskopf, Gurlovleen Rathore, Joe Garland, Trisha Donjakowski

2003-04 Carlos Fernandez, Neal Meyer, Chris Muscatello, Zenka Sellinger, Trisha Donjakowski, Rebecca Gabl, Doug Kremer, Mike Grosskopf, Peter Susalla, Saida Caballero, Erika Roesler, Eric Harding, Zhengfei Zheng, Jonathan Garrett, Koichi Murai

2002-03 Dave Leibrandt, Mike Grosskopf, Doug Kremer, Tyacie Corle, Peter Susalla, Erika Roesler, Eric Harding

2001-02 Eric Harding, Dave Leibrandt, Mike Grosskopf, Ayan Gosh, Luke Shaefer, Mike Grosskopf, Peter Susalla, Mike Kagan, Michael Thomas, Brandon Eagen

2000-01 Eric Harding, Leah Norstrud, Justin Benoit, Doug Gossiaux, Fred Ford

1999-00 Harry Reisig, Mike Lopez, Korbie Dannenberg, Eric Harding, Luke Gritter

1998-99 Gavin Koo, Harry Reisig, Mike Lopez, Shreya Shah, Joe Mrozinski, Stephen Steffes, Richard Algra

1997-98 Gavin Koo, Harry Reisig, Kristy Brock

1996-97 Harry Reisig, Kristy Brock



***Professional Service:***

Chair, 17th Annual Anomalous Absorption Conference Granlibakken, Tahoe City, CA, in May, 1987

Nominated to the Executive Committee, Division of Plasma Physics American Physical Society, 1989

Member, Fellowship Committee, Division of Plasma Physics of the American Physical Society, 1991

Member, International Steering Committee, International Topical Conference on Research Trends in Inertial Confinement Fusion, La Jolla, CA, Feb. 1991

Member, Program Committee, Division of Plasma Physics of the American Physical Society, Minneapolis, MN, Nov. 1994

Co-chair, Advanced Approaches to Economical Fusion Power, Monterey, CA, September, 1995

Member, Centennial Meeting Program Committee, American Physical Society, 1997-1999

Co-organizer, 2nd Topical Conference on Laboratory Astrophysics with Large Lasers, Tuscon, Arizona, Feb., 1998

Member, Executive Committee, University Fusion Association, 1998-2000

Member, Fellowship Committee, Division of Plasma Physics of the American Physical Society, 1998

Member, Organizing Committee, Snowmass Fusion Summer Study, 1998-1999

Organizing Group Leader, Frontier Science at the NIF: Episode I workshop 1999

Member, Organizing Committee, 3rd Topical Conference on Laboratory Astrophysics with Large Lasers, Houston, Mar. 2000

Member, DOE Committee for Review of Laser User Facilities, July-Oct. 1999

Member, DOE Committee to Review the Inertial Fusion Program at NRL, May 2000

Nominated for Vice-Chair Elect, Vice-Chair, then Chair, Division of Plasma Physics, American Physical Society, 2000

Member, Physics Division Review Committee, Los Alamos Nat. Lab., May 2001

Vice-Chair Elect, Topical Group on Plasma Astrophysics of the American Physical Society, 2000

Vice-Chair, Topical Group on Plasma Astrophysics of the American Physical Society, 2001

Chair, Topical Group on Plasma Astrophysics of the American Physical Society, 2002

Member, Program Committee, Division of Plasma Physics of the American Physical Society, Orlando, FL, 2002

Chair, 4rd International Conference on High Energy Density Laboratory Astrophysics, Ann Arbor, MI, Feb. 2002

Member, Executive Committee, University Fusion Association, 2002-2004

Member, Organizing Committee, Miniconference on Laboratory Astrophysics at APS/DPP meeting, 2003

Member, Organizing Committee, 5th International Conference on High Energy Density Laboratory Astrophysics, Tucson, AZ, Mar. 2004.

Member, Fellowship Committee, Division of Plasma Physics of the American Physical Society, 2004

Member, Scientific Organizing Committee, Michigan Center for Theoretical Physics Conference on Relativistic Jets, Ann Arbor, Dec. 2005.

Member, Organizing Committee, 6th International Conference on High Energy Density Laboratory Astrophysics, Houston, TX, Mar 2006

Member, Program Committee, Div. of Plasma Physics of the American Physical Society, 2006  
 Member, Organizing Committee, Advanced Accelerator Conference, Wisconsin, July 2006.  
 Member Stewardship Science Graduate Fellowship Committee, 2007  
 Member, Technical Program Committee, Inertial Fusion Science and Applications, Japan, Sept. 2007.  
 Member, Organizing Committee, Joint Conference on High-Energy-Density Physics and 7th International Conference on High Energy Density Laboratory Astrophysics, St. Louis, Mo, Apr. 2008  
 Member, Physics Adv. Council, Center for Self-Organization in Magnetized Plasmas, 2005-2008  
 Member, Advisory Council for UCLA's LAPD User Facility, 2000-2008  
 Member, High Energy Density (Betti) Report Subcommittee, Fusion Energy Sciences Advisory Committee, 2008  
 External member, JASONS review of National Ignition Campaign, January 2009  
 Member, Facilities Funding and Programs Study Group of the NRC Decadal Survey Astronomy & Astrophysics 2010, 2009  
 Member, Organizing Committee, Omega Laser Users Group workshop, April 2009  
 Co-chair, 2<sup>nd</sup> Int. Conf. on High Energy Density Physics, Austin, TX, May 2009  
 Chapter Lead, DOE Research Needs Workshop (ReNeW) on High Energy Density Laboratory Plasmas, 2009-2010  
 Member, Weapons Science Review Committee, Los Alamos National Lab, 2008-2014  
 Member, Working Group on Laboratory Astrophysics, Amer. Astro. Society, 2007- 2012  
 Member, Women in Plasma Physics Committee of the American Physical Society, 2008 – 2011  
 Treasurer, High Energy Density Science Association, 2006- 2008  
 Treasurer, High Energy Density Laboratory Astrophysics Conference, 2002 – present  
 Webmaster, High Energy Density Laboratory Astrophysics Conference, 2005 – 2010  
 Chair, Working Group on Laboratory Astrophysics, Amer. Astro. Society, 2010-2011  
 Member, Koonin Committee for review of progress in the National Ignition Campaign, Oct. 2010- 2012  
 Steering committee member, DOE Office of Science Workshop on Basic Research Directions at the National Ignition Facility, May 2011  
 Member, Executive Committee to initiate the Laboratory Astrophysics Division of the American Astronomical Society, 2012-  
 Member, Proposal Review Committee for the Linear Coherent Light Source, 2013-  
 Member, LMJ-PETAL Basic Science Review Committee, 2014  
 Member, Executive Committee, Omega Laser Users Group, 2008-present  
 Member, Executive Committee, NIF Users Group, 2012-present  
 Member, Editorial Board, High Energy Density Physics, The Journal, 2008 – present.  
 Member, Editorial Board, Physics of Plasmas, 2014-2018

### **Journal Referee**

Physical Review Letters  
 Nature  
 Physical Review A/E  
 Physics of Fluids B/ Physics of Plasmas

Geophysical Research Letters  
Astrophysical Journal  
Journal of the Optical Society B  
Laser and Particle Beams  
Physics Letters A  
Optics Letters  
Journal of Geophysical Research  
Journal of Physics D  
Astrophysics and Space Science  
AIAA Journal  
Plasma Physics and Controlled Fusion  
Shock Waves  
Nature Physics  
Review of Scientific Instruments  
American Journal of Physics

**Proposal Referee**

National Science Foundation  
National Science and Engineering Council, Canada  
Lawrence Livermore National Laboratory  
U.S. Dept. of Energy  
EPSRC, Britain

**Promotion or Thesis Referee or Reviewer**

University of California Los Angeles  
University of California San Diego  
Princeton University  
Stanford University  
Australian National University  
University of Rochester  
University of Michigan  
University of Toronto  
Universite de Paris VI  
Universite de Bordeaux  
Imperial College, London  
State University of New York Stony Brook  
University of Nevada Reno  
Centre d'Energie Atomique, France  
Department of Applied Science, UC Davis  
Chairman, 1990 Comprehensive Examination Committee  
Chairman, 1991 Comprehensive Examination Committee  
Chairman, 1991-1992 Peer Review of Teaching Committee  
Lawrence Livermore National Laboratory  
Chair, Foreign National Access Working Group, 1989-1990  
U.C. Davis Committees  
Decennial Review Committee for Crocker Nuclear Lab  
Chair, Conflict-of-Interest Committee, 1991-1992, 1992-1993

Numerous qualifying examination committees

**U of M, AOSS Department Service:**

Member, 1998, Space Physics Research Review Committee  
Member, 1998, Search Committee for Space Physics Research Lab  
Member, 1998, 1999, 2000, 2001, 2003, 2004 Graduate  
Education Committee  
Member, 1998-1999, Search Committee for Meteorologist  
Ex-Officio Member, 1998-2000, AOSS Executive Committee  
Member, Fall 1999 Qualifying Examination Committee  
Co-Organizer, Fall 1999, Fall 2000 Graduate Student Orientation  
Member, 2000-2001 Undergraduate Curriculum Redefinition  
Committee  
Member, Spring 2001 Qualifying Examination Committee  
Member, Spring 2002 Qualifying Examination Committee  
Member, Fall 2003 SPRL Review Committee  
Member, 2004-2005 Bargaining team for GSI contract  
Qualifying examination chair, 2006  
Chair, Promotion casebook committee, 2007  
Chair, Promotion casebook committee, 2008  
Chair, Promotion casebook committee, 2010  
Chair, Promotion casebook committee, 2014  
Graduate Chair, 2006 – 2014

## ***Major Scientific Accomplishments:***

### ***Plasma Spectroscopy:***

Showed that energetic oxygen, injected as an impurity by neutral-atom heating beams, can be confined in a magnetic mirror fusion machine [(Drake and Moos, *Nuclear Fusion* **19**, 407 (1979)], and that mirror-confined plasmas expel low-energy impurities. [(Drake and Moos, *Nuclear Fusion* **20**, 599 (1980)].

### ***Plasma Confinement:***

Unified confinement theory and stability theory to explain the observed plasma confinement in the Tandem Mirror Experiment [(Drake et al., *Nuclear Fusion* **21**, 359 (1981)].

Published the first experimental study of radial transport in magnetic-mirror plasmas [(Drake et al., *Nuclear Fusion* **25**, 2110 (1982)].

### ***Laser-Plasma Interactions:***

Discovered evidence of the production of hot electrons by the stimulated Raman scattering instability [(Drake et al., *Physical Review Letters* **53**, 1739 (1984)].

Discovered evidence that stimulated Raman scattering is an absolute instability under specific conditions; evaluated implications for laser fusion [(Drake et al., *Physical Review Letters* **60**, 1018 (1988) and other publications].

Quantified the effects of collisional damping and density-gradient scale length on the amplitude and spectrum of stimulated Raman scattering [several publications during 1988 and 1989].

Discovered the first evidence of stimulated Compton scattering in a laser-produced plasma [Drake et al., *Physical Review Letters* **64**, 423 (1990)].

Discovered the importance of effects of time-dependence for stimulated Brillouin scattering in laser-produced plasmas [Drake and Williams, *Physical Review Letters* **67**, 2477 (1991)]

Was first to identify the important of the Langmuir Decay threshold in controlling the onset of Langmuir turbulence in collisional plasmas [Drake and Batha, *Phys. Fluids B* **3**, 2936 (1991)].

Led a research team applying laser-plasma techniques to basic plasma physics, permitting numerous first observations of physical mechanisms [Numerous *Physical Review Letters*, 1990-present].

Provided the first confirmation of the theoretical calculation of convective gain for stimulated Brillouin scattering in inhomogeneous plasmas [Drake, et al., *Physical Review Letters* **77**, (1996)]

### ***Laboratory Astrophysics:***

Invented experimental system for the laboratory study of astrophysically relevant plasma effects driven by high-Mach-number flows [Drake, et al., *Phys. Rev. Lett.* **80**, 2068 (1998), *Ap.J. Lett.* **500**, L157 (1998).]

Provided first scaling analysis of the requirements of experiments to study astrophysically relevant diffusive particle acceleration. [Drake, *Phys. Plasmas* Nov. 2000]

Devised and led (as PI) first astrophysically relevant experiment to produce radiative precursor shocks. [Keiter (post doc) et al., *Phys. Rev. Lett.* Oct. 2002].

Identified enhanced transport of material by instabilities in supernova simulation experiment. [Drake, et al. *Phys. Plasmas* May 2004.]

Authored first textbook on High Energy Density Physics, including significant new theory of radiative shocks (2006)

### ***Major Leadership Accomplishments***

#### ***Magnetic Mirror Program***

Led several experiments and scoping studies, including the first experimental study of radial transport in magnetic-mirror plasmas.

#### ***Laser Fusion Program:***

- Led the activation of the Novette Facility for target experiments and directed the experiments from May, 1983 through January, 1984.
- Led the activation of the Nova target chamber and the first experiments using the Nova laser. This included managing a group of approximately 20 people for two years.
- Managed the Plasma Physics Project then the Plasma Group from 1984-1989
- Led the first target experiments to employ advanced pulse shaping on Nova.
- Led and managed an effort to use optical streak cameras to obtain  $\pm 10\%$  laser-pulse-shape measurements (1986 to 1988).

#### ***Plasma Physics Research Institute:***

- Served as acting director beginning Sept. 1989.
- Served as permanent director, Jan. 1990 to July 1996

#### ***Space Physics Research Laboratory:***

Served as director, July 1998-July 2002. (13 M\$ per year)

#### ***Center for Radiative Shock Hydrodynamics (CRASH):***

Led the proposal effort 2006 – 2008 and served as director, 2008 – 2014 (17 M\$/5 yrs)

***Invited Presentations at Conferences:***

1. "Current Results of the Tandem Mirror Experiment" Int. Symp. on Physics and Open-ended Fusion Systems, Tsukuba, Japan, April 1980
2. "TMX Experimental Results", Division of Plasma Physics of the American Physical Society, San Diego, CA, Nov. 1980
3. "TMX Results and Future Tandem Mirrors", 17th Annual Symposium of the New Mexico Chapter of the American Vacuum Society, Albuquerque, NM, April 1981
4. "Radial Transport Experiments in TMX", Gordon Research Conf. on Plasma Physics, Ventura, CA, June 1981
5. "Laser-Plasma Interaction Experiments Using Several Kilojoules of Green Light", IEEE Int. Conf. on Plasma Science, St. Louis, Mo., May 1984
6. "Results of Large-Plasma Experiments Using Multikilojoule, Submicron Lasers", Division of Plasma Physics of the American Physical Society, Boston, MA, Oct. 1984
7. "Nova Target Experiments", 7th International Workshop on Laser Interaction and Related Plasma Phenomena, Monterey, CA, Oct. 1985
8. "Preliminary Performance and ICF Target Experiments With Nova", 11th Symposium on Fusion Engineering, Austin, TX, Nov. 1985
9. "Laser-Plasma-Interaction Experiments Using Multikilojoule Lasers", 18th European Conference on Laser Interactions with Matter, May, 1987
10. "Overview of Raman Scattering Experiments Using Nova", 18th Annual Anomalous Absorption Conference, L'Esterel, Quebec, June, 1988
11. "A Survey of Raman Spectra", 9th International Workshop on Laser Interaction and Related Plasma Phenomena, Monterey, CA, November 1989
12. "Recent Studies of Simulated Raman Backscattering", 20th European Conference on Laser Interactions with Matter, January, 1990
13. "Stimulated Raman Backscattering from Laser-Produced Plasmas", National Academy of Sciences Workshop on Optical and Plasma Physics, UCLA, March 1990.
14. "Speculations on Stimulated Raman scattering from Laser-Produced Plasmas: 'Merely' Nonlinear or also Chaotic", 1990 CAP/NSERC Summer Workshop on "Nonlinear and Chaotic Phenomena in Plasmas, Solids, and Fluids", Edmonton, Alberta, July 1990.

15. "Trends in Laser-Plasma-Instability Experiments for Laser Fusion", International Workshop on Research Trends in ICF, La Jolla, CA, Feb. 4-6, 1991.
16. "Three-Wave Parametric Instabilities in Long-Scale-Length, Somewhat-Planar, Laser-Produced Plasmas", 21st European Conference on Laser Interactions with Matter, October, 1991, Warsaw, Poland.
17. "Applications of Nanosecond, Kilojoule Lasers to the Basic Physics of Waves in Plasmas", SPIE Laser and Sensor Engineering Symposium, Los Angeles, Jan. 1992
18. "The Ion Acoustic Decay Instability in Laser Plasmas: Fluid Theory and Second Harmonic Emission", 11th International Workshop on Laser Interaction and Related Plasma Phenomena, Monterey, CA, Oct. 1993
19. "The study of waves and instabilities using Thomson scattering in laser plasmas", US-China-Japan Workshop on Laser Plasma and Drivers, Beijing, Oct. 1994
20. "Is stimulated Brillouin scattering irrelevant to laser fusion", Laser-plasma interactions workshop, Banff, Canada, February 1995
21. "Experiments for Fusion and Physics Using Trident ", 25th Anomalous Absorption Conference, Aspen, Colorado, May 1995.
22. "The study of waves and instabilities using Thomson scattering in laser plasmas", IEEE International Conference on Plasma Science '95, Madison, Wisconsin, June 1995.
23. "Greatly enhanced noise and the onset of stimulated Brillouin scattering", Annual Meeting of the Division of Plasma Physics of the American Physical Society, Denver, CO, November 1996.
24. "Nonlinear Evolution of Parametric Instabilities in Laser Produced Plasmas: Review of experimental evidence", 2nd International Workshop on Laser Plasma Interaction Physics, Banff, Canada, February 1997.
25. "Thomson scattering studies of waves in laser-produced plasmas and their connection with ionospheric interactions", National Radio Science and URSI Meeting, Boulder, CO, January 1998.
26. "Laboratory Astrophysics Experiments Using Large Lasers", New Frontiers in Laboratory Astrophysics, Opening Lecture, Workshop by the Royal Astronomical Society and the Institute of Physics, London, October 1999.
27. "Laser Experiments to Simulate Supernova Remnants", Annual Meeting of the Division of Plasma Physics of the American Physical Society, New Orleans, LA, November 1999.
28. "Overview of Laser Astrophysics Experiments", American Astronomical Society, Rochester, NY, June 2000



29. "Basic Science: Implications for NIF Shock Diagnostics", National Ignition Facility Diagnostic Workshop, Tucson, Ariz., June 2000
30. "What's a Burning Plasma Good For?", Workshop on Burning Plasma Science, Austin, TX, Dec. 2000
31. "Plasma Laboratory Astrophysics: Mildly Relativistic Plasmas", National Research Council Committee on the Physics of the Universe, Pasadena, CA June 2001
32. "Supernova Hydrodynamics on the Omega Laser", International Conference on Fusion Sciences and Applications, Kyoto, Japan, Sept. 2001
33. "Breakthrough Science and the Role of Universities in High Energy Density Physics", National Research Council Committee on High Energy Density Physics, Irvine, CA Nov. 2001
34. "Laboratory Astrophysics with Intense Lasers: Introduction and Overview", Annual Seminar of the Laboratoire d'Utilisation des Lasers Intenses, Saint-Lary, Pyrenees, France, March 2002.
35. "Understanding Hydrodynamics of High Energy Density Matter: Laboratory Experiments and Astrophysical Connections", April Meeting of the American Physical Society, Albuquerque, NM, April, 2002
36. "Connecting Laboratory Experiments and Astrophysical Phenomena, Meeting on Intercomparison of Plasma Experiments in Laboratory and Space (IPELS), Whitefish, Montana June, 2003.
37. "Progress in Experimental Astrophysics at High Energy Density", Annual Meeting of the Division of Plasma Physics of the American Physical Society, Albuquerque, NM, October, 2003
38. "Radiative Shocks in the Laboratory and Astrophysics", 5<sup>th</sup> International Conference on High Energy Density Laboratory Astrophysics, Tucson, AZ, March 2004
39. "Hydrodynamics and Radiation Hydrodynamics with Astrophysical Applications", APS April meeting, Tampa, FL April 2005
40. "High Energy Density Physics: Recent Results and New Directions", Target Fabrication Specialist's Conference, Scottsdale, Arizona, May 2005.
41. "Hydrodynamic instabilities in the laboratory and astrophysics", Plenary lecture, European Conference on Plasma Science, Tarragona, Spain, June 2005
42. "Introduction to High Energy Density Physics", Opening Lecture, HEDP Summer School, Berkeley CA August 2005.
43. "Looking Toward Astrophysical Applications of Relativistic Lasers", Ultrafast Laser Applications conference, San Jose, Feb. 2006.

44. "HED Facilities and Their Connection to Issues in Astrophysics", Opening lecture, High Energy Density Laboratory Astrophysics Conference, Houston, TX, Mar. 2006.
45. "Theory of Radiative Shocks", IEEE International Conference on Plasma Science, Traverse City, MI, June 2006.
46. "Using Radiative Shock Experiments and Physical Thinking in Code Validation", Computational Methods in Transport Workshop, Granlibakken, CA, Sept. 2006.
47. "Overview of Laboratory Plasma Astrophysics," Workshop on Collisionless and Relativistic Plasma Astrophysics, Houston, TX, May 2007
48. "Compressible hydrodynamics, radiation transport, and radiation hydrodynamics," NNSA/Office of Science workshop on High Energy Density Laboratory Plasmas (HEDLP), Chicago, IL, May 2007
49. "Approaches to turbulence in high-energy-density experiments," Turbulent Mixing and Beyond, Trieste, Italy, Aug. 2007
50. "Experiments to explore structure in radiative shocks," Inertial Fusion Science and Applications, Kobe, Japan, Sept. 2007
51. "Toward astrophysical applications of relativistic lasers," International Symposium on Laser-Driven Relativistic Plasmas Applied for Science, Industry and Medicine, Kansai Photon Science Institute, Japan, Sept. 2007
52. "Introduction to High Energy Density Physics and its connections to Astrophysics", Annual science meeting of the Centre d'Energie Atomique, Bruyeres, France, Dec. 2007
53. "High Energy Density Laboratory Astrophysics and its connections to supernovae", Joint LLNL/LANL Astrophysics Initiative Workshop, March 2008
54. "Astrophysical problems for which high-energy-density physics can matter", April Meeting of the American Physical Society, St. Louis, April 2008
55. "Supernova-relevant experiments for the National Ignition Facility," European Conference on Laser Interaction with Matter, Darmstadt, Sept. 2008
56. "Perspectives on High-Energy-Density Physics," (Plenary lecture) Annual Meeting of the Division of Plasma Physics of the American Physical Society, Dallas, TX, Nov. 2008.

57. "Laboratory Astrophysics on the Linac Coherent Light Source", LCLS Workshop, Oxford, UK, Jan. 2009.
58. "Challenges to Understanding Radiative Shocks," 2009 IEEE Inter. Conf. on Plasma Science, San Diego CA, June 2009.
59. "Using High Power Lasers to Create Radiative Shock Waves," Conference on Lasers and Electro-Optics, Pacific Rim, Shanghai, Sept. 2009.
60. "High Energy Density Hydrodynamics and Radiation Hydrodynamics", Canadian Assoc. of Physics, Toronto, June 2010
61. "Producing Radiative Shocks for Laboratory Astrophysics Experiments", Workshop on Laser-Matter Interactions, Proquerolles, France, Sept. 2010
62. "Radiative Shocks in Laboratory Astrophysics", International Workshop on Radiation from High Energy Density Plasmas, Reno, Nevada, March 2011
63. "Basic Experimental Research in High-Energy-Density Physics", Sherwood Theory Meeting,
64. "Progress toward turbulent experiments at high energy density", Turbulent Mixing and Beyond, Trieste, Italy, August 2011
65. "A tour through shocks at HED: Collisional to collisionless ", CMSO conference, Hanover, New Hampshire, October 2011
66. "Various Challenges in Simulations of Laboratory Astrophysics Experiments", IPAM Program in Computational Methods in High Energy Density Plasmas: Workshop I: Computational Challenges in Hot Dense Plasmas, Los Angeles, March 2012
67. "Hydrodynamics at High Energy Density", School at Darmstadt, Germany, Oct. 2012
68. "High-Energy-Density Physics", plenary lecture, International Conference on High Energy Density Physics, Beijing, China, Oct. 2012
69. "Considerations relating to foam materials in laboratory astrophysics experiments", 5<sup>th</sup> International Laboratory Astrophysics Workshop, Weihai, China, August 2013.
70. "Recent Progress in Studies of Complex Hydrodynamics at High Energy Density," Plenary Lecture, International Conference on High Energy Density Physics, Beijing, China, Oct. 2014

***Invited Presentations by directly-guided post docs and students:***

1. S.H. Batha, "Forward Scattering of Laser Light", Annual Meeting of the Division of Plasma Physics of the American Physical Society, 1992
2. B.S. Bauer, "First Experimental Detection of Ion Plasma Waves", Annual Meeting of the Division of Plasma Physics of the American Physical Society, 1994
3. A.B. Reighard, "Astrophysical Connections to a Driven Radiative Shock Experiment", High Energy Density Laboratory Astrophysics, 2006.
4. Carolyn Kuranz, "Supernova Hydrodynamics Experiments with Attention to the Transition to Turbulence", High Energy Density Laboratory Astrophysics, 2006.
5. A.B. Reighard, "Experiments on Collapsing Radiative Shocks", Annual Meeting of the Division of Plasma Physics of the American Physical Society, 2006
6. Carolyn Kuranz, "Supernova Hydrodynamics Experiments on the Omega Laser," Nuclear Astrophysics Workshop, Livermore, CA, August 2007
7. Carolyn Kuranz, "Laboratory blast-wave driven instabilities," International Conference on High Energy Density Laboratory Astrophysics/International Conference on High Energy Density Physics at the April meeting of the American Physics Society, St. Louis, Mo, April, 2008
8. Carolyn Kuranz, "Laboratory blast wave driven instabilities on the Omega Laser," High Energy Density Science User's Project mini-symposium of Stewardship Science Academic Alliance Symposium, Washington, D.C., February 2008
9. Carolyn Kuranz, "Laboratory blast-wave driven instabilities," Annual Meeting of the Division of Plasma Physics of the American Physical Society, Dallas, TX, Nov. 2008.
10. Eric Harding, "Kelvin Helmholtz Experiments, 2<sup>nd</sup> Inter. Conf. on High Energy Density Physics, Austin TX, May 2009
11. Eric Harding, "Observations Of Subsonic And Supersonic Shear Flows In Laser Driven High-Energy-Density Plasmas," Annual Meeting of the Division of Plasma Physics of the American Physical Society, Atlanta, GA, Nov. 2009
12. Forrest Doss, "CRASH: Theory and Experiments on Radiative Shocks," International Conference on High Energy Density Laboratory Astrophysics, Pasadena, CA, March 2010
13. Forrest Doss, "Structure in Radiative Shocks", Annual Meeting of the Division of Plasma Physics of the American Physical Society, Chicago, IL, Nov. 2010

14. Anthony Visco, "Temperature Measurements in a Radiative Shock System", Radiation from High Energy Density Plasmas (RHEDP) International Workshop, Reno, NV March 2011
15. Forrest Doss, "Structure in Radiative Shocks," 3rd International Conference on High Energy Density Physics, Lisbon, Portugal, May 2011
16. Channing Huntington, "Same-Shot X-Ray Thomson Scattering And Streaked Imaging Of Radiative Shock Experiments At Omega", International Conference on Plasma Science, Chicago, IL, June 2011
17. Eliseo Gamboa, "Imaging x-ray Thomson scattering instrumentation and experiments", High Temperature Plasma Diagnostics conference, 2012
18. Christine Krauland, "Radiative Reverse Shock Laser Experiments Relevant to Accretion Processes in Cataclysmic Variables", Annual Meeting of the Division of Plasma Physics of the American Physical Society, Providence, Rhode Island, Nov. 2012
19. Carlos Di Stefano, "Observation and modeling of mixing-layer development in HED blast-wave-driven shear flow", Annual Meeting of the Division of Plasma Physics of the American Physical Society, Denver, CO Nov 2013

***Lectures:***

"Physics of Laser Plasma Interactions"  
Massachusetts Institute of Technology, 1988  
Subject 6.965 (G): gave 9 of 18 lectures

***Summer Schools:***

Summer School: Foundations of High-Energy-Density Physics  
August 2004  
August 2006  
July 2008  
August 2010  
August 2012  
June 2014

***Seminars and Colloquia:***

On Magnetic Mirror Topics:

Princeton Plasma Physics Laboratory, fall 1979  
Max Planck Institute, Garching, April 1980  
Fontenay-aux-Rose, April 1980  
Culham laboratory, April 1980  
Sandia National Laboratories, Albuquerque, August 1980  
University of Wisconsin, Madison, 1981

University of Maryland, 1981  
Dartmouth University, spring 1981

- "The Significance of Observed Trends in Raman Scattering Data":  
Los Alamos National Laboratory, August 1987  
Naval Research Laboratory, November 1988  
University of Rochester, November 1988
- "Progress Toward Laser Fusion Using Nova":  
Princeton Plasma Physics Laboratory, November 1988  
University of Rochester, November 1988  
University of Maryland, May 1989  
Cornell University, May 1989
- "Stimulated Raman Backscattering from Laser-Produced Plasmas":  
U.C.Davis, March, 1989  
U.C.Irvine, November 21, 1989
- "Waves in Laser-Produced Plasmas"  
U.C. Davis, May 1991
- "Stimulated Brillouin Scattering: Tests of the Convective Theory"  
Ecole Polytechnique, July 1992
- "Parametric Interactions in Laser Plasmas"  
Univ. of Colorado, Feb. 1993  
M.I.T., March 1993
- "The Laser as a Tool for the study of waves and turbulence in plasmas"  
Univ. of Alberta, Sept. 1994
- "Laser Scattering from Tailored Plasmas"  
Univ. of Michigan, Sept. 1995  
Univ. of Miami, Oct. 1995
- "Laboratory Supernovae: Using big lasers to model exploding stars"  
Sandia National Laboratory, Feb. 1999  
Univ. of Toronto, Feb. 1999  
Lawrence Livermore National Laboratory, Aug. 1999
- "Laboratory Experiments to Simulate Supernova Remnants"  
Univ. of Chicago, Sept. 1999  
Naval Research Laboratory, Nov. 1999  
Los Alamos National Laboratory, Jan. 2000
- "Plasma hydrodynamics", and "Laboratory simulation of astrophysical phenomena"  
DOE National Undergraduate Fellowship Program, June 2000
- "The quest for fusion: when and how will humans make power like the stars do?"  
Michigan Alumni Association, July 2000
- "Laboratory Supernovae: Using big lasers to simulate exploding stars"  
Michigan Alumni Association, July 2000
- "Astrophysics Experiments with Lasers and Z Pinches"  
Univ. of Toledo, November 2000

Univ. of Rochester, April 2000

“Connecting Laboratory Experiments with Astrophysical Phenomena”

Brigham Young University, Feb. 2003

Rochester Inst. Of Technology, Feb. 2003

West Virginia Wesleyan, Feb . 2003

Swarthmore, Feb. 2003

UC Irvine, March 2003

Optical Society of America, March 2003

Rutgers, April 2003

Imperial College, November 2003

West Virginia University, February 2004

Ohio State University, January 2005

Massachussetts Institute of Technology, January 2006

University of Michigan Physics Dept., Feb. 2006

“Hydrodynamics and radiation hydrodynamics with astrophysical applications”

SUNY Stony Brook, Applied Mathematics, March 2008

“High energy density physics with astrophysical applications: hydrodynamics and radiation hydrodynamics”

Observatoire de Meudon, May 2010

CEA Bruyeres, May 2010

“High-energy-density physics of relevance to astrophysics”

SUNY Stony Brook, Physics, November 2010

High-energy-density physics”

University of Washington, April 2013

Rice University, April 2013

Ohio State University, April 2014

CELIA (Univ. Bordeaux) April 2014

“Laboratory astrophysics at high energy density”

Rice University, April 2013

***Books Published:***

R.P. Drake, High Energy Density Physics: Foundations, Inertial Fusion, and Experimental Astrophysics, 534 pages, Springer, Berlin (2006) ISBN-10 3-540-29314-0

***Refereed Publications*** (graduate students underlined, post-docs in italics):

1. R.P.Drake and H.W.Moos, "Evidence for neutral-beam-injected oxygen impurities in 2XIIB", *Nucl. Fusion* **19**,407-410 (1979).
2. R.P.Drake and H.W.Moos, "An extreme-ultraviolet study of the 2XIIB neutral-beam-heated mirror machine, *Nucl. Fusion* **20**, 599-610 (1980).
3. D.L.Correll, J.F.Clauser, F.H.Coengsen, W.F.Cummins, R.P.Drake, J.H.Foote, A.H.Futch, R.K.Goodman, D.P.Grubb, G.M.Melin, W.E.Nexsen, T.C.Simonen, B.W.Stallard, W.C.Turner, "Production of large-radius, high-beta, confined mirror plasmas", *Nucl. Fusion* **20**, 655-664 (1980).
4. F.H.Coengsen, T.A.Casper, C.A.Anderson, J.F.Clauser, W.C.Condit, D.L.Correll, W.F.Cummins, J.C.Davis, R.P.Drake, J.H.Foote, A.H.Futch, R.K.Goodman, D.P.Grubb, G.A.Hallock, R.S.Hornady, A.L.Hunt, B.G.Logan, R.H.Munger, W.E.Nexsen, T.C.Simonen, D.R.Slaughter, B.W.Stallard, O.T.Strand, "Electrostatic plasma confinement experiments in a Tandem Mirror system ", *Phys. Rev. Lett.* **44**, 1132-1135 (1980).
5. R.P.Drake, G.Deis, M.Richardson, T.C.Simonen, "Gas control and wall conditioning in TMX", *J. Nucl. Materials* **93/94**, 291-296 (1980).
6. R.P.Drake, T.A.Casper, J.F.Clauser, F.H.Coengsen, D.L.Correll, W.F.Cummins, J.C.Davis, J.H.Foote, A.H.Futch, R.K.Goodman, D.P.Grubb, R.S.Hornady, W.E.Nexsen, T.C.Simonen, B.W.Stallard, "Effect of end-cell stability on the confinement of the central-cell plasma in TMX", *Nucl. Fusion* **21**, 359-364 (1981).
7. R.P.Drake, D.D.Lang, A.L.Hunt, W.L.Pickles, T.C.Simonen, T.P.Stack, K.L.Wilson, M.I.Baskes, L.G.Haggmark, M.E.Malinowski, "Design of first walls and beam dumps for the Tandem Mirror Experiment Upgrade", *J. Vac. Sci. Tech.* **20**, 1288-1291 (1982).
8. R.P.Drake, E.B.Hooper, C.V.Karmendy, S.L.Allen, T.A.Casper, J.F.Clauser, F.H.Coengsen, R.H.Cohen, D.L.Correll, J.C.Davis, J.H.Foote, A.H.Futch, R.K.Goodman, D.P.Grubb, G.E.Gryczkowski, G.A.Hallock, A.L.Hunt, W.E.Nexsen, W.L.Pickles, A.E.Pontau, P.Poulsen, T.C.Simonen, O.T.Strand, W.R.Wampler, "Radial Transport in the central cell of the tandem mirror experiment", *Phys. Fluids* **25**, 2110-2120 (1982).
9. D.L.Correll, S.L.Allen, T.A.Casper, J.F.Clauser, P.Coakely, F.H.Coengsen, W.C.Condit, W.F.Cummins, J.C.Davis, R.P.Drake, J.H.Foote, A.H.Futch, R.K.Goodman, D.P.Grubb, G.A.Hallock, E.B.Hooper, R.S.Hornady, "Ambipolar potential formation and axial confinement in TMX", *Nucl. Fusion* **22**, 223-234 (1982).
10. E.B.Hooper, G.E.Gryczkowski, R.P.Drake, "Plasma generation in gas box fueling for tandem mirrors", *J. Vac. Sci. Tech.* **20**, 1259-1262 (1982).



11. W.L.Pickles, A.K.Chargin, R.P.Drake, A.L.Hunt, D.D.Lang, J.J.Murphy, P.Poulsen, T.C.Simonen, T.H.Batzer, T.P.Stack, R.L.Wong, "The LLNL Tandem Mirror Experiment Upgrade vacuum system", *J. Vac. Sci. Tech.* **20**, 1177-1181 (1982).
12. R.P.Drake, "Control of plasma-wall interactions in tandem mirrors", *Nucl. Tech./Fusion* **3**, 405-415 (1983).
13. D.P.Grubb, S.L.Allen, T.A.Casper, J.F.Clauser, F.H.Coensgen, R.H.Cohen, D.L.Correll, W.F.Cummins, J.C.Davis, R.P.Drake, J.H.Foote, A.H.Futch, R.K.Goodman, G.E.Gryczkowski, E.B.Hooper, R.S.Hornady, A.L.Hunt, C.V.Karmendy, W.E.Nexsen, W.L.Pickles, G.D.Porter, P.Poulsen, T.D.Rognlien, T.C.Simonen, D.R.Slaughter, P.Coakley, G.A.Hallock, O.T.Strand, "Energy confinement studies in the Tandem Mirror Experiment: power flow", *Phys. Fluids* **26**, 1987-2002 (1983).
14. D.P.Grubb, S.L.Allen, T.A.Casper, J.F.Clauser, F.H.Coensgen, D.L.Correll, W.F.Cummins, J.C.Davis, D.Dietrich, R.P.Drake, J.H.Foote, R.J.Fortner, A.H.Futch, R.K.Goodman, G.E.Gryczkowski, E.B.Hooper, R.S.Hornady, A.L.Hunt, C.V.Karmendy, T.Nash, W.E.Nexsen, W.L.Pickles, G.D.Porter, P.Poulsen, T.C.Simonen, D.R.Slaughter, G.A.Hallock, O.T.Strand, "Energy confinement studies in the Tandem Mirror Experiment: power balance", *Phys. Fluids* **26**, 2003-2010 (1983).
15. W.L.Pickles, M.O.Calderon, M.R.Carter, C.A.Clower, R.P.Drake, A.L.Hunt, D.D.Lang, T.C.Simonen, and W.C.Turner, "Dynamic gas flow during plasma operation in TMX-U", *J. Vac. Sci. Tech.* **A1**, 1288-1292 (1983).
16. S.L.Allen, C.A.Clower, R.P.Drake, E.B.Hooper, A.L.Hunt, and R.Munger, "Initial wall conditioning for the TMX-U fusion experiment", *J. Vac. Sci. Tech.* **A1**, 916-919 (1983).
17. R.P.Drake, R.E.Turner, B.F.Lasinski, K.G.Estabrook, E.M.Campbell, C.L.Wang, D.W.Phillion, E.A.Williams, and W.L.Kruer, "Efficient Raman sidescatter and hot-electron production in laser-plasma interaction experiments", *Phys. Rev. Lett.* **53**, 1739-1742 (1984).
18. R.E.Turner, K.G.Estabrook, R.L.Kauffman, D.R.Bach, R.P.Drake, D.W.Phillion, B.F.Lasinski, W.L.Kruer, E.A.Williams, and E.M.Campbell, "Evidence for collisional damping in high-energy Raman scattering experiments at 0.26 microns", *Phys. Rev. Lett.* **54**, 189-192 (1985).
19. K.R.Manes, O.C.Barr, E.S.Bliss, R.P.Drake, R.O.Godwin, D.G.Gritton, J.S.Hildum, W.F.Holloway, C.A.Hurley, B.C.Johnson, D.J.Kuizenga, B.Merritt, R.G.Ozarski, F.Reinecker Jr., J.R.Severyn, D.R.Speck, M.A.Summers, G.J.Suski, E.P.Wallerstein, "Novette facility: activation and experimental results", *Laser and Particle Beams* **3**, 173-188 (1985).
20. F.Ze, L.J.Suter, S.M.Lane, E.M.Campbell, W.C.Mead, J.D.Lindl, M.D.Rosen, D.W.Phillion, C.W.Hatcher, R.P.Drake, J.S.Hildum, K.R.Manes, "Compression

measurements in ablatively driven inertial confinement fusion", *Comm. Plas. Phys. Cont. Fus.* **10**, 33-41 (1986).

21. E.M.Campbell, J.T.Hunt, E.S.Bliss, D.R.Speck, R.P.Drake, "Nova experimental facility", *Rev. Sci. Instrum.* **57**, 2101-2106 (1986).

22. R.E.Turner, Kent Estabrook, R.P.Drake, E.A.Williams, H.N.Kornblum, W.L.Kruer, E.M.Campbell, "Observation of forward Raman scattering in laser-produced plasmas", *Phys. Rev. Lett.* **57**, 1725-1728 (1986).

23. R.P.Drake, "Laser-plasma-interaction experiments using multikilojoule lasers", *Laser and Particle Beams* **6**, 235-244 (1988).

24. R.P.Drake, P.E.Young, E.A.Williams, Kent Estabrook, W.L.Kruer, B.F.Lasinski, C.B.Darrow, H.A.Baldis, T.W.Johnston, "Laser-intensity-scaling experiments in long-scale-length, laser-produced plasmas", *Phys. Fluids.* **31**, 1795-1802 (1988).

25. R.P.Drake, E.A.Williams, P.E.Young, Kent Estabrook, W.L.Kruer, H.A.Baldis, T.W.Johnston, "Evidence that stimulated Raman scattering in laser-produced plasmas is an absolute instability", *Phys. Rev. Lett.* **60**, 1018-1021 (1988).

26. R.P.Drake, R.E.Turner, B.F.Lasinski, E.A.Williams, D.W.Phillion, K.G.Estabrook, W.L.Kruer, E.M.Campbell, T.W.Johnston, K.R.Manes, J.S.Hildum, "Studies of Raman scattering from disk targets irradiated by several kilojoules of 0.53-micron laser light", *Phys. Fluids.* **31**, 3130-3142 (1988).

27. F.Ze, R.L.Kauffman, B.Lasinski, L.Suter, S.Langer, H.Kornblum, G.Tietbohl, T.Thiessen, D.Montgomery, R.P.Drake, and E.M.Campbell, "Time-resolved x-ray conversion efficiencies of laser-heated plasmas", *Rev. Sci. Inst.* **59**, 1801-1803 (1988).

28. P.E.Young, H.A.Baldis, R.P.Drake, E.M.Campbell, Kent Estabrook, "Direct Evidence of ponderomotive filamentation in a laser-produced plasma", *Phys. Rev. Lett.* **61**, 2336-2339 (1988).

29. P.E.Young, B.F.Lasinski, W.L.Kruer, E.A.Williams, K.G. Estabrook, E.M.Campbell and R.P.Drake, "Simultaneous spectrally and spatially resolved measurements of  $3\omega_0$  emission from laser-produced plasmas", *Phys. Rev. Lett.* **61**, 2766-2769 (1988).

30. R.P.Drake, "Control of stimulated Raman scattering for laser fusion by means of collisional damping", *Comments Plas. Phys.Cont. Fus.* **XII**, No.4, 181-190 (1989).

31. R.P.Drake, E.A.Williams, P.E.Young, Kent Estabrook, W.L.Kruer, H.A.Baldis, T.W.Johnston, "Reduction of emission in the stimulated Raman scattering frequency band to thermal noise levels by collisional damping in a laser-produced plasma", *Phys. Rev.A* **39**, 3536-3540 (1989).

32. R.P.Drake, D.W.Phillion, Kent Estabrook, R.E.Turner, R.L.Kauffman, and E.M.Campbell, "Hydrodynamic expansion of exploding-foil targets irradiated by  $0.53 \mu\text{m}$  light", *Phys. Fluids B* **1**, 1089-1096 (1989).
33. H.A.Baldis, P.E.Young, R.P.Drake, W.L.Kruer, K.Estabrook, E.A.Williams, and T.W.Johnston, "Competition between the stimulated Raman and Brillouin scattering instabilities in  $0.35 \mu\text{m}$  irradiated CH foil targets" *Phys. Rev. Lett.* **62**, 2829-2832 (1988).
34. R.P.Drake, "The scaling of absolutely-unstable, stimulated Raman scattering from planar, laser-produced plasmas", *Phys. Fluids B* **1**, 1082-1088 (1989).
35. R.P.Drake, R.E.Turner, B.F.Lasinski, E.M.Campbell, W.L.Kruer, E.A.Williams, and R.L.Kauffman, "Measurements of absorption and Brillouin sidescattering from planar plasmas produced by  $0.53 \mu\text{m}$  laser light", *Phys.Fluids B* **1**, 1295-1300 (1989).
36. R.P.Drake, R.E.Turner, B.F.Lasinski, E.A.Williams, Kent Estabrook, W.L.Kruer, E.M.Campbell, T.W.Johnston, "X-ray emission caused by Raman scattering in long-scale-length plasmas", *Phys. Rev. A***40**, 3219-3225 (1989).
37. R.P.Drake, "The effect of enhanced plasma waves on Thomson scattering with a high-frequency probe laser", *Phys. Fluids B* **1**, 2291-2293 (1989).
38. R.P.Drake, E.A.Williams, P.E.Young, Kent Estabrook, W.L.Kruer, D.S.Montgomery, H.A.Baldis, T.W.Johnston, "Narrow Raman spectra: the competition between collisional and Landau damping", *Phys. Fluids B* **1**, 2217-2223. (1989).
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