

Craig L. Sarazin

Biographical Data

BORN: August 11, 1950; Milwaukee, Wisconsin USA

MARRIED: Mimi Magyar, April 4, 2015

CHILDREN: Stephen Neil, February 7, 1976
Andrew Thomas, November 9, 1978

OFFICE ADDRESS: Department of Astronomy
University of Virginia
P.O. Box 400325
530 McCormick Road
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Charlottesville, VA 22903-7876

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cls7i@virginia.edu

EDUCATION: Ph.D. Physics, Princeton University, Princeton, NJ, 1975
M.A. Physics, Princeton University, Princeton, NJ, 1973
B.S. Physics, California Institute of Technology, Pasadena,
CA, 1972
Ph.D. thesis, *The Role of Dust in H II Regions*, John N.
Bahcall, supervisor.

EDUCATIONAL AWARDS
AND HONORS: Haren Lee Fisher Physics Prize, California Institute of Tech-
nology, 1971.
National Science Foundation Graduate Fellow, 1972–1975.
National Merit Scholar, 1968–1972.

PROFESSIONAL SOCIETIES: American Astronomical Society
High Energy Astrophysics Division, AAS
International Astronomical Union
Division D: High Energy Phenomena and Fundamental Physics
Division H: Interstellar Matter and Local Universe
Division J: Galaxies and Cosmology
Commission 28: Galaxies, IAU
Commission 34: Interstellar Medium, IAU
COSPAR Associate, Member of Scientific Commission E

Craig L. Sarazin

Professional Experience

- CURRENT POSITION: W. H. Vanderbilt Professor of Astronomy, University of Virginia, Charlottesville, VA, 1997–.
- LONG TERM POSITIONS: Chairman of the Department of Astronomy, Director of McCormick Observatories, and Director of the Virginia Institute of Theoretical Astronomy, University of Virginia, Charlottesville, VA, 1992–1995, 2014–2015.
- Professor of Astronomy, University of Virginia, Charlottesville, VA, 1987–1996.
- Associate Professor of Astronomy, University of Virginia, Charlottesville, VA, 1980–1987.
- Assistant Professor of Astronomy, University of Virginia, Charlottesville, VA, 1977–1980.
- Member, School of Natural Science, Institute for Advanced Study, Princeton, NJ, 1975–1977.
- VISITING POSITIONS: Erasmus Mundus Visiting Professor, Institute for Astro- and Particle Physics, University of Innsbruck, 2011
- Visiting Scientist, Inter-University Centre for Astronomy and Astrophysics, Pune, India, 1995
- Visiting Scientist, Space Telescope Science Institute, Baltimore, MD, 1993–1995.
- Visiting Professor, Physics Department, Scuola Normale, Pisa, Italy, 1992.
- Visiting Fellow, Institute of Astronomy, Cambridge University, Cambridge, UK, 1987.
- Visiting Fellow, Joint Institute for Laboratory Astrophysics, University of Colorado and the National Bureau of Standards, Boulder, CO 1985–1986.
- Visiting Professor of Physics, School of Natural Science, Institute for Advanced Study, Princeton, NJ, 1981–1982.
- Visiting Associate Scientist, National Radio Astronomy Observatory, Charlottesville, VA, summers 1979–1981.
- Visiting Member, School of Natural Science, Institute for Advanced Study, Princeton, NJ, 1980.

Visiting Assistant Professor of Astronomy, University of California, Berkeley, CA 1979.

Visiting Assistant Scientist, National Radio Astronomy Observatory, Charlottesville, VA, summers 1977–1978.

Visiting Fellow, Institute of Astronomy, Cambridge University, Cambridge, UK, 1976.

Robert Millikan Fellow, Physics Department, California Institute of Technology, summer 1975.

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Committees: Professional

- U.S. Representative and Member, ESA XMM-Newton Users Group, 2011–
- Member, NASA MIDEX Mission Selection Panel, 2017
- Member, Scientific Organizing Committee, annual meetings on ‘Alpine Cosmology Workshop,’ Innsbruck, Austria, 2013–
- Chair, NASA XMM-Newton Users Committee, 2009–2017
- Member, Scientific Organizing Committee, ESA Conference on “XMM-Newton: The Next Decade”, 2015–2016
- Chair, European Space Agency XMM-Newton Observing Time Allocation Committee, AO-15, 2015
- Member, NASA Astrophysics Explorer Program Selection Panel, 2015
- Member, Scientific Organizing Committee, Green Bank Workshop on High Frequency Science with the GBT, 2014–2015
- Chair, Science Advisory Board, Graduate Programs in Astrophysics, Physics, Mathematics, Computer Science, and Civil Engineering, University of Innsbruck, 2012–2014
- Spokesperson for XMM-Newton satellite, NASA Senior Review Panel, Washington, DC, 2014
- Member, Scientific Organizing Committee, meeting on “The X-ray View of Galaxy Ecosystems,” Cambridge, MA, 2013–2014
- Member, Scientific Organizing Committee, meeting on “New Paths in Studies of Galaxy Clusters,” Innsbruck, Austria, 2012–2013
- Spokesperson for XMM-Newton satellite, NASA Senior Review Panel, Washington, DC, 2012
- Member, Scientific Organizing Committee, meeting on “Galaxy Clusters as Giant Cosmic Laboratories,” Madrid, Spain, 2011–2012
- Member, Scientific Organizing Committee, meeting on “Colliding Clusters of Galaxies and Nonthermal Phenomena,” Nice, France, 2010
- Member, Review Panel for XMM/Newton Cycle 10 Proposals, 2010
- Spokesperson for XMM-Newton satellite, NASA Senior Review Panel, Washington, DC 2010
- Member, Scientific Organizing Committee, Kavli Institute for Theoretical Physics Workshop on Clusters of Galaxies, Santa Barbara, CA, 2008–2011
- Member, Scientific Organizing Committee, International Astronomical Union General Assembly Joint Discussion meeting on “Hot Interstellar Matter in Elliptical Galaxies”, Rio de Janeiro, Brazil, 2007–2009
- Member, Scientific Organizing Committee, meeting on “The Warm and Hot Universe,” New York, NY, 2007–2008
- Member, External Review Panel, Astronomy Ph.D. program at the Rochester Institute of Technology, 2007
- Member, National Research Council, Beyond Einstein Program Assessment Committee, 2006–2007
- Member, Review Committee for Astronomy Programs at the Deutsche Forschungsgemeinschaft (German Research Foundation), 2006–2007
- Chair, Astronomy and Space Physics Science Council, Universities Space Research Association, 2004–2006
- Member, Astronomy and Space Physics Science Council, Universities Space Research Association, 2000–2006
- Member, Scientific Organizing Committee, meeting on “Heating vs. Cooling in Galaxies and Clusters of Galaxies,” Garching, Germany, 2005–2006

Associate Chair, Clusters Proposal Review Panel, Chandra Cycle 8, 2006
Member, Extragalactic Proposal Review Panel, Hubble Space Telescope Cycle 13, 2004
Member, Scientific Organizing Committee, meeting on “A Pan-Chromatic View of Clusters of Galaxies and the Large-Scale Structure,” Tonantzintla, Mexico, 2005
Member, Scientific Organizing Committee, meeting on “Galaxies Viewed with Chandra,” Cambridge, MA, 2004
Member, Scientific Organizing Committee, meeting on “Cosmic Rays and Magnetic Fields in Large Scale Structure,” Busan, Korea, 2004.
Member, Review Panel for XMM/Newton Cycle 3 Proposals, 2003
Member, Scientific Organizing Committee, meeting on “The Riddle of Cooling Flows,” Charlottesville, Va., 2002–2003
Member, Scientific Organizing Committee, Soft X-ray Emission from Clusters of Galaxies and Related Phenomena, Huntsville, AL, 2002
Member, Scientific Organizing Committee, meeting of the Southeastern Section of the American Physical Society, Auburn, AL, 2002
Member, Scientific Organizing Committee, The Future of Extreme Ultraviolet Astronomy, Albuquerque, NM, 2002
Member, NASA Chandra Cycle-3 Final Proposal Review Panel, 2001
Chair, NASA Chandra Users Committee, 1997–2001
Member, NASA Chandra Users Committee, 1993–2001
Member, Scientific Organizing Committee, The High Energy Universe at Sharp Focus: Chandra Science, Minnesota, 2000–2001
Member, Scientific Organizing Committee, IAP 2000 Conference on Constructing the Universe with Clusters of Galaxies, Paris, France, 2000
Member, NASA Astro-E Users Committee, 1999–2000
Internal Referee, Report of Astronomy and Astrophysics Survey Committee, National Research Council 1999–2000
Member, High Energy Astrophysics from Space Panel, Astronomy and Astrophysics Survey Committee, National Research Council 1998–2000
Member, NASA ASCA Users Committee, 1995–2000
Member, NASA Working Group on X-ray Astronomy, 1989–1999
Member, Heineman Prize Committee, American Astronomical Society, 1995–1998
Member, Scientific Organizing Committee, Ringberg Workshop on “Diffuse Thermal and Relativistic Plasma in Galaxy Clusters,” Ringberg, Germany, 1997–1999
Member, Scientific Organizing Committee, ASCA “Cherry Blossom” US-Japanese Conference on X-ray Astronomy, Washington, DC, 1997
Member, Review Panel on a New Science Strategy for Space Astronomy and Astrophysics, Space Studies Board, National Academy of Sciences, 1996–1997
Member, Scientific Organizing Committee, Conference on X-ray Imaging and Spectroscopy of Cosmic Hot Plasmas, Tokyo, 1996
Member, Scientific Organizing Committee, Conference on Cluster Cooling Flows, Israel, 1996
Member, Time Allocation Committee, Kitt Peak National Observatory, 1995
Member, NASA Long Term Space Astrophysics Review Panel, 1994
Member, Scientific Organizing Committee, Aspen Astrophysics Workshop on the Physics of Clusters of Galaxies, 1994.
Member, Scientific Organizing Committee, Moriond Astrophysics Conference on Clusters of Galaxies, 1994.
Chairman, NASA ASCA Extragalactic Review Panel, 1993.
Member, External Visiting Committee for Astronomy, University of Maryland, 1992.
Member, NASA ROSAT Review Panel, 1992.
Member, NASA Review Panel on High Energy Astrophysics Theory, 1991.

Member, Scientific Organizing Committee, NATO Advanced Study Workshop on Clusters and Superclusters of Galaxies, 1990–1991.
Chairman, Proposal Review Panel on Clusters of Galaxies for ROSAT, NASA, 1989.
Chairman, Scientific Organizing Committee, meeting on “Dark Matter in the Universe,” Southeastern Section, American Physical Society, 1989
Member, Committee on Space Astronomy and Astrophysics, Space Science Board, National Academy of Sciences, 1984–1988
Member, Scientific Organizing Committee, IAU. Colloquium 115 on High Resolution X-ray Spectroscopy of Cosmic Plasmas, 1988
Member, Scientific Organizing Committee, NATO Advanced Study Workshop on Cooling Flows in Galaxies and Clusters, 1987
Chairman, Scientific Organizing Committee, Institute for Advanced Study Workshop on X-ray Emission from Clusters of Galaxies, 1981

Committees: University

Member, Vice President for Research Internal Review Committee, 2016–2017
Member, Faculty of Arts & Sciences Nominating Committee, 2016–2017
Member, Committee for Research and Faculty Development, College of Arts and Sciences, 2014–
Member, Ad Hoc Promotions and Tenure Committee for Christopher Neu, Physics Department, 2013
Member, Ad Hoc Committee to Evaluate the Physics Chair, 2013
Member, Vice President for Research Internal Review Committee, 2008–2010
Member, Review Panel for FEST proposals, 2002
Member, Faculty Senate, University of Virginia, 1997–2001
Member, Promotions and Tenure Committee, College of Arts and Sciences, 1998–1999, 2000–2001
Member, Committee on Research and Scholarship, Faculty Senate, University of Virginia, 1997–1999
Chair, Ad Hoc Committee to Recommend Chair of Astronomy Department, College of Arts and Sciences, 1998
Member, Ad Hoc Subcommittee on a Faculty Center, Faculty Senate, University of Virginia, 1997–1998
Member, Ad Hoc Committee to Recommend Chair of Physics Department, College of Arts and Sciences, 1996
Member, Computing Committee, College of Arts and Sciences, 1992–1995
Member, Executive Committee, Faculty Forum for Scientific Research, 1991–1992
Member, Academic Computing Subcommittee, Committee on Information Technology and Communications, 1991–1992
Member, Faculty Forum for Scientific Research, 1988–1992
Member, Ad Hoc Subcommittee on Relocation of the Academic Computing Center, Committee on Information Technology and Communications, 1991–1992
Member, Academic Advisory Committee, College of Arts and Sciences, 1987–1992
Member, Advisory Committee, Institute of Nuclear and Particle Physics, Associate Provost for Research, 1987–1992
Member, University Computer Policy Committee, Associate Provost for Research, 1989–1991
Member, Selection Committee, Academic Computing Center Unix Computer Systems, Associate Provost for Research, 1990
Member, Ad Hoc Committee on a Faculty Grievance, College of Arts and Sciences, 1989–1990

Member, Subcommittee on Advanced Computing Resources, Computer Policy Committee,
1988–89
Member, ROTC Advisory Committee, 1978–79

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Grants as PI or Co-PI

Present

- National Aeronautics and Space Administration, Chandra Cycle 16, *The Burst Cluster: Dark Matter in the Merging Cluster Host of the Short Gamma-Ray Burst GRB050509B*, GO5-16131X, (U.VA. 149787-101-GG11880-31671), November 2014 – January 2018, \$64,220, PI
- National Aeronautics and Space Administration, XMM-Newton Cycle 13, *PKS B1400-33 and Abell S753: A Very Bright Radio Relic in a Poor Cluster*, NNX15AG26G, (U.VA. 148122-101-GP10186-31671), March 2015 - March 2017, \$59,651
- Virginia Space Grant Consortium, *Undergraduate Research Fellowship for Avery Bailey*, (U.Va. 148749-101-GG11848-31671), June 2015 – May 2016, \$3,000, PI.
- National Aeronautics and Space Administration, Chandra Cycle 16, *PKS B1400-33 and Abell S753: A Very Bright Radio Relic in a Poor Cluster*, GO5-16146 (U.Va. 150781-101-GG11912-31671), June 2015 – January 2018, \$47,434, PI
- National Aeronautics and Space Administration, XMM-Newton Cycle 14, *Origin of the SZ and Radio Structures in the Massive Clash Cluster MACS J1206*, NNX16AH23G, (U.VA. 153021-101-GP10197-31671), March 2016 - March 2017, \$53,284, PI
- National Aeronautics and Space Administration, XMM-Newton Cycle 15, *Merger Shocks and the Origin of the Large X-ray vs. SZ Discrepancy in Abell 611*, NNX17AC69G, (U.Va. 153943-101-GP10198-31671), November 2016 – November 2017, \$51,668, PI

Approved But No Funds Yet Received

- National Aeronautics and Space Administration, Chandra Cycle 18, *Radio Galaxies at the Crossroads: The Origin of X-Shaped Radio Sources and the Role of Supermassive Black Hole Mergers*, March 2017 – March 2019, \$39,300, PI

Past

- National Aeronautics and Space Administration, Hubble Cycle 18, *Deep Hubble Observations of NGC 1023: Testing the Origin of Low-Mass X-ray Binaries in a Lenticular Galaxy*, HST-GO-12202.01-A (U.Va. 138961-101-GG11498-31671 08/31/2014), September 2011 – August 2015, \$42,528, PI
- National Aeronautics and Space Administration, ADAP2012, *Discovering d'Artagnan: Determining the Properties of the Nearby Middle-Aged Pulsar PSR J1741–2054*, NNX13AE64G (U.VA. 142424-101-GP10176-31671), January 2013 – January 2016, \$79,890, PI
- National Aeronautics and Space Administration, Chandra Cycle 15, *Did Precessing Jets and/or a Merger Make a Diamond in Abell 2626?*, GO4-15123X (U.VA. 145101-101-GG11703-31671), October 2013 – January 2016, \$59,436, PI.
- Virginia Space Grant Consortium, *Undergraduate Research Fellowship for Adrian Mead*, (U.Va. 143497-101-GG11647-31671), June 2013 – May 2014, \$6,700, PI.
- National Aeronautics and Space Administration, Herschel Science Center, Herschel OT2, *Dust in the Wind: The Role of Dust in Ram-Pressure Stripped Gas and Intracluster Star Formation (Part II)*, NHSC RSA P12-78175, (U.VA. 138672-101-GG11478-31671), July 2012 – December 2014, \$44,000, PI
- National Aeronautics and Space Administration, Herschel Science Center, Herschel OT2, *Heating the cool gas filaments in NGC 1275*, NHSC RSA P12-78175, (U.VA. 138672-101-GG11478-31671), July 2012 – December 2014, \$5,000, PI
- National Aeronautics and Space Administration, Hubble Cycle 18, *A Hot X-Ray Tail from a Transforming Galaxy in A3627*, HST-GO-12372.03-A (U.Va. 138668-101-GG11477-31671), July 2011 – June 2014, \$18,775, PI
- National Aeronautics and Space Administration, Hubble Cycle 18, *AGN Heating and cooling in the Most Luminous Group Cool Core*, HST-GO-12373.03-A (U.Va. 138041-101-GG11433-31671), April 2011 – March 2014, \$18,800, PI
- National Aeronautics and Space Administration, Herschel Science Center, Herschel OT1, *Dust in the Wind: The Role of Dust in Ram-Pressure Stripped Gas and Intracluster Star Formation*, RSA 1437096 OT1_ssivanan_1 (U.Va. 138672-101-GG11478-31671), July 2011 – December 2013, \$47,332, PI
- National Aeronautics and Space Administration, Herschel Science Center, Herschel OT1, *Keeping the Cool Gas in Galaxy Clusters Warm*, RSA 1437096 OT1_wjaffe_1 (U.Va. 138672-101-GG11478-31671), July 2011 – December 2013, \$5,000, PI
- National Aeronautics and Space Administration, Chandra Cycle 10, *A Merger Shock Front Due to Subcluster Infall in Abell 2061?*, GO9-0148X (U.Va. 134576-101-GG11271-31671), November 2009 – November 2013, \$36,365, PI.
- National Aeronautics and Space Administration, Chandra Cycle 11 EPO, *Addressing the Science Education of Elementary School Students in Rural Albemarle County With a Mobile Planetarium* an E/PO grant associated with *Binary Formation in the Sparse Globular Cluster NGC 3201* and *Strong Shocks, Cavities, and AGN Heating in Galaxy Groups*, GO0-11049X (U.Va. 135232-101-GG11296-31671), March 2010 – November 2013, \$34,700, PI.
- National Aeronautics and Space Administration, Chandra Cycle 11 EPO, *Addressing the Nature of Science Through a Telescope Loaner Program for Teachers* an E/PO grant associated with *Constraining the Distance & Temperature of LAT PSR J1742–20, the Newly Discovered Nearby Middle-Aged Neutron Star*, GO0-11097X (U.Va. 135159-101-GG11292-31671), March 2010 – May 2013, \$13,775, PI.
- National Aeronautics and Space Administration, Chandra Cycle 11, *Constraining the Distance & Temperature of LAT PSR J1742–20, the Newly Discovered Nearby Middle-Aged Neutron Star*, GO0-11097X (U.Va. 135650-101-GG11292-31671), March 2010 – May 2013, \$34,610, PI.
- National Aeronautics and Space Administration, Chandra Cycle 11, *Binary Formation*

- in the Sparse Galactic Globular Cluster NGC 3021*, GO0-11049X (U.Va. 136785-101-GG11296-31671), March 2010 – September 2013, \$55,428, PI.
- National Aeronautics and Space Administration, ADP2010, *The Physics of Cosmic Shocks: An XMM-Newton Large Project to Observe the NW Merger Shock and Radio Relic in Abell 3667*, NNX11AD15G (U.Va. 137196-101-GP10161-31671), January 2011 – December 2013, \$124,564, PI
- National Aeronautics and Space Administration, Chandra Cycle 12, *Abell 665: Determining the Connection Between Cluster Dynamics and Radio Halos*, GO1-12169X (U.Va. 137274-101-GG11412-31671), January 2011 – January 2014, \$42,000, PI.
- National Aeronautics and Space Administration, Hubble Cycle 17, *Binary Formation in the Sparse Galactic Globular Cluster NGC 3021*, HST-GO-12012.02-A (U.Va. 135602-101-GG11310-31671), May 2010 – April 2013, \$8,972, PI
- National Aeronautics and Space Administration, Chandra Cycle 12, *A Hot X-Ray Tail from a Transforming Galaxy in A3627*, GO1-12103X (U.Va. 137294-101-GG11415-31671), January 2011 – January 2013, \$41,190, PI.
- National Aeronautics and Space Administration, Chandra Cycle 12, *AGN Heating and Cooling in the Most Luminous Group Cool Core*, GO1-12159A (U.Va. 137217-101-GG11403-31671), January 2011 – January 2013, \$40,189, PI.
- National Aeronautics and Space Administration, Chandra Cycle 11, *Strong Radio AGN in the Center of Galaxy Groups*, GO0-11008A, (U.Va. 139465-101-GG11517-31671), November 2011 – November 2012, \$77,994, PI.
- National Aeronautics and Space Administration, Herschel Science Center, Herschel KP-AO1, *Constraining the Cold Gas and Dust in Cluster Cooling Flows*, RSA 1373266 (U.Va. 132844-101-GG11187-31671), April 2009 – September 2012, \$52,034, PI
- National Aeronautics and Space Administration, Chandra Cycle 10, *Chandra Observations of Abell 3653, the Cluster with the Largest Known cD Peculiar Velocity*, GO9-0135X (U.Va. 133612-101-GG11195-31671), July 2009 – July 2012, \$40,680, PI.
- National Aeronautics and Space Administration, Hubble Cycle 17, *Probing the Globular Cluster / Low Mass X-ray Binary Connection in Early-type Galaxies at Low X-ray Luminosities*, HST-GO-11679.01 (U.Va. 135053-101-GG11286-31671), February 2010 – January 2012, \$39,936, PI
- National Aeronautics and Space Administration, Chandra Cycle 9, *Are the X-Ray Binaries in S0 Galaxies Different From Those in Ellipticals?*, GO8-9085X (U.Va. 129996-101-GG11033-31671), January 2008 – January 2012, \$73,639, PI.
- National Aeronautics and Space Administration, Chandra Cycle 9 EPO, *The Nature of Science: A Planetarium Show on Globular Clusters at the Science Museum of Virginia* an E/PO grant associated with *Are the X-Ray Binaries in S0 Galaxies Different From Those in Ellipticals?* and *The Nature of the Intermediate-Luminosity X-ray Sources in Globular Clusters*, GO8-9085X (U.Va. 129831-101-GG11033-31671 and 129859-101-GG11033-31671), January 2008 – January 2012, \$30,000, PI.
- National Aeronautics and Space Administration, Hubble Cycle 17, *Intracluster Star Formation and Galaxy Transformation: ESO 137-001 in A3627*, HST-GO-11683.01-A (U.Va. 133828-101-GG11242-31671), August 2009 – July 2011, \$14,630, PI
- National Aeronautics and Space Administration, XMM-Newton Cycle 8, *Building a Representative Sample of Local Galaxy Groups*, NNX09AQ01G (U.Va. 134027-101-GP10154-31671), August 2009 – August 2011, \$97,769, PI
- National Aeronautics and Space Administration, Chandra Cycle 10 EPO, *Addressing the Nature of Science Through a Telescope Loaner Program for Teachers*, an E/PO grant associated with *Chandra Observations of Abell 3653, the Cluster with the Largest Known cD Peculiar Velocity*, GO9-0135X (U.Va. 133043-101-GG11195-31671), April 2009 – April 2011, \$14,999, PI.
- National Aeronautics and Space Administration, Suzaku Cycle 3, *Hard X-ray Inverse Compton Emission from the Radio Relic and the Dynamics of the Merging Subgroup in the*

- Coma Cluster*, NNX09AH74G (U.Va. 132918-101-GP10149-31671), April 2009 – April 2011, \$16,133, PI
- National Aeronautics and Space Administration, Suzaku Cycle 3, *Properties of the Merger and Radio Source Interaction in the Cygnus A Cluster*, NNX09AH25G (U.Va. 132857-101-GP10148-31671), April 2009 – April 2011, \$8,995, PI
- National Aeronautics and Space Administration, Chandra Cycle 08, *X-ray Thermal Coronae of Early-Type Galaxies in Hot Clusters*, GO7-8089A (U.Va. 131909-101-GG11143-31671), March 2009 – March 2011, \$40,531, PI.
- National Aeronautics and Space Administration, XMM Cycle 7, *The High-Mass X-ray Binaries V0332+53, 4U0115+63, and A0535+262 in Quiescence*, NNX09AG25G (U.Va. 133505-101-GP10150-31671), March 2009 – March 2011, \$23,300, PI.
- National Aeronautics and Space Administration, Chandra Cycle 8, *Deep Chandra and Hubble Observations of NGC 1023: Testing the Origin of Low-Mass X-ray Binaries in a Lenticular Galaxy*, GO7-8089X (U.Va. 131909-101-GG11143-31671), October 2008 – March 2011, \$58,478, PI
- National Aeronautics and Space Administration, Suzaku Cycle 3, *PKS B1400-33 and Abell S753: A Very Bright Radio Relic in a Poor Cluster*, NNX08AZ99G (U.Va. 131349-101-GP10138-31671), September 2008 – February 2011, \$23,361, PI
- National Aeronautics and Space Administration, Chandra Cycle 9, *The Nature of the Intermediate-Luminosity X-ray Sources in Globular Clusters*, GO8-9053X (U.Va. 129566-101-GG11021-3167), January 2008 – January 2011, \$46,120, PI.
- National Aeronautics and Space Administration, Chandra Cycle 10, *Searching for Millisecond Pulsars in Extremely Low-Mass White Dwarf Binaries*, GO9-0033X (U.Va. 132360-101-GG11168-31671), January 2009 – January 2011, \$21,518, PI.
- National Aeronautics and Space Administration, Chandra Cycle 8, *Abell 119: Cluster Mergers and the Origin of Narrow-Angle-Tail Radio Galaxies*, GO7-8129X (U.Va. 129089-101-GG10994-31671), September 2007 – September 2010, \$36,200, PI.
- National Aeronautics and Space Administration, Chandra Cycle 8, *The Halo Structure of RCS2-2327.4-0204*, GO7-8135X (U.Va. 128945-101-GG10983-31671), August 2007 – August 2010, \$23,000, PI.
- Virginia Space Grant Consortium, *Thermal and Non-Thermal Effects of Cluster Mergers: Graduate Fellowship for Daniel Wik*, (U.Va. 128155-101-GG10943-31670, 130303-101-GG11056-31671, 133152-101-GG11207-31671), June 2007 – August 2010, \$15,000, PI.
- National Aeronautics and Space Administration, XMM-Newton Cycle 7, *XMM-Newton Observation of the NW Merger Shock and Radio Relic in Abell 3667*, NNX08AZ34G (U.Va. 131158-101-GP10132-31671), July 2008 – July 2010, \$55,000, PI
- National Aeronautics and Space Administration, XMM-Newton Cycle 7, *Searching for Millisecond Pulsars in Extremely Low-Mass White Dwarf Binaries*, NNX08AX24G (U.Va. 131274-101-GP10136-31671), July 2008 – July 2010, \$51,500, PI
- National Aeronautics and Space Administration, XMM-Newton Cycle 7, *Abell 2063: The Physics of Cooling Flow Clusters with Central Radio Sources*, NNX08AW83G (U.Va. 131309-101-GP10137-31671), July 2008 – July 2010, \$50,000, PI
- National Aeronautics and Space Administration, Suzaku Cycle 2, *A Suzaku Snapshot Survey of High-Redshift Galaxy Clusters from the RCS Survey*, NNX08AI27G (U.Va. 129944-101-GP10127-31671), March 2008 – March 2010, \$19,667, PI.
- National Aeronautics and Space Administration, Chandra Cycle 9, *ESO 137-001 in A3627: ISM Stripping and Intracluster X-ray Binaries*, GO8-9083X (U.Va. 131030-101-GG11104-31671), June 2008 – June 2010, \$67,540, PI.
- National Aeronautics and Space Administration, GALEX Cycle 3, *Measuring Star Formation Rates in Clusters of Galaxies with GALEX*, NNX07AJ38G (U.Va. 128078-101-GP10122-31671), June 2007 – June 2009, \$83,999, PI.
- National Aeronautics and Space Administration, Chandra Cycle 8, *The Galactic Generation-X: The First Study of the X-ray Properties of Massive E+A Galaxies*, GO7-8078X

- (U.Va. 128167-101-GG10946-31671), March 2007 – May 2010 \$41,272, PI.
- National Aeronautics and Space Administration, Hubble Cycle 14, *Resolving the Connection Between Globular Clusters and Low-Mass X-ray Binaries*, HST-GO-10597.03 (U.Va. 124340-101-GG10759-31671), November 2005 – October 2009, \$17,292, PI.
- National Aeronautics and Space Administration, Chandra Cycle 8, *Generating a Homogeneous Library of Isolated Binary Galaxy Cluster Mergers — Applications to Dark Energy Surveys*, TM7-8010X (U.Va. 127502-101-GG10904-31671), January 2007 – January 2009, \$44,000, PI.
- National Aeronautics and Space Administration, Chandra Cycle 8, *Solving the Cooling Flow Mystery: Understanding Variations in Star Formation Efficiency Using the Chandra Archive*, AR7-8012X (U.Va. 127605-101-GG10910-31671), January 2007 – January 2009, \$65,000, PI.
- National Aeronautics and Space Administration, Chandra Cycle 8, *A High Resolution Model of Interstellar Absorption*, TM7-8011A (U.Va. 127410-101-GG10898-31671), January 2007 – January 2009, \$30,541, PI.
- National Aeronautics and Space Administration, Chandra Cycle 8, *A High Resolution Model of Interstellar Absorption*, TM7-8011A (U.Va. 127410-101-GG10898-31671), January 2007 – January 2009, \$30,541, PI.
- National Aeronautics and Space Administration, Chandra Cycle 7, *A High Resolution Study of Interstellar Absorption*, GO6-7133X (U.Va. 127202-101-GG10889-31671), December 2006 – December 2008, \$61,107, PI.
- National Aeronautics and Space Administration, Hubble Cycle 15, *Probing the Globular Cluster / Low Mass X-ray Binary Connection in Early-type Galaxies at Low X-ray Luminosities*, HST-GO-10835.01-A (U.Va. 127433-101-GG10901-31671), December 2006 – December 2008, \$39,951 PI.
- National Aeronautics and Space Administration, XMM Cycle 5, *The Local Galaxy Cluster Mass Function of the Brightest Clusters in the Sky - I*, NNX06AE76G (U.Va. 127504-101-GP10120-3167), September 2006 – August 2008, \$40,044, PI.
- National Aeronautics and Space Administration, XMM Cycle 5, *Mass Constraints on High Redshift Clusters of Galaxies with XMM-Newton*, NNX06AE75G (U.Va. 127447-101-GP10118-31671), September 2006 – August 2008, \$55,418, PI.
- National Aeronautics and Space Administration, Suzaku Cycle 1, *Hard X-ray Inverse Compton Emission and a Merger Shock Associated with the Brightest Known Radio Relic in Abell 3667*, NNX06AI37G (U.Va. 126822-101-GP10116-31671), September 2006 – September 2008, \$42,560, PI.
- National Aeronautics and Space Administration, Suzaku Cycle 1, *Nailing Down the Hard X-ray Inverse Compton Emission from the Radio Halo in the Coma Cluster*, NNX06AI44G (U.Va. 127501-101-GP10119-31671), September 2006 – September 2008, \$51,401, PI.
- National Aeronautics and Space Administration, XMM Cycle 5, *Understanding Gas Interactions in Groups: NGC 1600*, NNX06AE78G (U.Va. 126314-101-GP10115-31671). August 2006 – July 2008, \$64,366, PI.
- National Aeronautics and Space Administration, Hubble Cycle 14, *Probing The Galaxy-wide Globular Cluster — Low Mass X-ray Binary Connection in Early-type Galaxies*, HST-GO-10582.02 (U.Va. 124877-101-GG10782-31671), December 2005 – November 2008, \$47,946, PI.
- National Aeronautics and Space Administration, XMM Cycle 4, *The Physics of Cooling Flow Clusters with Central Radio Sources*, NNG06GD54G (U.Va. 124992-101-GP10110-31671), February 2006 – February 2008, \$43,400, PI.
- National Aeronautics and Space Administration, XMM Cycle 4, *The Local Galaxy Cluster Mass Function of the Brightest Clusters in the Sky*, NNG05GO50G (U.Va. 124073-101-GP10103-31671), August 2005 – August 2007, \$36,800, PI.
- National Aeronautics and Space Administration, Chandra Cycle 6, *Low Mass X-ray Binaries and Globular Clusters in the Early-Type Galaxy NGC 4365*, CXC GO5-6086X

- (U.Va. 122627-101-GG10021-31671), May 2005 – May 2007, \$71,179, PI.
- National Aeronautics and Space Administration, Chandra Cycle 6, *Stellar Mass Loss Versus External Accretion in the X-ray Bright Elliptical NGC 5813*, CXC GO5-6081X, (U.Va. 123075-101-GG10275-31671), April 2005 – April 2007, \$33,940, PI.
- National Aeronautics and Space Administration, Chandra Cycle 6, *The Interaction between Cluster Central Radio Sources and Cooling Flows*, CXC GO5-6126X (U.Va. 123008-101-GG10302-31671), March 2005 – March 2007, \$31,899, PI.
- National Aeronautics and Space Administration, Chandra Cycle 6 EPO, *Stellar Evolution Planetarium Show at the Science Museum of Virginia*, an E/PO grant associated with *Low Mass X-ray Binaries and Globular Clusters in the Early-Type Galaxy NGC 4365*, CXC GO5-6086X (U.Va. 122627-101-GG10021-31671), January 2005 – December 2006, \$26,155, PI.
- National Aeronautics and Space Administration, Chandra Cycle 5, *Filamentary Radio Relics in Clusters of Galaxies: Radio Bubbles or Merger Shocks?*, GO4-5133X (U.Va. 122091-101-GG10663-31671), September 2004 – September 2006, \$43,450, PI.
- National Aeronautics and Space Administration, XMM Cycle 3, *Abell 520: A Complex Merging Cluster with an Unusual Radio Halo*, NNG05GA34G (U.Va. 122124-101-GP10090-31671) September 2004 – September 2006, \$44,000, PI.
- National Aeronautics and Space Administration, XMM Cycle 3, *The Complex Dynamics of the Thermal and Nonthermal Intracluster Gas*, NNG04GP46G (U.Va. 121776-101-GP10087-31671), September 2004 – August 2006, \$41,600, PI.
- National Aeronautics and Space Administration, XMM Cycle 3, *X-Ray Emission from Filamentary Radio Relics & Mergers in Clusters of Galaxies*, NNG04GO34G (U.Va. 121658-101-GP10085-31671), August 2004 – August 2006, \$8,400, PI.
- National Aeronautics and Space Administration, XMM Cycle 3, *The Physics of Cooling Flow Clusters with Central Radio Sources*, NNG04GO80G (U.Va. 121695-101-GP10086-31671), August 2004 – August 2006, \$38,300, PI.
- Virginia Space Grant Consortium, *Chandra X-ray Observations X-ray Binaries in Elliptical Galaxies: Graduate Fellowship for Greg Sivakoff*, (U.Va. 121318-101-GG10630-31670), August 2004 – May 2006, \$10,000, PI.
- National Aeronautics and Space Administration, Chandra X-ray Center, *Formation, Evolution, and Dynamics of Compact Objects in the Galaxy: Chandra Postdoctoral Fellowship for Dr. Eric D. Pfahl*, CXC PF4-50024 (U.Va. 121370-101-GG10635-31671), August 2004 - July 2005, \$101,693, PI.
- National Aeronautics and Space Administration, Chandra Cycle 5, *Chandra Observations of Galaxy Clusters with Large cD Galaxy Peculiar Velocities*, GO4-5137X (U.Va. 121007-101-GG10616-31671), May 2004 – May 2006, \$47,567, PI.
- National Aeronautics and Space Administration, Hubble Cycle 12, *Deep Chandra and Hubble Observations NGC 4697, the Nearest Optically Luminous, X-ray Faint Elliptical Galaxy*, HST-GO-10003.01-A (U.Va. 120552-101-GG10606-31671), February 2004 – January 2007, \$8,959, PI.
- National Aeronautics and Space Administration, Chandra Cycle 4, *Low Mass X-ray Binaries and Globular Clusters in Virgo Early-Type Galaxies*, CXC GO3-4099X (U.Va. 118198-101-GG10505-31671), November 2002 – November 2005, \$40,513, PI.
- National Aeronautics and Space Administration, Chandra Cycle 4 E/PO, *Black Holes, Seeing the Unseeable: A Planetarium Show at the Science Museum of Virginia*, an E/PO grant associated with *Low Mass X-ray Binaries and Globular Clusters in Virgo Early-Type Galaxies*, CXC GO3-4099X (U.Va. 118198-101-GG10505-31671), November 2002 – November 2005, \$14,995, PI.
- National Aeronautics and Space Administration, XMM Cycle 2, *Stellar Mass Loss Versus External Accretion in X-ray Bright Ellipticals*, NAG5-13645 (U.Va. 119815-101-GP10075-31671), September 2003 – September 2005, \$38,000, PI.
- National Aeronautics and Space Administration, XMM Cycle 2, *Radio Halos and Relics and*

- Merger Shocks in Clusters of Galaxies*, NAG5-13737 (U.Va. 119932-101-GP10077-31671), September 2003 – September 2005, \$36,000, PI.
- National Aeronautics and Space Administration, Chandra Cycle 5, *Using the Chandra Archive To Study Low Mass X-ray Binaries & Globular Clusters in Virgo & Non-Virgo Early-Type Galaxies*, AR4-5008X (U.Va. 120344-101-GG10591-31671), January 2004 – January 2006, \$30,520, PI.
- National Aeronautics and Space Administration, Chandra Cycle 5, *Deep Chandra and Hubble Observations NGC 4697, the Nearest Optically Luminous, X-ray Faint Elliptical Galaxy*, GO4-5093X (U.Va. 120375-101-GG10593-31671), January 2004 – January 2006, \$74,399, PI.
- National Aeronautics and Space Administration, Chandra Cycle 5, *What Bends the Lobes of WAT Radio Sources in Isolated Environments - Are They in Fossil Groups?*, GO4-5150X (U.Va. 120345-101-GG10592-31671), January 2004 – January 2006, \$49,470, PI.
- National Aeronautics and Space Administration, Chandra Cycle 5, *The HIFLUGCS Cluster Survey: A Cornerstone for Cosmology*, GO4-5132X (U.Va. 120417-101-GG10596-31671), January 2004 – January 2006, \$50,744, PI.
- National Aeronautics and Space Administration, Chandra Cycle 5, *Probing the Complex Structure in the Core of Abell 2029*, GO4-5149X (U.Va. 120424-101-GG10597-31671), January 2004 – January 2006, \$42,199, PI.
- National Aeronautics and Space Administration, Chandra Cycle 4, *The HIFLUGCS Cluster Survey: A Cornerstone for Cosmology*, GO3-4160X (U.Va. 118642-101-GG10523-31671), March 2003 – March 2005, \$97,279, PI.
- National Aeronautics and Space Administration, Chandra Cycle 4, *A High Redshift ($z = 0.95$) Cluster Revealed by a FIRST Bent-Double Radio Source*, GO3-4155X (U.Va. 118727-101-GG10525-31671), March 2003 – March 2005, \$28,515, PI.
- National Aeronautics and Space Administration, XMM Cycle 2, *The Origin of the Disturbed Cool Core and Filamentary Radio Source in Abell 133*, NAG5-13088 (U.Va. 118567-101-GP10068-31671), March 2003 – March 2005, \$38,000, PI.
- National Aeronautics and Space Administration, XMM Cycle 2, *The Physics of Cooling Flow Clusters with Central Radio Sources*, NAG5-13089 (U.Va. 118570-101-GP10069-31671), March 2003 – March 2005, \$38,000, PI.
- National Aeronautics and Space Administration, Chandra Cycle 3, *The Interaction Between Cluster Central Radio Sources and Cooling Flows*, GO2-3160X (U.Va. 118403-101-GG10515-31671), February 2003 – February 2005, \$29,064, PI.
- National Aeronautics and Space Administration, Chandra Cycle 3 E/PO, *The Largest Structures in the Universe: Exhibits for the McCormick Observatory E/PO Program*, an E/PO grant associated with *The Interaction Between Cluster Central Radio Sources and Cooling Flows*, GO2-3160X (U.Va. 118403-101-GG10516-31671), February 2003 – February 2005, \$9,995, PI.
- National Aeronautics and Space Administration, Chandra Cycle 4, *The HIFLUGCS / Chandra Archive Cluster Survey: A Cornerstone for Cosmology*, CXC AR3-4014X (U.Va. 118245-101-GG10510-31671), December 2002 – December 2004, \$28,000, PI.
- National Aeronautics and Space Administration, Chandra Cycle 4, *Low Mass X-ray Binaries and Globular Clusters in Virgo and Non-Virgo Early-Type Galaxies from the Chandra Archive*, CXC AR3-4005X (U.Va. 118256-101-GG10511-31671), December 2002 – December 2004, \$38,000, PI.
- National Aeronautics and Space Administration, Chandra Cycle 3, *Resolving the X-Ray Binary Population in Early-Type Galaxies*, CXC GO2-3099X (U.Va. 118034-101-GG10498-31671), November 2002 – November 2004, \$34,200, PI.
- National Aeronautics and Space Administration, Chandra Cycle 3, *Merger Shocks in Clusters of Galaxies*, CXC GO2-3159X (U.Va. 117485-101-GG10480-31671), August 2002 – August 2004, \$40,305, PI.
- National Aeronautics and Space Administration, Chandra Cycle 3 EPO, *Space Travels: A*

- New Component on X-ray Astronomy for the Science Museum of Virginia's Traveling Exhibition and Program for Schools and Communities*, an E/PO grant associated with *Stellar Mass Loss Versus External Accretion in X-ray Bright Ellipticals*, CXC GO2-3100X (U.Va. 117269-101-GG10483-31671), August 2002 – August 2004, \$9,995, PI.
- National Aeronautics and Space Administration, Chandra Cycle 3, *Stellar Mass Loss Versus External Accretion in X-ray Bright Ellipticals*, CXC GO2-3100X (U.Va. 117269-101-GG10473-31671), August 2002 – August 2004, \$66,068, PI.
- National Aeronautics and Space Administration, Chandra Cycle 5, *The Formation of Wide-Angle Tailed Radio Sources: Interaction Between the Radio Lobes and the Intracluster Medium*, March 2004 – August 2004, \$37,417, PI, transferred to Dr. Elizabeth Blanton at Boston University when she left U.Va.
- National Aeronautics and Space Administration, Chandra X-ray Center, *The Interactions between Radio Lobes and X-ray Gas in Clusters and Groups: Chandra Postdoctoral Fellowship for Dr. Elizabeth L. Blanton*, CXC PF1-20017 (U.Va. 114060-101-GG10355-89898) August 2001 - July 2004, \$229,282, PI.
- Virginia Space Grant Consortium, *X-ray Observations of Elliptical Galaxies: Graduate Fellowship for Scott Randall*, (U.Va. 116869-101-GG10454-3167), June 2002 – May 2004, \$10,000, PI.
- National Aeronautics and Space Administration, XMM Cycle 1, *Merger Shocks in Clusters of Galaxies*, NAG5-10075 (U.Va. 5-28810) November 2000 – November 2003, \$38,700, PI.
- National Aeronautics and Space Administration, XMM Cycle 1, *Stellar Mass Loss Versus External Accretion in X-ray Bright Ellipticals*, NAG5-10074 (U.Va. 5-28811), November 2000 – November 2003, \$40,000, PI.
- National Aeronautics and Space Administration, Chandra Cycle 2, *The Interaction between Cluster Central Radio Sources and Cooling Flows*, CXC GO1-2133X (U.Va. 5-28846), May 2001 – May 2003, \$59,501, PI.
- National Aeronautics and Space Administration, Chandra Cycle 2, *Merger Shocks in Clusters of Galaxies*, CXC GO1-2123X (U.Va. 5-28845), May 2001 – May 2003, \$59,885, PI.
- National Aeronautics and Space Administration, Chandra Cycle 2, *Resolving the X-ray Binary Population in Early-Type Galaxies*, CXC GO1-2078X (U.Va. 5-28847), June 2001 – June 2003, \$54,700, PI.
- National Aeronautics and Space Administration, Chandra Cycle 2, *Filamentary Radio Relics and Mergers in Clusters of Galaxies*, CXC GO1-2122X (U.Va. 5-28819), October 2000 – October 2001, \$52,987, PI.
- National Aeronautics and Space Administration, Chandra Cycle 1, *The Interaction Between Cluster Central Radio Sources and Cooling Flows*, CXC GO0-1158X (U.Va. 5-28821), September 2000 – September 2001, \$45,835, PI.
- National Aeronautics and Space Administration, Chandra Cycle 1, *Subcluster Mergers, Radio Relics, and the Cooling Flow in Abell 85*, CXC GO0-1173X (U.Va. 5-28807), August 2000 – August 2001, \$47,480, PI.
- National Aeronautics and Space Administration, Applied Information Systems (subcontract through NCSU), *Nonequilibrium Effects and Shock Models*, NAG5-9490 (U.Va. 5-28779), July 2000 – July 2001, \$19,381
- National Aeronautics and Space Administration, Chandra Cycle 1, *Stellar Mass Loss Versus External Accretion in X-ray Bright Ellipticals*, CXC GO0-1141X (U.Va. 5-28781) May 2000 – May 2001, \$45,064, PI.
- National Aeronautics and Space Administration, Chandra Cycle 1, *Resolving the Mystery of X-Ray Faint Elliptical Galaxies*, CXC GO0-1019X (U.Va. 5-28764), March 2000 – March 2001, \$59,841, PI.
- National Aeronautics and Space Administration, ADP, *Cooling Gas, Cold Gas, and the Dynamical History of Clusters of Galaxies*, NAG 5-8390 (U.Va. 5-28717), March 1999 –

- March 2000, \$19,927, PI.
- National Aeronautics and Space Administration, ATP, *Dynamics and Emission of Hot Astrophysical Plasmas*, NAG 5-3057, September 1995 – September 1999, \$288,000, PI.
- National Aeronautics and Space Administration, ASCA, *Cluster Dark Matter Density Profiles at Very Large Radii, X-Ray Spectra of Cluster Cooling Flows: Spectral Evidence for Cooling and Cold Gas*, and *An ASCA Observation of the Rich cD Cluster A2107 in the Center of the Hercules Supercluster*, NAG 5-4516, September 1997 – August 1999, \$48,300, PI.
- National Aeronautics and Space Administration, ASCA, *X-Ray Spectra of Cluster Cooling Flows with Excess Absorption: Spectral Diagnostics for Cooling and Cold Gas, X-Ray Spectra of Elliptical Galaxies: Gas Dynamics, Chemical Evolution, and Missing Mass, The X-Ray Spectrum of Triangulum Australis: Probing the High Luminosity Tail of X-Ray Clusters, Mapping the Temperature Structure of Almost Relaxed Clusters, X-Ray Spectra of the Hercules Cluster – The Interaction of Intracluster Gas, Gas Stripping, and Radio Plasma*, and *B2 1028+313 and Abell 1030: A Quasar in the Center of a Cluster Cooling Flow*, NAG 5-2526, March 1994 – March 1998, \$243,689, PI.
- National Aeronautics and Space Administration, ROSAT, *Twilight of the Gods: The Massive, Long Period, Accreting Binary VV Cephei Enters Eclipse*, NAG 5-4787, July 1997 – June 1998, \$6,400, PI.
- National Aeronautics and Space Administration, ROSAT, *B2 1028+313 and Abell 1030: A Quasar in the Center of a Cluster Cooling Flow*, NAG 5-3308, August 1996 – January 1998, \$7,600, PI.
- National Aeronautics and Space Administration, ROSAT, *Cooling Flow Clusters with Evidence for Star Formation and/or Cool Gas, The Nature of the X-Ray Filaments in Cluster Cooling Flows, A High Resolution Study of X-ray Emission from Bright Elliptical Galaxies, NGC 7144: A Non-Cluster Elliptical with a Massive Dark Halo?, Filaments and Cool Gas in Cluster Cooling Flows*, and *Aligned Radio, Optical, and X-ray Structures in Clusters of Galaxies*, NAG 5-1891, February 1992 – August 1996, \$128,000, PI.
- National Aeronautics and Space Administration, ATP, *Emission Processes and Dynamics of Hot Gases in Astrophysics*, NAGW-2376, February 1991 – July 1996, \$587,500, Co-PI.
- National Aeronautics and Space Administration, ROSAT, *Cooling Flow Clusters with Evidence for Star Formation and/or Cool Gas*, and *A Detailed Study of the X-ray Emission from Bright Elliptical Galaxies*, NAG 5-1577, January 1991 – November 1992, \$83,000, PI.
- National Aeronautics and Space Administration, *Emission Processes and Dynamics of Hot Gases in Astrophysics*, NAGW-764, March 1988 – February 1991, \$555,000, Co-PI.
- National Aeronautics and Space Administration, *Emission Processes and Dynamics of Hot Gases in Astrophysics*, NAGW-764, July 1985 – February 1988, \$480,000, Co-PI.
- National Science Foundation, *Emission from Plasmas in Supernovae, Quasars, and Clusters of Galaxies*, AST 81-20260, July 1984 – January 1987, \$69,954, PI.
- National Science Foundation, *Ionized Gas in Galaxies and Clusters of Galaxies*, AST 81-20260, May 1982 – October 1984, \$42,000, PI.
- National Aeronautics and Space Administration, *X-ray Observations of Southern High Red-shift Clusters*, NAG-8308, February 1980 – February 1982, \$3,398, PI.
- National Aeronautics and Space Administration, *X-ray Observations of M51 and M81 – the Dynamics of Spiral Galaxies*, NAS8-33348, May 1979 – October 1981, \$2,000, PI.

Pending

Approved Grants But Funds Withdrawn Due to Satellite Failure

- National Aeronautics and Space Administration, Astro-E2 Cycle 1, *Properties of the Merger and Radio Source Interaction in the Cygnus A Cluster*, January 2006 – January 2008, \$37,841, PI.
- National Aeronautics and Space Administration, Astro-E2 Cycle 1, *Resolving the Iron Absorption Lines in the X-ray Dipper 4U 1916–05*, January 2006 – January 2008, \$33,852, PI.
- National Aeronautics and Space Administration, Astro-E Cycle 1, *Subcluster Mergers, Radio Relics, and the Cooling Flow in Abell 85*, June 1999 – June 2001, \$62,194, PI.
- National Aeronautics and Space Administration, Astro-E Cycle 1, *High Resolution X-Ray Spectra of Cluster Cooling Flows: Spectral Evidence for Cooling and Cold Gas*, June 1999 – June 2001, \$38,484, PI.
- National Aeronautics and Space Administration, Astro-E Cycle 1, *Properties of the Merger and Cooling Flow in the Cygnus A Cluster*, June 1999 – June 2001, \$67,691, PI.

Allocated Observing Time as PI

- European Space Agency, XMM-Newton Cycle 16, *Probing the Merger in ACT-CL J0256.5+0006: Understanding Low-Power Radio Halos*, 2017, 93,000 seconds, PI
- National Aeronautics and Space Administration, Chandra Cycle 18, *Radio Galaxies at the Crossroads: The Origin of X-Shaped Radio Sources and the Role of Supermassive Black Hole Mergers*, 2017, 55,000 seconds, PI
- European Space Agency, XMM-Newton Cycle 15, *Merger Shocks and the Origin of the Large X-ray vs. SZ Discrepancy in Abell 611*, 2016, 87,000 seconds, PI
- European Space Agency, XMM-Newton Cycle 14, *Origin of the SZ and Radio Structures in the Massive CLASH Cluster MACS J1206*, 2015, 126,000 seconds, PI
- National Aeronautics and Space Administration, Chandra Cycle 16, *PKS B1400-33 and Abell S753: A Very Bright Radio Relic in a Poor Cluster*, 2014, 94,000 seconds, PI
- National Aeronautics and Space Administration, Chandra Cycle 16, *The Burst Cluster: Dark Matter in the Merging Cluster Host of the Short Gamma-Ray Burst GRB050509B*, 2014, 210,000 seconds, PI
- National Radio Astronomy Observatory, JVLA, *PKS B1400-33 and Abell S753: A Very Bright Radio Relic in a Poor Cluster*, 2014, 28,800 seconds, PI
- National Aeronautics and Space Administration, Chandra Cycle 15, *Did Precessing Jets and/or a Merger Make a Diamond in Abell 2626?*, 2014, 120,000 seconds, PI.
- European Space Agency, XMM Cycle 13, *PKS B1400-33 and Abell S753: A Very Bright Radio Relic in a Poor Cluster*, 2014, 136,000 seconds, PI
- National Aeronautics and Space Administration, NuStar, *PKS B1400-33 and Abell S753: A Very Bright Radio Relic in a Poor Cluster*, 2014, 120,000 seconds, PI
- National Aeronautics and Space Administration, Chandra Cycle 15, *Did Precessing Jets and/or a Merger Make a Diamond in Abell 2626?*, 2014, 120,000 seconds, PI
- European Space Agency, XMM Cycle 12, *Merger Activity and Radio Emission Within and Between Abell 2061 and 2067*, 2013, 45,000 seconds, PI
- European Space Agency, XMM Cycle 12, *The Burst Cluster: Dark Matter in the Merging Cluster Host of the Short GRB050509B*, 2013, 132,000 seconds, PI
- National Radio Astronomy Observatory, EVLA 2013A, *Is the Diffuse Radio Source in Abell 2061 a USS Cluster Halo, Relic, or Hybrid?*, 2013, 57,600 seconds, PI
- European Space Agency, XMM Cycle 11, *Constraining the X-ray Spectral and Timing Characteristics of PSR J1741-2054*, 2012, 72,000 seconds, PI.
- European Space Agency, XMM Cycle 11, *Are All ULXs Created Equal? The Globular Cluster ULX in the S0 Galaxy NGC 1380*, 2012, 97,000 seconds, PI.
- European Space Agency, XMM Cycle 11, *Abell 3653 and the Origin of Large cD Peculiar Velocities*, 2012, 58,000 seconds, PI.
- National Aeronautics and Space Administration, Chandra Cycle 13, *A Powerful Outburst in the Enigmatic Cluster RX J0334.2-0111?*, 2012, 68,000 seconds, PI.
- National Aeronautics and Space Administration, Chandra Cycle 13, *X-raying the Spectacular Star-Forming Trail Behind IC 3418*, 2012, 35,000 seconds, PI.
- Chandra Cycle 12, *A Hot X-Ray Tail from a Transforming Galaxy in A3627*, 2011, 95,000 seconds, PI.
- Chandra Cycle 12, *AGN Heating and Cooling in the Most Luminous Group Cool Core*, 2011, 89,000 seconds, PI.
- Chandra Cycle 12, *Abell 665: Determining the Connection Between Cluster Dynamics and Radio Halos*, 2011, 100,000 seconds, PI.
- Hubble Cycle 18, *A Hot X-Ray Tail from a Transforming Galaxy in A3627*, 2011, 3 orbits, PI.
- Hubble Cycle 18, *AGN Heating and cooling in the Most Luminous Group Cool Core*, 2011, 3 orbits, PI.

Hubble Cycle 18, *Deep Hubble Observations of NGC 1023: Testing the Origin of Low-Mass X-ray Binaries in a Lenticular Galaxy*, 2011, 8 orbits, PI.

NRAO EVLA 2011, *AGN Heating and cooling in the Most Luminous Group Cool Core*, 2011, 43,200 seconds, PI.

Suzaku Cycle 5, *Understanding the Physics Around the Cluster Virial Radius*. 2010, 244,000 seconds, PI.

XMM Cycle 9, *The Physics of Cosmic Shocks: The NW Merger Shock and Radio Relic in Abell 3667*, 2009, 331,000 seconds, PI.

XMM Cycle 9, *The Double Relic Cluster Abell 2345: A Dramatic Off-Axis Merger*, 2009, 56,000 seconds, PI.

Chandra X-ray Observatory Cycle 11, *Strong Radio AGN in the Center of Galaxy Groups*, 2009, 156,000 seconds, PI.

Chandra X-ray Observatory Cycle 11, *Strong Shocks, Cavities, and AGN Heating in Galaxy Groups*, 2009, 109,000 seconds, PI.

Chandra X-ray Observatory Cycle 11, *Binary Formation in the Sparse Galactic Globular Cluster NGC 3201*, 2009, 85,000 seconds, PI.

Chandra X-ray Observatory Cycle 11, *Constraining the Distance & Temperature of LAT PSR J1742–20, the Newly Discovered Nearby Middle-Aged Neutron Star*, 2009, 50,000 seconds, PI.

Hubble Space Telescope Cycle 17, *Binary Formation in the Sparse Galactic Globular Cluster NGC 3201*, 2009, 1 orbit, PI.

NRAO VLA Observatory, *Strong Shocks, Cavities, and AGN Heating in Galaxy Groups*, 2009, 11 hours, PI.

NRAO GBT Observatory, *Binary Formation in the Sparse Galactic Globular Cluster NGC 3201*, 2009, 1 hour, PI.

XMM-Newton X-ray Observatory Cycle 8, *Building a Representative Sample of Local Galaxy Groups*, 2008, 330,000 seconds, PI.

XMM-Newton X-ray Observatory Cycle 8, *Unraveling the Dynamical States of Abell 2345 and 2254*, 2008, 61,000 seconds, PI.

XMM-Newton X-ray Observatory Cycle 8, *The Connection of X-ray Tails and HI Tails of Late-Type Cluster Galaxies*, 2008, 140,000 seconds, PI.

Chandra X-ray Observatory Cycle 10, *Searching for Millisecond Pulsars in Extremely Low-Mass White Dwarf Binaries*, 2008, 28,200 seconds, PI.

Chandra X-ray Observatory Cycle 10, *Chandra Observations of Abell 3653, the Cluster with the Largest Known *cD* Peculiar Velocity*, 2008, 47,000 seconds, PI.

Chandra X-ray Observatory Cycle 10, *A Merger Shock Front Due to Subcluster Infall in Abell 2061?*, 2008, 32,000 seconds, PI.

Hubble Space Telescope Cycle 17, *Probing the Globular Cluster / Low Mass X-ray Binary Connection in Early-type Galaxies at Low X-ray Luminosities*, 2008, 6 orbits, PI.

Suzaku X-ray Observatory Cycle 3, *PKS B1400-33 and Abell S753: A Very Bright Radio Relic in a Poor Cluster*, 2008, 120,000 seconds, PI.

Suzaku X-ray Observatory Cycle 3, *Hard X-ray Inverse Compton Emission from the Radio Relic and the Dynamics of the Merging Subgroup in the Coma Cluster*, 2008, 161,000 seconds, PI.

Suzaku X-ray Observatory Cycle 3, *Properties of the Merger and Radio Source Interaction in the Cygnus A Cluster*, 2008, 45,000 seconds, PI.

Suzaku X-ray Observatory Cycle 3, *Understanding Physics At And Beyond The Cluster Virial Radius*, 2008, 110,000 seconds, PI.

XMM/Newton X-ray Observatory, ESA, Cycle 7, *XMM-Newton Observation of the NW Merger Shock and Radio Relic in Abell 3667*, 2008, 53,000 seconds, PI.

XMM/Newton X-ray Observatory, ESA, Cycle 7, *Abell 2063: The Physics of Cooling Flow Clusters with Central Radio Sources*, 2008, 23,000 seconds, PI.

XMM/Newton X-ray Observatory, ESA, Cycle 7, *Searching for Millisecond Pulsars in Extremely Low-Mass White Dwarf Binaries*, 2008, 78,000 seconds, PI.

XMM/Newton X-ray Observatory, ESA, Cycle 7, *Merger Activity In and Between Abell 2061 and 2067*, 2008, 30,000 seconds, PI.

Suzaku X-ray Observatory Cycle 3, *A Suzaku Snapshot Survey of High-Redshift Galaxy Clusters from the RCS Survey*, 2007, 58,000, PI.

Chandra X-ray Observatory Cycle 9, *Are the X-Ray Binaries in S0 Galaxies Different From Those in Ellipticals?*, 2007, 148,000 seconds, PI.

Chandra X-ray Observatory Cycle 9, *The Nature of the Intermediate-Luminosity X-ray Sources in Globular Clusters*, 2007, 35,000 seconds, PI.

Chandra X-ray Observatory Cycle 8, *Abell 119: Cluster Mergers and the Origin of Narrow-Angle-Tail Radio Galaxies*, 2006, 49,000 seconds, PI.

Chandra X-ray Observatory Cycle 8, *Deep Chandra and Hubble Observations of NGC 1023: Testing the Origin of Low-Mass X-ray Binaries in a Lenticular Galaxy*, 2006, 192,000 seconds, PI.

Chandra X-ray Observatory Cycle 8, *The Galactic Generation-X: The First Study of the X-ray Properties of Massive E+A Galaxies*, 2006, 50,000 seconds, PI.

Hubble Space Telescope Cycle 15, *Deep Chandra and Hubble Observations of NGC 1023: Testing the Origin of Low-Mass X-ray Binaries in a Lenticular Galaxy*, 2006, 5 orbits, PI.

Hubble Space Telescope Cycle 15, *Probing the Globular Cluster / Low Mass X-ray Binary Connection in Early-type Galaxies at Low X-ray Luminosities*, 2006, 10 orbits, PI.

Suzaku X-ray Observatory Cycle 1, *Nailing Down the Hard X-ray Inverse Compton Emission from the Radio Halo in the Coma Cluster*, 2006, 180,000 seconds, PI

Suzaku X-ray Observatory Cycle 1, *Hard X-ray Inverse Compton Emission and a Merger Shock Associated with the Brightest Known Radio Relic in Abell 3667*, 2006, 135,000 seconds, PI.

XMM/Newton X-ray Observatory, ESA, Cycle 5, *Understanding Gas Interactions in Groups: NGC 1600*, 2006, 85,300 seconds, PI.

Chandra X-ray Observatory Cycle 7, *A High Resolution Study of Interstellar Absorption*, 2005, 100,000 seconds, PI

Astro-E2 X-ray Observatory Cycle 1, *Properties of the Merger and Radio Source Interaction in the Cygnus A Cluster*, 2005, 100,000 seconds, PI

Astro-E2 X-ray Observatory Cycle 1, *Resolving the Iron Absorption Lines in the X-ray Dipper 4U 1916–05*, 2005, 50,000 seconds, PI

Hubble Space Telescope Cycle 14, *Probing The Galaxy-wide Globular Cluster — Low Mass X-ray Binary Connection in Early-type Galaxies*, 2005, 12 orbits, PI

Hubble Space Telescope Cycle 14, *Resolving the Connection Between Globular Clusters and Low- Mass X-ray Binaries*, 2005, 9 orbits, PI

XMM/Newton X-ray Observatory, ESA, Cycle 4 *The Local Galaxy Cluster Mass Function of the Brightest Clusters in the Sky*, 2005, 227,700 seconds, PI.

XMM/Newton X-ray Observatory, ESA, Cycle 4 *The Physics of Cooling Flow Clusters with Central Radio Sources*, 2005, 22,600 seconds, PI.

Chandra X-ray Observatory Cycle 6, *Low Mass X-ray Binaries and Globular Clusters in the Early-Type Galaxy NGC 4365*, 2004, 160,300 seconds, PI.

Chandra X-ray Observatory Cycle 6, *Stellar Mass Loss Versus External Accretion in the X-ray Bright Elliptical NGC 5813*, 2004, 49,000 seconds, PI.

Chandra X-ray Observatory Cycle 6, *The Interaction between Cluster Central Radio Sources and Cooling Flows*, 2004, 41,000 seconds, PI.

XMM/Newton X-ray Observatory, ESA, Cycle 3 *The Physics of Cooling Flow Clusters with Central Radio Sources*, 2003, 103,300 seconds, PI.

XMM/Newton X-ray Observatory, ESA, Cycle 3 *The Complex Dynamics of the Thermal and Nonthermal Intracluster Gas*, 2003, 88,700 seconds, PI.

Chandra X-ray Observatory Cycle 5 and Hubble Space Telescope Cycle 12, *Deep Chandra and Hubble Observations NGC 4697, the Nearest Optically Luminous, X-ray Faint Elliptical Galaxy*, 2003, 160,000 seconds on Chandra, one orbit on Hubble, PI.

Chandra X-ray Observatory Cycle 5, *Filamentary Radio Relics in Clusters of Galaxies: Radio Bubbles or Merger Shocks?*, 2003, 53,000 seconds, PI.

Chandra X-ray Observatory Cycle 5, *Chandra Observations of Galaxy Clusters with Large cD Galaxy Peculiar Velocities*, 2003, 77,000 seconds, PI.

Chandra X-ray Observatory Cycle 5, *The HIFLUGCS Cluster Survey: A Cornerstone for Cosmology*, 2003, 83,000 seconds, PI.

XMM/Newton X-ray Observatory, ESA, Cycle 2 *Radio Halos and Relics and Merger Shocks in Clusters of Galaxies*, 2002, 122,000 seconds, PI.

XMM/Newton X-ray Observatory, ESA, Cycle 2 *The Origin of the Disturbed Cool Core and Filamentary Radio Source in Abell 133*, 2002, 35,000 seconds, PI.

XMM/Newton X-ray Observatory, ESA, Cycle 2 *The Physics of Cooling Flow Clusters with Central Radio Sources*, 2002, 63,000 seconds, PI.

XMM/Newton X-ray Observatory, ESA, Cycle 2 *Stellar Mass Loss Versus External Accretion in X-ray Bright Ellipticals*, 2002, 89,000 seconds, PI.

XMM/Newton X-ray Observatory, ESA, Cycle 2 European Space Agency, XMM Cycle 2, *A High-Redshift ($z = 0.95$) Cluster Revealed by a FIRST Bent-Double Radio Source*, 2002, 38,000 seconds, PI.

Chandra X-ray Observatory Cycle 4, *Low Mass X-ray Binaries and Globular Clusters in Virgo Early-Type Galaxies*, 2002, 44,000 seconds, PI.

Chandra X-ray Observatory Cycle 4, *A High Redshift ($z = 0.95$) Cluster Revealed by a FIRST Bent-Double Radio Source*, 2002, 20,000 seconds, PI.

Chandra X-ray Observatory Cycle 4, *The HIFLUGCS Cluster Survey: A Cornerstone for Cosmology*, 2002, 120,000 seconds, PI.

Chandra X-ray Observatory Cycle 3, *The Interaction Between Cluster Central Radio Sources and Cooling Flows*, 2002, 26,000 seconds, PI.

Chandra X-ray Observatory Cycle 3, *Stellar Mass Loss Versus External Accretion in X-ray Bright Ellipticals*, 2002, 95,000 seconds, PI.

Chandra X-ray Observatory Cycle 3, *Resolving the X-Ray Binary Population in Early-Type Galaxies*, 2002, 36,000 seconds, PI.

Chandra X-ray Observatory Cycle 3, *Merger Shocks in Clusters of Galaxies*, 2002, 50,000 seconds, PI.

Chandra X-ray Observatory Cycle 2, *Filamentary Radio Relics and Mergers in Clusters of Galaxies*, 2001, 36,000 seconds, PI.

Chandra X-ray Observatory Cycle 2, *The Interaction between Cluster Central Radio Sources and Cooling Flows*, 2001, 53,000 seconds, PI.

Chandra X-ray Observatory Cycle 2, *Resolving the X-ray Binary Population in Early-Type Galaxies*, 2001, 84,000 seconds, PI.

Chandra X-ray Observatory Cycle 2, *Merger Shocks in Clusters of Galaxies*, 2001, 56,000 seconds, PI.

XMM/Newton X-ray Observatory, ESA, Cycle 1, *Merger Shocks in Clusters of Galaxies*, 2000, 63,000 seconds, PI.

XMM/Newton X-ray Observatory, ESA, Cycle 1, *Stellar Mass Loss Versus External Accretion in X-ray Bright Ellipticals*, 2000, 82,000 seconds, PI.

Astro-E X-ray Observatory, *Properties of the Merger and Cooling Flow in the Cygnus A Cluster*, 2000, 140,000 seconds, PI.

Astro-E X-ray Observatory, *Subcluster Mergers, Radio Relics, and the Cooling Flow in Abell 85*, 2000, 108,000 seconds, PI.

Astro-E X-ray Observatory, *High Resolution X-ray Spectra of Cluster Cooling Flows: Spectral Evidence for Cooling and Cold Gas*, 2000, 39,000 seconds, PI.

Chandra X-ray Observatory Cycle 1, *Subcluster Mergers, Radio Relics, and the Cooling Flow in Abell 85*, 2000, 40,000 seconds, PI.

Chandra X-ray Observatory Cycle 1, *The Interaction Between Cluster Central Radio Sources and Cooling Flows*, 2000, 37,000 seconds, PI.

Chandra X-ray Observatory Cycle 1, *Stellar Mass Loss Versus External Accretion in X-ray Bright Ellipticals*, 2000, 40,000 seconds, PI.

Chandra X-ray Observatory Cycle 1, *Resolving the Mystery of X-Ray Faint Elliptical Galaxies*, 2000, 70,000 seconds, PI.

ASCA X-ray Observatory, *Cooling Gas, Cold Gas, and the Dynamical History of Clusters of Galaxies*, 1999, 100,000 seconds, PI.

ROSAT X-ray Observatory, *Cluster Environment Surrounding the Giant FR II, NVSS 2146+82*, 1999, 40,000 second, administrative PI.

ASCA X-ray Observatory, *X-Ray Spectra of Cluster Cooling Flows with Excess Absorption: Spectral Diagnostics for Cooling and Cold Gas*, 1994-1998, 429,000 seconds, PI.

ROSAT X-ray Observatory, *Low Luminosity X-ray Sources and UV Bright Stars in Globular Clusters*, 1997-1998, 223,000 seconds, PI.

ROSAT X-ray Observatory, *Twilight of the Gods: The Massive, Long Period, Accreting Binary VV Cephei Enters Eclipse*, 1996-1997, 20,000 seconds, PI.

ASCA X-ray Observatory, *An ASCA Observation of a Rich cD Cluster A2107 in the Center of the Hercules Supercluster*, 1997-1998, 30,000 seconds, PI.

ASCA X-ray Observatory, *Cluster Dark Matter Density Profiles at Very Large Radii*, 1997-1998, 50,000 seconds, PI.

ASCA X-ray Observatory, *B2 1028+313 and Abell 1030: A Quasar in the Center of a Cluster Cooling Flow*, 1995, 40,000 sec, PI.

ASCA X-ray Observatory, *X-Ray Spectra of Elliptical Galaxies: Gas Dynamics, Chemical Evolution, and Missing Mass*, 1995-1997, 80,000 sec, PI.

ASCA X-ray Observatory, *Mapping the Temperature Structure of Almost Relaxed Clusters*, 1996-1997, 110,000 seconds, PI.

ASCA X-ray Observatory, *Searching for Two Component Emission from X-Ray FAINT Early-Type Galaxies: NGC 3115 and NGC 3379*, 1996, 40,000 seconds, PI.

ASCA X-ray Observatory, *The X-Ray Spectrum of Triangulum Australis: Probing the High Luminosity Tail of X-Ray Clusters*, 1995, 20,000 sec, PI.

ASCA X-ray Observatory, *X-Ray Spectra of the Hercules Cluster – The Interaction of Intracluster Gas, Gas Stripping, and Radio Plasma*, 1995, 20,000 sec, PI.

ROSAT X-ray Observatory, *B2 1028+313 and Abell 1030: A Quasar in the Center of a Cluster Cooling Flow*, 1996, 40,000 sec, PI.

ROSAT X-Ray Observatory, *Filaments and Cool Gas in Cluster Cooling Flows*, 1991-1994, 186,600 seconds, PI.

ROSAT X-Ray Observatory, *Aligned Radio, Optical, and X-ray Structures in Clusters of Galaxies*, 1994, 13,100 seconds, PI.

ROSAT X-Ray Observatory, *NGC7144: A Non-Cluster Elliptical with a Massive Dark Halo?*, 1993, 28,200 seconds, PI.

ROSAT X-ray Observatory, *A High Resolution Study of X-ray Emission from Bright Elliptical Galaxies*, 1991-1993, 164,000 seconds, PI.

Very Large Array Radio Observatory, *Radio Imaging of the Complex X-ray Source 2A0335+096*, 1992, 6 hours in C array, 7 hours in D array, PI.

Einstein X-ray Observatory, *X-ray Observations of Southern High Redshift Clusters*, 12,000 seconds, PI.

Einstein X-ray Observatory, *X-ray Observations of M51 and M81 – the Dynamics of Spiral Galaxies*, 20,000 seconds, PI.

Allocated Super-Computing Time as PI

National Science Foundation, XSEDE, *Simulating Galaxies in Cluster Environments: Balancing Ram Pressure Stripping, Thermal Conduction, and Radiative Cooling using Magnetohydrodynamic Simulations*, 456,000 core hours, 220 TB storage (value \$26,848.16)
National Science Foundation, TeraGrid, *Generating A Homogeneous Library of Isolated Binary Galaxy Cluster Mergers — Application to Dark Energy Surveys*, DAC-TG AST080006, November 2007 – November 2008, 30,000 CPU hours on 17–32 processors, PI.
National Science Foundation, Pittsburgh Supercomputing Center, *Hydrodynamical Simulations of the Shaping of Supernovae and Planetary Nebulae*, PSC 89–0313P, June 1990 – June 1991, 50 hours, PI.
National Science Foundation, Pittsburgh Supercomputing Center, *Hydrodynamic Simulations of the Formation and Evolution of Early-Type Galactic Systems*, June 1989 – June 1990, 5 hours, PI.
National Science Foundation, Pittsburgh Supercomputing Center, *Propagation of Jets through Cooling Flows in Galaxies*, PSCA-121, January 1987 – January 1988, 50 hours, PI.

Post-Doctoral Fellows Supervised - Since 2000

Elizabeth Blanton, 2000–2001, 2001–2004 Chandra Fellow, 2004
Thomas Reiprich, 2001–2004
Yutaka Fujita, 2001–2002, Japanese Society for the Promotion of Science Fellow
Motokazu Takizawa, 2001–2002, Japanese Society for the Promotion of Science Fellow
Tracy Clarke, 2002–2004
Eric Pfahl, 2004–2005, Chandra Fellow
Adrienne Juett, 2004–2007
Amalia (Molly) Hicks, 2005–2008
Craig Heinke, 2007–2008
Gregory Sivakoff, 2008–2011
Ming Sun, 2008–2012
Rukmani Vijayaraghavan, 2015–

Craig L. Sarazin

Publications

BOOKS:

- “X-ray Emission from Clusters of Galaxies,” C. L. Sarazin, (Cambridge: Cambridge University Press), i–x,1–252 (1988), ISBN: 978-0-521-32957-6 (hardcover), 978-0-521-11313-7 (paperback).
- “NASA’s Beyond Einstein Program: An Architecture for Implementation,” Kennel, C., Rothenberg, J., Adelberger, E., Adkins, W., Applequist, T., Barrowman, J., Bearden, D., Devlin, M., Fuller, J., Gebhardt, K., Gibson, W., Harrison, F., Lankford, A., McCarthy, D., Meyer, S., Primack, J., Randall, L., Sarazin, C., Ulvestad, J., Will, C., Witherell, M., & Wright, N., (Washington: National Academy of Sciences), i–xi,1–174 (2007), ISBN: 978-0-309-11162-1

ARTICLES OR BOOK CHAPTERS:

- * “X-Ray Background Fluctuations,” C. Sarazin and G. P. Garmire, *Caltech Technical Report CIT-XRR-2*, 1-6 (1971).
- “The Proton-Proton Reaction at High Energies,” C. L. Sarazin, *Nuovo Cimento*, **26B**, 94-99 (1975).
- * “Dust in the H II Region NGC 2024,” C. L. Sarazin, *Bulletin American Astronomical Society*, **7**, 259-260 (1975).
- “The Role of Dust in NGC 2024,” C. L. Sarazin, *Astrophysical Journal*, **204**, 68-72 (1976).
- “Infrared Studies of an Ionization Front in the Orion Nebula,” E. E. Becklin, S. Beckwith, I. Gatley, G. Neugebauer, C. L. Sarazin, and M. W. Werner, *Astrophysical Journal*, **207**, 770-779 (1976).
- “Abundance Gradients in Extragalactic H II Regions and Internal Absorption by Dust,” C. L. Sarazin, *Astrophysical Journal*, **208**, 323-335 (1976).
- “Effects of Dust on the Structure of H II Regions,” C. L. Sarazin, *Astrophysical Journal*, **211**, 772-785 (1977).
- * “Models for the X-Ray Line Emission from Clusters of Galaxies,” C. L. Sarazin and J. N. Bahcall, *Bulletin American Astronomical Society*, **8**, 335-356 (1977).
- “Parameters and Predictions for X-Ray Emitting Gas in Coma, Perseus, and Virgo,” J. N. Bahcall and C. L. Sarazin, *Astrophysical Journal (Letters)*, **213**, L99-L103 (1977).
- “X-Ray Line Emission for Clusters of Galaxies: II. Numerical Models,” C. L. Sarazin and J. N. Bahcall, *Astrophysical Journal Supplement*, **34**, 451-467 (1977).
- “On the Zeeman Splitting of X-Ray Lines by Neutron Star Magnetic Fields,” C. L. Sarazin and J. N. Bahcall, *Astrophysical Journal (Letters)*, **216**, L67-L70 (1977).

*Not Refereed

- “X-Ray Line Spectroscopy for Clusters of Galaxies: I,” J. N. Bahcall and C. L. Sarazin, *Astrophysical Journal*, **219**, 781-794 (1978).
- “The Effect of Multiple Grain Components on Infrared Radiation Transfer and the 10μ Silicate Feature,” C. L. Sarazin, *Astrophysical Journal*, **220**, 165-170 (1978).
- * “Dips in the Cosmic Background,” C. L. Sarazin, *Physics News*, 10-11 (1978).
- * “Optical Pumping and Fine Structure Absorption in Quasars,” C. L. Sarazin, B. P. Flannery, and G. B. Rybicki, *Bulletin American Astronomical Society*, **10**, 449-450 (1978).
- “Dynamical Interactions and Astrophysical Effects of Stable Heavy Neutrinos,” G. Steigman, C. Sarazin, H. Quintana, and J. Faulkner, *Astronomical Journal*, **83**, 1050-1061 (1978).
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- “A Possible Record of X and/or Gamma Rays from Supernovae in Glacial Ice,” R. T. Rood, C. L. Sarazin, E. J. Zeller, and B. C. Parker, *Nature*, **282**, 701-703h (1979).
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- * “Beam Models for SS433,” M. C. Begelman, C. L. Sarazin, S. P. Hatchett, C. F. McKee, and J. Arons, *Bulletin American Astronomical Society*, **11**, 672 (1979).
- “Galactic Coronae, Quasar Absorption Lines, and the Origin of the Intracluster Medium,” C. L. Sarazin, *Astrophysical Letters*, **20**, 93-100 (1979).
- * “Disk-Driven Precession in SS433,” C. L. Sarazin, M. C. Begelman, and S. P. Hatchett, *Bulletin American Astronomical Society*, **11**, 786-787 (1979).
- “A Maximum Likelihood Method for Determining the Distribution of Galaxies in Clusters,” C. L. Sarazin, *Astrophysical Journal*, **236**, 75-83 (1980).
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- * “Star Formation in X-Ray Cluster Cooling Flows,” R. E. White and C. L. Sarazin, *Bulletin American Astronomical Society*, **15**, 945 (1983).
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- “LOFAR, VLA, and Chandra Observations of the Toothbrush Galaxy Cluster,” van Weeren, R. J., Brunetti, G., Brüggén, M., Andrade-Santos, F., Ogorean, G. A., Williams, W. L., Röttgering, H. J. A., Dawson, W. A., Forman, W. R., de Gasperin, F., Hardcastle, M. J., Jones, C., Miley G. K., Rafferty, D. A., Rudnick, L., Sabater, J., Sarazin, C. L., Shimwell, T. W., Bonafede, A., Best, P. N., Bîrzan, L., Cassano, R., Chy.uzy, K. T., Croston, J. H., Dijkema, T. J., Enßlin, T., Ferrari, C., Heald, G., Hoeft, M., Horellou, C., Jarvis, C., Kraft, R. P., Mevius, M., Intema, H. T., Murray, S. S., Orrú, E., Pizzo, R., Sridhar, S. S., Simionescu, A., Stroe, A., van der Tol, S., and White, G. J. 2016, *Astrophysical Journal*, **818**, id 204, 19 pp, DOI 10.3847/0004-637X/818/2/204
- “A Strong Merger Shock in Abell 665,” Dasadia, S., Sun, M., Sarazin, C., Morandi, A., Markevitch, M., Wik, D., Feretti, L., Giovannini, G., Govoni, F., & Vacca V. 2016, *Astrophysical Journal Letters*, **820**, id L20, 5 pp, DOI 10.3847/2041-8205/820/1/L20

- “LOFAR Facet Calibration,” van Weeren, R. J., Williams, W. L., Hardcastle, M. J., Shimwell, T. W., Rafferty, D. A., Sabater, J., Heald, G., Sridhar, S. S., Dijkema, T. J., Brunetti, G., Brüggem, M., Andrade-Santos, F., Ogrean, G. A., Röttgering, H. J. A., Dawson, W. A., Forman, W. R., de Gasperin, F., Jones, C., Miley G. K., Rudnick, L., Sarazin, C. L., Bonafede, A., Best, P. N., Birzan, L., Cassano, R., Chy.uzy, K. T., Croston, J. H., Enßlin, T., Ferrari, C. Hoeft, M., Horellou, C., Jarvis, C., Kraft, R. P., Mevius, M., Intema, H. T., Murray, S. S., Orrú, E., Pizzo, R., Simionescu, A., Stroe, A., van der Tol, S., and White, G. J. 2016, *Astrophysical Journal Supplement*, **223**, id 2, 16 pp, DOI 10.3847/0067-0049/223/1/2
- “Exploring the Outskirts of the Galaxy Cluster Merger A1750 Along the Putative Large-Scale Filament,” Bulbul, Esra, Randall, Scott W., Bayliss, Matthew, Miller, Eric, Andrade-Santos, Felipe, Johnson, Ryan, Bautz, Mark, Blanton, Elizabeth, Forman, William R., Jones, Christine, Murray, Steve, Sarazin, Craig L., and Ezer, Cemile 2016, *Bulletin American Astronomical Society, High Energy Astrophysics Division*, **15**, id 111.02, 1 pp
- * “The Merger Dynamics of Abell 2061,” Bailey, Avery, Sarazin, Craig L., Clarke, Tracy E., Chatzikos, Marios, Hogge, Taylor, Wik, Daniel R., Rudnick, Lawrence, Farnsworth, Damon, Van Weeren, Reinout J., & Brown, Shea 2016, *Bulletin American Astronomical Society, High Energy Astrophysics Division*, **15**, id 111.04, 1 pp
- “Shocking Features in the Merging Galaxy Cluster RXJ0334.2–0111,” Dasadia, Sarthak Sun, Ming, Morandi, Andrea, Sarazin, Craig, Clarke, Tracy, Nulsen, Paul, Harris, Dan, Forman, Bill, Massaro, Francesco, & Roediger, Elke 2016, *Monthly Notices Royal Astronomical Society*, **458**, id 681–694, 14 pp, DOI 10.1093/mnras/stw291
- “The Reproducible Radio Outbursts of SS Cygni,” Russell, T. D., Miller-Jones, J. C. A., Sivakoff, G. R., Altamirano, D., O’Brien, T. J., Page, K. L., Templeton, M. R., Körding, E. G., Knigge, C., Rupen, M. P., Fender, R. P., Heinz, S., Maitra, D., Markoff, S., Migliari, S., Remillard, R. A., Russell, D. M., Sarazin, C. L., and Waagen, E. O. 2016, *Monthly Notices Royal Astronomical Society*, **460**, 3720–3732 DOI 10.1093/mnras/stw1238
- “Suzaku X-Ray Observations of the Nearest Non-Cool Core Cluster, Antlia: Dynamically Young but with Remarkably Relaxed Outskirts,” Wong, K.-W., Irwin, J. A., Wik, D. R., Sun, M., Sarazin, C. L., Fujita, Y., & Reiprich, T. H. 2016, *Astrophysical Journal*, **829**, 49, 21 pp, DOI 10.3847/0004-637X/829/1/49
- “The Co-Evolution of Galaxies, their ISM, and the ICM: The Hydrodynamics of Galaxy Transformation,” Vijayaraghavan, Rukmani, Sarazin, Craig L., & Ricker, Paul M. 2017, *Bulletin American Astronomical Society*, **229**, id 346.16, 1 pp
- “Probing WHIM around Galaxy Clusters with Fast Radio Bursts and the Sunyaev-Zel’dovich Effect,” Fujita, Y., Akahori, T., Umetsu, K., Sarazin, C. L., & Wong, K.-W. 2017, *Astrophysical Journal*, **834**, 13, 8 pp, DOI 10.3847/1538-4357/834/1/13
- “Galaxy Cluster Pressure Profiles as Determined by Sunyaev–Zel’dovich Effect Observations with MUSTANG and Bolocam. II. Joint Analysis of Fourteen Clusters,” Romero, C., Mason, B. S., Sayers, J., Mroczkowski, T., Sarazin, C. L., Donahue, M., Baldi, A., Clarke, T. E., Young, A. Sievers, J., Dicker, S. R., Reese, E. D., Czakon, N., Devlin, M., Korngut, P. M., & Golwala, S. 2017, *Astrophysical Journal*, in press (astro-ph 1608.03980)

- * “Hitting the JACPOT: Current & Future Probes of the Accretion Disk — Radio Jet Coupling of X-Ray Binaries,” Sivakoff, G. R., Miller-Jones, J. C. A., Rupen, M. P., Altamirano, D., Sarazin, C. L., & JACPOT Collaboration 2017, in *IAU Symposium 285, New Horizons in Time Domain Astronomy*, in press
 - * “Multiplex SQUID/TES Array at Ninety GHz (MUSTANG) and Future Prospects for MUSTANG2,” Young, A. Aguirre, J., Devlin, M. J., Dicker, S. R., Korngut, P. M., Mason, B. S., Mroczkowski, T., Reese, E. D., Romero, C., Rosenman, M. Sarazin, C. L., Sievers, J., & Sun M. 2017, in *Cosmology with X-ray and Sunyaev-Zeldovich Effect Observations of Galaxy Clusters*, in press
 - * “Radio Observations of the Merging Cluster Abell 2146,” Romero, C., Mason, B. S., Interna, H., Mroczkowski, T., Reese, E. D., Young, A., Devlin, M. J., Dicker, S. R., Korngut, P. M., Sarazin, C. L., Sun M., & Sievers, J. 2017, in *Cosmology with X-ray and Sunyaev-Zeldovich Effect Observations of Galaxy Clusters*, in press
 - * “Reviving an Ultra Steep Spectrum Relic in the Merging Cluster Abell 2443,” Clarke, T. E., Randall, S. W., Sarazin, C. L., Blanton, E., Giacintucci, S., & Intema, H. 2017, in *Nature’s Particle Accelerators*, ed. M. Markevitch, in press
 - * “Merger in the Ultra-Steep Spectrum Radio Cluster Abell 2443: Faster than a Speeding Bullet (Cluster)?”, Mroczkowski, T., Clarke, T., Randall, S., Giacintucci, S., Intema, H., Sarazin, C. L., & Blanton, E. 2017, in *Proceeding of Zeldovich 100th Anniversary Celebration*, in press
- “The Evaporation and Survival of Cluster Galaxies’ Coronae Part I: The Effectiveness of Isotropic Thermal Conduction Including Saturation,” Vijayaraghavan, Rukmani, & Sarazin, Craig 2017, *Astrophysical Journal*, submitted (astro-ph 11702.03971)
- “The Evaporation and Survival of Cluster Galaxies’ Coronae Part II: The Effectiveness of Anisotropic Thermal Conduction and Survival of Stripped Galactic Tails,” Vijayaraghavan, Rukmani, & Sarazin, Craig 2017, *Astrophysical Journal*, submitted
- “Deep XMM-Newton Observations of the NW Radio Relic Region of Abell 3667.” Sarazin, Craig L., Finoguenov, Alexis, Wik, Daniel R., & Clarke, Tracy E. 2017, *Astrophysical Journal*, submitted (astro-ph 1606.07433)
- “The Merger Dynamics of Abell 2061 and the Origin of the Diffuse Radio Sources,” Hogge, Taylor G., Sarazin, Craig L., & Wik, Daniel R. 2017, *Astrophysical Journal*, submitted
- “The SLAM Project: I. Description of Simulations,” Chatzikos, M., Sarazin, C. L., & O’Shea, B. W. 2017, *Astrophysical Journal*, submitted
- “Extreme Jet Ejections from the Black Hole X-ray Binary V404 Cygni,” Tetarenko, A., Sivakoff, G. R., Miller-Jones, J. C. A., Curran, P.A., Russell, T. D., Coulson, I. M., Heinz, S., Maitra, D., Markoff, S., Migliari, S., Petitpas, G. R., Rupen, M. P., Rushton, A., Russell, D. M., & Sarazin, C. L. 2017, *Monthly Notices Royal Astronomical Society*, submitted

Craig L. Sarazin

Seminars, Colloquia, and Invited Talks

- American Astronomical Society Meeting, Bloomington, IN, talk, *Dust in the H II Region NGC 2024*, March 1975.
- California Institute of Technology, Pasadena, CA, Astrophysics Seminar, *Dust in H II Regions*, July 1975.
- American Astronomical Society Meeting, Haverford, PA, talk, *Models for X-ray Line Emission from Clusters of Galaxies*, June 1976.
- Mullard Space Flight Center, Surrey, England, Seminar, *X-ray Lines from Clusters of Galaxies*, July 1976.
- Massachusetts Institute of Technology, Cambridge, MA, Astronomy Colloquium, *X-ray Lines from Clusters of Galaxies*, October 1976.
- State University of New York, Stony Brook, NY, Astronomy Colloquium, *X-ray Lines from Clusters of Galaxies*, November 1976.
- University of Pennsylvania, Philadelphia, PA, Astronomy Colloquium, *X-ray Lines from Clusters of Galaxies*, December 1976.
- Columbia University, New York, NY, Astronomy Colloquium, *X-ray Lines from Clusters of Galaxies*, January 1977.
- University of Maryland, College Park, MD, Astronomy Colloquium, *X-ray Lines from Clusters of Galaxies*, February 1977.
- University of Virginia, Charlottesville, VA, Astronomy Colloquium, *X-ray Lines from Clusters of Galaxies*, February 1977.
- Rutgers University, New Brunswick, NJ, Astronomy Colloquium, *X-ray Lines from Clusters of Galaxies*, February 1977.
- Harvard College, Cambridge, MA, High Energy Astrophysics Seminar, *X-ray Lines from Clusters of Galaxies*, May 1977.
- Goddard Space Flight Center, Greenbelt, MD, Astrophysics Colloquium, *X-ray Lines from Clusters of Galaxies*, February 1978.
- National Radio Astronomy Observatory, Charlottesville, VA, Seminar, *The Distance from Quasars to Absorbing Clouds*, June 1978.
- Harvard College, Cambridge, MA, Center for Astrophysics Seminar, *Optical Pumping and Fine Structure Lines*, June 1978.
- Yale University, New Haven, CT, Astronomy Colloquium, *Fine Structure Lines in Quasars and H II Regions*, June 1978.

American Astronomical Society Meeting, Madison, WI, talk, *Fine Structure Lines and the Distance from Quasars to Absorbing Clouds*, and chairman of session on X-ray Astronomy, June 1978.

Rochester University, Rochester, NY, Astronomy Colloquium, *Fine Structure Lines in Quasars and H II Regions*, December 1978.

University of California, Los Angeles, CA, Astronomy Colloquium, *Fine Structure Lines in Quasars and H II Regions*, February 1979.

University of California, Santa Cruz, CA, Astronomy Colloquium, *Galactic Coronae, Quasar Absorption Lines, and the Origin of the Intracluster Medium*, March 1979.

University of California, Berkeley, CA, Astronomy Seminar, *Beam Models for SS433*, April 1979.

University of California, Berkeley, CA, Astronomy Colloquium, *Galactic Coronae, Quasar Absorption Lines, and the Origin of the Intracluster Medium*, April 1979.

National Radio Astronomy Observatory, Charlottesville, VA, Seminar, *Beam Models for SS433*, June 1979.

University of Virginia, Charlottesville, VA, Astronomy Colloquium, *Beam Models for SS433*, September 1979.

Pennsylvania State University, University Park, PA, Astronomy Colloquium, *Beam Models for SS433*, October 1979.

Harvard College, Cambridge, MA, Theoretical Astrophysics Seminar, *Beams and Precession in SS433*, October 1979.

High Energy Astrophysics Division Meeting, Cambridge, MA, talk, *Disk-Driven Precession in SS433*, January 1980.

Pennsylvania State University, University Park, PA, Astronomy Seminar, *Galactic Coronae, Quasar Absorption Lines, and the Origin of the Intracluster Medium*, February 1980.

Cornell University, Ithaca, NY, Astronomy Colloquium, *SS433 – the Cosmic Corkscrew?*, February 1980.

Johns Hopkins University Physics Workshop, *Atomic Physics Data Needs in Astrophysics*, invited opening talk and chairman of the session on *Photoionization and the Auger Effect*, March 1980.

University of Michigan, Ann Arbor, MI, Astronomy Colloquium, *SS433 – the Cosmic Corkscrew?*, April 1980.

Institute for Advanced Study Workshop on X-ray Clusters of Galaxies, Princeton, NJ, Invited Review Talk, *Models for the X-ray Emission from Clusters of Galaxies*, May 1980.

National Radio Astronomy Observatory, Charlottesville, VA, Seminar, *The Man with the Twisted Disk*, July 1980.

- National Radio Astronomy Observatory, Charlottesville, VA, Seminar, *Wuts GUTs?*, August 1981.
- Princeton University, Princeton, NJ, Astronomy Colloquium, *X-ray Line Emission from Supernova Remnants*, February 1982.
- New York University, New York, NY, Physics Colloquium, *X-ray Line Emission from Supernova Remnants*, February 1982.
- Rutgers University, New Brunswick, NJ, Physics Colloquium, *X-ray Line Emission from Supernova Remnants*, March 1982.
- Bell Telephone Laboratories, Murray Hill, NJ, Physics Colloquium, *X-ray Line Emission from Supernova Remnants*, March 1982.
- Bell Telephone Laboratories, Murray Hill, NJ, Physics Seminar, *SS433 – the Cosmic Corkscrew?*, May 1982.
- IAU Symposium 101, Supernova Remnants and their X-ray Emission, Venice, Italy, talk, *X-ray Line Emission from Supernova Remnants and Models for Nonequilibrium Ionization*, August 1982.
- Space Telescope Science Institute, Baltimore, MD, colloquium, *The X-ray Spectra of Supernova Remnants*, December 1982.
- University of Maryland, College Park, MD, Astronomy Colloquium, *The X-ray Spectra and Origin of Type I Supernovae*, September 1983.
- National Radio Astronomy Observatory, Charlottesville, VA, Seminar, *The X-ray Spectra and Origin of Type I Supernovae*, September 1983.
- Aspen Center for Physics Astrophysics Workshop on the Physical Basis for the Distance Scale, Aspen, CO, talks, *Cooling Flows and the Formation of cD Galaxies*, and *Radio Recombination Lines and the Distances to Quasars*, and *Core Radii and the Distributions of Galaxies in Clusters*, June 1984.
- Department of Terrestrial Magnetism, Carnegie Institution, Washington, DC, Astronomy Colloquium, *X-ray Emission from Type I Supernova Remnants*, May 1985.
- Greenbank Workshop on Gaseous Halos of Galaxies, Greenbank, WV, Invited Review, *X-ray Emission from Haloes of Galaxies: Theory*, May 1985.
- American Astronomical Society Meeting, Charlottesville, VA, talk, *Head–Tail Radio Galaxies and the Orbits of Galaxies in Clusters*, June 1985.
- International Astronomical Union Symposium 117: Dark Matter in the Universe, Princeton, NJ, Invited Review, *Gaseous Halos of Galaxies and Clusters of Galaxies: Theory*, June 1985.
- Joint Institute for Laboratory Astrophysics, National Bureau of Standards and the University of Colorado, Boulder, CO, Astrophysics Lunch Seminar, *Cooling Flows in Elliptical Galaxies*, September 1985.

- University of Wyoming, Laramie, WY, Physics Department Colloquium, *Cooling Flows in Galaxies and Clusters of Galaxies*, October 1985.
- University of Colorado, Boulder, CO, Astrophysics and Planetary Atmospheres and Science Graduate Seminar, *Clusters of Galaxies*, October 1985.
- Joint Institute for Laboratory Astrophysics, National Bureau of Standards and the University of Colorado, Boulder, CO, Colloquium, *Cooling Flows in Clusters of Galaxies*, November 1985.
- American Astronomical Society Meeting, Houston, TX, Invited Talk, *Cooling Flows and the X-ray Emission of Elliptical Galaxies*, January 1986.
- University of Illinois, Urbana, IL, Astronomy and Physics Joint Colloquium, *Cooling Flows and the X-ray Emission of Elliptical Galaxies*, April 1986.
- Joint Institute for Laboratory Astrophysics, National Bureau of Standards and the University of Colorado, Boulder, CO, Astrophysics Lunch Seminar, *Narrow-Angle-Tail Radio Galaxies and the Orbits of Galaxies in Clusters*, May 1986.
- National Radio Astronomy Observatory and New Mexico Institute of Mining and Technology, Socorro, NM, Joint Astrophysics Colloquium, *Cooling Flows and the X-ray Emission of Elliptical Galaxies*, May 1986.
- University of New Mexico, Albuquerque, NM, Physics Department Colloquium, *Cooling Flows and the X-ray Emission of Elliptical Galaxies*, May 1986.
- International Astronomical Union Symposium 127: Structure and Dynamics of Elliptical Galaxies, Princeton, NJ, Invited Talk, *Mass Distributions of Elliptical Galaxies at Large Radii*, May 1986.
- Greenbank Workshop on Continuum Radio Processes in Clusters of Galaxies, Greenbank, WV, Invited Talk, *X-ray Observations of Clusters: Physical Implications*, August 1986.
- National Radio Astronomy Observatory, Charlottesville, VA, Seminar, *Cooling Flows and the X-ray Emission of Elliptical Galaxies*, September 1986.
- International Conference on the Physics and Chemistry of Small Clusters, Richmond, VA, Invited Talk, *The Cosmic Corkscrew*, October 1986.
- Rensselaer Polytechnic Institute, Troy, NY, Physics Department Colloquium, *Cooling Flows and the X-ray Emission of Elliptical Galaxies*, January 1987.
- NATO Advanced Study Workshop on Cooling Flows in Galaxies and Clusters, Cambridge University, Cambridge, England, Invited Review Talk, *The Properties of Clusters of Galaxies*, June 1987.
- Cornell University, Ithaca, NY, Astronomy Department Colloquium, *Cooling Flows and the X-ray Emission of Elliptical Galaxies*, February 1988.
- Princeton University, Princeton, NJ, Astrophysics Department Colloquium, *Cooling Flows and the X-ray Emission of Elliptical Galaxies*, March 1988.

- Johns Hopkins University, Baltimore, MD, Astrophysics Group Seminar, *Cooling Flows and the X-ray Emission of Elliptical Galaxies*, April 1988.
- International Astronomical Union Colloquium 115: High Resolution X-ray Spectroscopy of Cosmic Plasmas, Cambridge, MA, Invited Review, *X-ray Spectra of Clusters of Galaxies*, August 1988.
- NASA Space Telescope Science Institute, Baltimore, MD, Colloquium, *X-ray Emission from Normal Elliptical Galaxies*, November 1988.
- National Radio Astronomy Observatory, Charlottesville, VA, Seminar, *Environmental Effects on the Hot Gas in Elliptical Galaxies*, April 1989.
- Ettore Majorana Centre, Erice, Italy, Invited Talk, *The X-ray Emission of Normal Elliptical Galaxies and their Environment*, May 1989.
- Wyoming Conference on the Interstellar Medium in External Galaxies, Jackson Lake Lodge, Wyoming, Invited Review Talk, *Cooling Flows and X-ray Emission*, July 1989.
- Ohio State University, Columbus, OH, Astronomy Department Colloquium, *X-ray Emission from Elliptical Galaxies*, February 1990.
- Canadian Institute for Theoretical Astrophysics, Toronto, Canada, Colloquium, *X-ray Emission from Elliptical Galaxies*, May 1990.
- University of New Mexico, Albuquerque, NM, Astronomy Department Colloquium, *Gas Stripping and X-ray Emission from Elliptical Galaxies*, May 1990.
- National Radio Astronomy Observatory and New Mexico Institute of Mining and Technology, Socorro, NM, Joint Astrophysics Colloquium, *Gas Stripping and X-ray Emission from Elliptical Galaxies*, June 1990.
- University of Virginia, Summer on the Lawn Program, *Space Exploration: Man's Place in the Cosmos*, June 1990.
- Sesto Pusteria Workshop on Environmental Effects in Cluster and Superclusters, Sesto Pusteria, Italy, Invited Talk, *Environmental Effects and the Gaseous Content of Early-Type Galaxies*, July 1990.
- Varenna Workshop on Iron Line Diagnostics in X-ray Sources, Varenna, Italy, Invited Review Talk, *Iron Line Diagnostics in Elliptical Galaxies and Cluster Cooling Flows*, October 1990.
- University of Bologna, Astronomy Colloquium, *X-ray Emission from Elliptical Galaxies*, October 1990.
- Yamada Conference on Frontiers of X-ray Astronomy, Nayoga, Japan, Invited Review Talk, *Cooling Flows in Clusters of Galaxies*, April 1991.
- NATO Advanced Study Institute on Clusters and Superclusters of Galaxies, Cambridge, England, Invited Review Talk, *The Intracluster Medium*, July 1991.

SISSA International Conference on Galaxy Environments and the Large Scale Structure of the Universe, Trieste, Italy, Invited Review Talk, *Developments in Clusters of Galaxies*, October 1991.

Naval Research Laboratory, Space Sciences Colloquium, *Filaments in Cluster Cooling Flows*, January 1992.

University of Maryland, College Park, MD, Department of Astronomy Colloquium, *Filaments in Cluster Cooling Flows*, February 1992.

XIIth Moriond Astrophysics Meeting on Physics of Nearby Galaxies, Nature or Nurture, Les Arc, France, Invited Review Talk, *X-ray Emission from Galaxies*, March 1992.

XIIth Moriond Astrophysics Meeting on Physics of Nearby Galaxies, Nature or Nurture, Les Arc, France, Conference Summary Talk, March 1992.

Meudon Observatory, Paris, France, Astronomy Colloquium, *Filaments in Cluster Cooling Flows*, March 1992.

World Space Congress, Washington, DC, contributed talk, *Filaments in Cluster Cooling Flows*, September 1992

Scuola Normale Superiore, Pisa, Italy, Astronomy Colloquium, *Filaments in Cluster Cooling Flows*, November 1992.

Scuola Normale Superiore, Pisa, Italy, Astronomy Colloquium, *X-ray Emission from Elliptical Galaxies*, November 1992.

Arcetri Observatory, Florence, Italy, Astronomy Colloquium, *Filaments in Cluster Cooling Flows*, December 1992.

Canadian Institute Advanced Research Meeting on Clusters of Galaxies, Banff, Alberta, Invited Review Talk, *Recent X-ray Observations of Clusters*, February 1993.

Space Telescope Science Institute, Baltimore, MD, Astronomy Colloquium, *Filaments in Cluster Cooling Flows*, March 1993.

Moriond Conference on Clusters of Galaxies, Méribel, France, Invited Review Talk, *X-Ray, Radio, and Optical Structures in Cooling Flow Clusters*, March 1994.

Aspen Astrophysics Workshop on the Physics of Clusters of Galaxies, Aspen, CO, Invited Review Talk, *Magnetic Fields in Clusters of Galaxies*, June 1994.

High Energy Astrophysics Division Meeting, Napa, CA, Invited Review Talk, *Hot, Cooling, and Cold Gas in Clusters of Galaxies*, November 1994.

Eleventh Colloquium on UV and X-Ray Spectroscopy of Astrophysical and Laboratory Plasmas, Nagoya, Japan, Invited Review Talk, *X-ray Spectra of Clusters of Galaxies and Cluster Cooling Flows*, May 1995.

Nagoya University, Nagoya, Japan, Physics Colloquium, *Magnetic Fields, Radio Sources, and Cluster Cooling Flows*, June 1995.

Tokyo Metropolitan University, Tokyo, Japan, Physics Colloquium, *Magnetic Fields, Radio Sources, and Cluster Cooling Flows*, June 1995.

Space Telescope Science Institute, Baltimore, MD, ISM/IGM Seminar, *Cold Gas and Excess Absorption in Cluster Cooling Flows?*, August 1995.

Max Planck Institute for Extraterrestrial Physics, Munich, Germany, Astronomy Colloquium, *Magnetic Fields, Radio Sources, and Cluster Cooling Flows*, September 1995.

Röntgenstrahlung from the Universe Meeting, Würzburg, Germany, Invited Review Talk, *ROSAT Observations and Correlated X-ray, Radio, and Optical Features in Cluster Cooling Flows*, September 1995.

Northwestern University, Evanston, IL, Astronomy Colloquium, *Magnetic Fields, Radio Sources, and Cluster Cooling Flows*, October 1995.

Elliptical Galaxies: Dynamics and Structure Meeting, Pune, India, Invited Review Talk, *X-Ray Emission from Normal Elliptical Galaxies*, November 1995.

Elliptical Galaxies: Dynamics and Structure Meeting, Pune, India, Invited Review Talk, *Clusters of Galaxies, cD Galaxies, and Cluster Cooling Flows*, December 1995.

Elliptical Galaxies: Dynamics and Structure Meeting, Pune, India, Invited Review Talk, *Magnetic Fields and Correlated X-Ray, Radio, and Optical Structures in Cooling Flow cD Galaxies*, December 1995.

University of Toronto, Toronto, Canada, Astronomy Colloquium, *Magnetic Fields, Radio Sources, and Cluster Cooling Flows*, March 1996.

University of Michigan, Ann Arbor, MI, Astronomy Colloquium, *Magnetic Fields, Radio Sources, and Cluster Cooling Flows*, April 1996.

Cooling Flows in Clusters and Galaxies Meeting, Oranim, Israel, Invited Review Talk, *Cluster Cooling Flows: Recent Progress and Outstanding Problems*, August 1996.

Cooling Flows in Clusters and Galaxies Meeting, Oranim, Israel, Conference Summary Talk, August 1996.

The Nature of Elliptical Galaxies Meeting, Canberra, Australia, Invited Review Talk, *X-ray Emission from Ellipticals and cD Galaxies*, August 1996.

Workshop on High Throughput X-ray Spectroscopy, Boston, MA, Invited Review Talk, *High Resolution X-ray Spectra of Cluster Cooling Flows*, September 1996.

National Radio Astronomy Observatory, Charlottesville, VA, Seminar, *Radio Sources and Blue Lobes in Cluster Cooling Flows*, December 1996.

Clusters of Galaxies at Different Redshifts Meeting, Ruidosa, New Mexico, Invited Review, *Cooling Flows and the Dynamics of Clusters*, May 1997.

Goddard Space Flight Center, Greenbelt, MD, High Energy Astrophysics Colloquium, *X-Ray Spectra of Clusters and Early-Type Galaxies*, July 1997.

- Ringberg Workshop on Clusters of Galaxies as Cosmological Probes, Ringberg, Germany, Invited Review, *Extreme Ultraviolet Emission from Clusters of Galaxies: Inverse Compton Radiation from a Relic Population of Cosmic Ray Electrons?*, October 1997.
- National Radio Astronomy Observatory, Charlottesville, VA, Jansky Symposium, *Cosmological Implications of Cluster Temperature Measurements*, October 1997.
- National Radio Astronomy Observatory, Charlottesville, VA, Seminar, *Extreme Ultraviolet Emission from Clusters of Galaxies: Inverse Compton Radiation from a Relic Population of Cosmic Ray Electrons?*, November 1997.
- Space Telescope Science Institute, Baltimore, MD, ISM/IGM Seminar, *Extreme Ultraviolet Emission from Clusters of Galaxies: Inverse Compton Radiation from a Relic Population of Cosmic Ray Electrons?*, March 1998.
- Saclay Laboratory, Paris, France, Astrophysics Colloquium, *Extreme Ultraviolet Emission from Clusters of Galaxies: Inverse Compton Radiation from a Relic Population of Cosmic Ray Electrons?*, April 1998.
- University of Michigan, Ann Arbor, MI, Astrophysics Seminar, *Extreme Ultraviolet Emission from Clusters of Galaxies: Inverse Compton Radiation from a Relic Population of Cosmic Ray Electrons?*, April 1998.
- Ohio State University, Columbus, OH, Astronomy Department Colloquium, *Extreme Ultraviolet Emission from Clusters of Galaxies: Inverse Compton Radiation from a Relic Population of Cosmic Ray Electrons?*, April 1998.
- Ohio University, Athens, OH, Physics Department Colloquium, *Extreme Ultraviolet Emission from Clusters of Galaxies: Inverse Compton Radiation from a Relic Population of Cosmic Ray Electrons?*, April 1998.
- Harvard/Smithsonian Center for Astrophysics, Cambridge, MA, High Energy Astrophysics Seminar, *Extreme Ultraviolet Emission from Clusters of Galaxies: Inverse Compton Radiation from a Relic Population of Cosmic Ray Electrons?*, May 1998.
- Roma II University, Rome, Italy, Astronomy Colloquium, *Extreme Ultraviolet Emission from Clusters of Galaxies: Inverse Compton Radiation from a Relic Population of Cosmic Ray Electrons?*, May 1998.
- BeppoSAX Science Data Center, Rome, Italy, Astrophysics Colloquium, *Extreme Ultraviolet Emission from Clusters of Galaxies: Inverse Compton Radiation from a Relic Population of Cosmic Ray Electrons?*, May 1998.
- CNR, Milan, Italy, Astrophysics Colloquium, *Extreme Ultraviolet Emission from Clusters of Galaxies: Inverse Compton Radiation from a Relic Population of Cosmic Ray Electrons?*, May 1998.
- Brera Observatory, Merate, Italy, Astrophysics Colloquium, *Extreme Ultraviolet Emission from Clusters of Galaxies: Inverse Compton Radiation from a Relic Population of Cosmic Ray Electrons?*, May 1998.
- National Radio Astronomy Observatory, Charlottesville, Jansky Symposium, *Hard X-ray Emission and the Radio Halo in the Coma Cluster: the X Factor?*, October 1998.

North Carolina State University, Physics Department Colloquium, *Luminous Plasma and Dark Matter in Clusters of Galaxies*, November 1998.

ASCA Symposium on Heating and Acceleration in the Universe, Tokyo, Japan, Invited Review Talk, *Nonthermal Particles and Emission from Clusters of Galaxies*, March 1999 (missed talk due to travel difficulties.).

Ringberg Workshop on Diffuse Thermal and Relativistic Plasma in Galaxy Clusters, Ringberg, Germany, Invited Review, *Models for the Relativistic Particle Population and Emission from Clusters of Galaxies*, April 1999.

Conference on Large Scale Structure in the X-ray Universe, Santorini, Greece, Invited Review, *Thermal and Nonthermal Effects of Merger Shocks on Clusters of Galaxies*, September 1999.

University of Minnesota, Astronomy Department Colloquium, *Thermal and Nonthermal Effects of Merger Shocks on Clusters of Galaxies*, December 1999.

Fermi National Accelerator Laboratory, Illinois, Astrophysics Colloquium, *Thermal and Nonthermal Effects of Merger Shocks on Clusters of Galaxies*, February 2000

Institut d'Astrophysique 2000 Conference: Constructing the Universe with Clusters of Galaxies, Paris, France, Invited Review, *Cluster mergers and non-thermal emission*, July 2000

National Radio Astronomy Observatory, Charlottesville, Jansky Symposium, *Resolving the Mystery of X-ray-Faint Elliptical Galaxies*, October 2000

High Energy Astrophysics Division Meeting, Honolulu, Hawaii, Talk, *Resolving the Mystery of X-ray Faint Elliptical Galaxies: Chandra X-ray Observations of NGC 4697*, November 2000

Moriond Conference on Galaxy Clusters and the High Redshift Universe Observed in X-rays. Les Arcs, France, Invited Review Talk, *Merger Shocks and Nonthermal Processes in Clusters of Galaxies*, March 2001

Conference on Two Years of Science with Chandra, Washington, DC, Talk, *Chandra Observations of the Low Mass X-ray Binary Populations of X-ray Faint Elliptical and S0 Galaxies*, September 2001

Rutgers University, Physics Department Colloquium, *Resolving the Mystery of X-ray Faint Elliptical Galaxies*, January 2002

M.I.T, Physics Department Colloquium, *Recent Chandra X-ray Observations of Clusters of Galaxies, the Largest Objects in the Universe*, March 2002

American Astronomical Society meeting, Topic Session on EUV Astronomy, Albuquerque, NM, invited review talk on *Diffuse EUV Emission from Clusters of Galaxies*, June 2002

American Astronomical Society meeting, Special Session on High Energy Processes in Normal Galaxies, Albuquerque, NM, invited review talk on *X-ray Emission from Normal Elliptical Galaxies*, June 2002

American Astronomical Society meeting, Joint AAS/NASA HQ/Chandra X-ray Center press conference, Albuquerque, NM, *Black Holes in Distant Galaxies Point to Wild Youth*, June 2002

Aspen Center for Physics Astrophysics Workshop on the Compact Object Populations in External Galaxies, Aspen, CO, invited talks on *Low Mass X-ray Binaries in Early-Type Galaxies*, and *Luminous X-ray Binaries in Globular Clusters*, June 2002

Division of Plasma Physics, American Physical Society, annual meeting, Orlando, FL, invited review talk on *Hot Plasma in Clusters of Galaxies, the Largest Objects in the Universe*, November 2002

Kapteyn Observatory Colloquium, Leiden University, Leiden, The Netherlands, *Chandra Observations of Low Mass X-ray Binaries, Globular Clusters, and Hot Gas in Elliptical Galaxies*, April 2003

Groningen University Astronomy Colloquium, Groningen, The Netherlands, *Chandra Observations of Low Mass X-ray Binaries, Globular Clusters, and Hot Gas in Elliptical Galaxies*, April 2003

International Astronomical Union, Sydney, Australia, invited review talk on *Mergers and Non-Thermal Processes in Clusters*, July 2003

Joint European Southern Observatory, Max Planck Institute for Astrophysics, and Max Planck Institute for Extraterrestrial Physics Colloquium, Garching, Germany, *The Dynamical Intracluster Medium: Chandra and XMM-Newton X-ray Observations*, November 2003

Astronomy Colloquium, Innsbruck University, Innsbruck, Austria, *The Dynamical Intracluster Medium: Chandra and XMM-Newton X-ray Observations*, December 2003

High Energy Astrophysics Seminar, Max Planck Institute for Astrophysics and Max Planck Institute for Extraterrestrial Physics, Garching, Germany, *X-ray Binaries and Globular Clusters in Elliptical Galaxies*, December 2003

Invited Review Talk, X-ray and Radio Connections Meeting, Santa Fe, NM, *Mergers and Non-Thermal Processes in Clusters of Galaxies*, February 2004

National Radio Astronomy Observatory, Colloquium, Charlottesville, VA, *The Dynamic Intracluster Medium: Interaction of X-ray and Radio Plasma*, February 2004

Invited Review Talk, Making Waves with Intermediate-Mass Black Holes Meeting, State College, PA, *The Observational Connection Between ULX/IMBHs and Star Clusters*, May 2004

Invited Talk, Galaxies Viewed with Chandra Meeting, Cambridge, MA, *Low Mass X-ray Binaries and Globular Clusters in Early-Type Galaxies*, July 2004

Invited Review Talk, COSPAR Meeting, Paris, France, *Interactions between Radio Sources and X-ray Gas at the Centers of Cooling Core Clusters*, July 2004

- Invited Review Talk, Cosmic Rays and Magnetic Fields in Large Scale Structure Meeting, Busan, Korea, *Review on Mergers, Cosmic Rays, and Non-Thermal Processes in Clusters of Galaxies*, August 2004
- National Radio Astronomy Observatory, Charlottesville, VA, Seminar, *What are Radio Sources Made of?*, October 2004
- Invited Talk, The Future of Cosmology with Clusters of Galaxies Meeting, Kona, HI, *The Effects of Cluster Mergers on their X-ray and SZ Properties and Use as Cosmological Probes*, February 2005
- Invited Lecture Series (four lectures), Guillermo Haro International School, A Pan-Chromatic View of Clusters of Galaxies and the Large-Scale Structure, Puebla, Mexico *Gas Dynamics in Clusters*, June 2005
- Invited Talk, Swift Science Conference, Goddard Space Flight Center, Maryland, *The Host Galaxies of Short Gamma-Ray Bursts*, July 2005
- Invited Talk, IAU Symposium 230, Populations of High Energy Sources in Galaxies, Dublin, Ireland, *Low Mass X-ray Binaries and Globular Clusters in Early-Type Galaxies*, August 2005
- Invited Talk, The X-ray Universe 2005, San Lorenzo de El Escorial, Spain, *Low Mass X-ray Binaries and Globular Clusters in Early-Type Galaxies*, September 2005
- E. O. Hulbert Colloquium, Naval Research Laboratory, Washington, DC, *The Dynamical Intracluster Medium*, October 2005
- Invited Review, Heating vs. Cooling in Galaxies and Clusters of Galaxies Meeting, Garching, Germany, *Introduction to Cluster Cooling Cores*, August 2006
- Invited Review, IAU General Assembly, Joint Discussion 12, Prague, CZ, *Diffuse Radio Sources in Clusters of Galaxies: Models and Long Wavelength Radio Observations*, August 2006
- Astronomy Colloquium, Argelander Institute of Astronomy, Bonn University, and Max Planck Institute for Radioastronomy, Bonn, Germany, *X-ray Binaries and Globular Clusters in Elliptical Galaxies*, January 2007
- Astronomy Colloquium, Department of Physics and Astronomy, UC Irvine, Irvine, CA, *X-ray Binaries and Globular Clusters in Elliptical Galaxies*, February 2007.
- Invited Talk, Aspen Center for Physics, Meeting on Clusters as Cosmological Probes, Aspen, Colorado, *Cluster Mergers as a Problem for Cosmological Tests: Can Radio Observations Help?*, February 2007.
- Astronomy Colloquium, Argelander Institute of Astronomy, Bonn University, and Max Planck Institute for Radioastronomy, Bonn, Germany, *Radio and Hot Gas Interactions in Clusters of Galaxies*, April 2007.
- Astronomy Colloquium, Innsbruck University, Innsbruck, Austria, *X-ray Binaries and Globular Clusters in Elliptical Galaxies*, April 2007.

High Energy Astrophysics Seminar, Max Planck Institute for Astrophysics and Max Planck Institute for Extraterrestrial Physics, Garching, Germany, *X-ray Binaries and Globular Clusters in Elliptical Galaxies*, April 2007.

Invited Talk, Meeting on X-ray Surveys: Evolution of Accretion, Star-Formation, and the Large-Scale Structure, Rodos Island, Greece, *Low Frequency Radio Observations and the Effects of Mergers and Radio Galaxies on the IC Gas in Clusters of Galaxies*, July 2007

Astronomy Colloquium, Rochester Institute of Technology, Rochester, NY, *X-ray Binaries and Globular Clusters in Elliptical Galaxies*, October 2007

Invited Talk, NRAO-U.Va. Tuesday Lunch talks, *Report of the Beyond Einstein Program Assessment Committee*, September 2007

Invited Talk, The Suzaku X-ray Universe meeting, San Diego, *Suzaku XIS, HXD, and XMM-Newton Observations of Thermal and Nonthermal Emission at Large Radii in the Merging Cluster Abell 3667*, December 2007

Invited Talk, The Warm/Hot Universe meeting, New York, *Hard X-rays from Clusters: Suzaku and XMM-Newton Observations of Coma, Abell 3667, and Ophiuchus*, May 2008

Invited Talk, The X-ray Universe 2008 meeting, Granada, Spain, *Hard X-ray Emission and IC in Coma and Abell 3667 from Suzaku and XMM-Newton*, May 2008

Invited Lectures (3), Enrico Fermi International School of Physics, Varenna, Italy, *Our Basics Theoretical Understanding of Clusters of Galaxies, The Physics of the Intracluster Gas, and Recent Results and Outstanding Problems with the Intracluster Gas*, July 2008

Invited Review Talk, Putting Gravity to Work: From Black Holes to Galaxy Clusters conference, Cambridge, England, *X-ray Observations of Clusters of Galaxies and Cool Cores*, July 2008

Invited Review Talk, The Cool, Cooler and Cold — Cluster Cooling Flows in a New Light workshop, Leiden, Netherlands, *X-ray Observations of Cluster Cores*, September 2008

Astronomy Colloquium, Kavli Institute for Particle Astrophysics and Cosmology, Stanford University, Palo Alto, CA, *Nonthermal and Thermal Plasma in Clusters of Galaxies*, October 2008

NASA Goddard Center Science Colloquium, Greenbelt, MD, *Hot Baryons in the Biggest Potential Wells in the Universe*, December 2008

Astronomy Colloquium, University of Colorado, Boulder, CO, *X-ray Binaries and Globular Clusters in Elliptical Galaxies*, February 2009

Astrophysics Seminar, Technion University, Haifa, Israel, *X-ray Binaries and Globular Clusters in Elliptical Galaxies*, May 2009

Astrophysics Colloquium, Tel Aviv University, Tel Aviv, Israel, *Nonthermal and Thermal Plasma in Clusters of Galaxies*, May 2009

Physics Colloquium, Technion University, Haifa, Israel, *Hot Baryons in the Biggest Potential Wells in the Universe*, May 2009

Astrophysics Colloquium, Weizmann Institute, Rehovot, Israel, *Nonthermal and Thermal Plasma in Clusters of Galaxies*, May 2009

Astrophysics Seminar, Weizmann Institute, Rehovot, Israel, *X-ray Binaries and Globular Clusters in Elliptical Galaxies*, May 2009

Astrophysics Colloquium, Hebrew University, Jerusalem, Israel, *Nonthermal and Thermal Plasma in Clusters of Galaxies*, May 2009

Invited Review Talk, The Energetic Cosmos: From Suzaku to Astro-H, Otaru, Japan, *Thermal and Nonthermal Hard X-ray Emission from Clusters of Galaxies*, June 2009

Invited Review Talk, Hot ISM in Elliptical Galaxies, IAU Joint Discussion, Rio de Janeiro, Brazil, *Feedback and Environmental Effects in Elliptical Galaxies*, August 2009

Invited Review Talk, High Energy Astrophysics Division meeting, Kona, Hawaii, *The Interaction of Hot Gas, Cool Gas and Dust, and Radio Plasma in the Central Galaxies of Cool Core Clusters*, February 2010

Invited Review Talk, SnowCluster meeting, Snowbird, Utah, *Nonthermal Emission and the Dynamical State of Clusters*, March 2010

Invited Talk, Galaxy Clusters: Observations, Physics, and Cosmology meeting, Garching, Germany, *Nonthermal Emission and the Dynamical State of Clusters*, July 2010

Invited Review Talk, New Paths in Studies of Galaxy Clusters meeting, Stubai Alpen, Austria, *The Physics of Cluster Mergers*, August 2010

Invited Talk, Non-Thermal Phenomena in Colliding Galaxy Clusters meeting, Nice, France, *Observations of Hard X-rays from Galaxy Clusters and Cluster Mergers*, November 2010

Invited Opening Review Talk, Structure in Clusters and Groups of Galaxies in the Chandra Era meeting, Boston, *Chandra's Clear View of the Structure of Clusters*, July 2011

Physics Colloquium, University of Innsbruck, Innsbruck, Austria, *Clusters of Galaxies, the Largest Objects in the Universe*, November 2011

Astrophysics Colloquium, Argelander Institute for Astronomy, Bonn University, and Max Planck Institute for Radio Astronomy, Bonn, Germany, *Merger Shocks in Clusters of Galaxies*, November 2011

Invited Review Talk, Obergurgl Winter School on Computational Interdisciplinary Modeling, Obergurgl, Austria, *Numerical Simulations of Large Scale Structure and Cluster Mergers*, January 2012

Invited Talk, Galaxy Clusters as Giant Cosmic Laboratories Conference, Madrid, Spain, *X-ray Observations of Shocks and Radio Emission in Abell 3667, Abell 665, Abell 2061, and the Cygnus-A Cluster*, May 2012

Invited Talk, American Astronomical Society Meeting, Anchorage, Alaska, *SLAM High Resolution Numerical Simulations of the SZ Signatures of Cluster Mergers*, June 2012

- Invited Talk, Half a Century of X-ray Astronomy Meeting, Mykonos, Greece, *The Merger Shock in Abell 3667 and the Origin of the Radio Relic*, September 2012
- Invited Review Talk, Obergurgl Winter Meeting on Computational Interdisciplinary Modeling, Obergurgl, Austria, *Numerical Simulations of Large Scale Structure and Cluster Mergers*, March 2013
- Invited Talk, The X-ray Universe 2014, Dublin, Ireland, *XMM-Newton and Chandra Observations of the Remarkable Dynamics of the Intracluster Medium and Radio Sources in the Clusters Abell 2061, 2626, and 3667*, June 2014
- Invited Review Talk, The X-ray View of Galaxy Ecosystems Meeting, Boston, *The Physical State of the Hot and Cool Gas in Elliptical and BCG Galaxies*, July 2014
- Invited Review Talk, The X-ray View of Galaxy Ecosystems Meeting, Boston, *Closing Discussion Session Chair*, July 2014
- Invited Talk, Alpine Cosmology Workshop 2014, Gschnitztal, Austria, *X-ray Observations of the Dynamics of Galaxy Clusters and the Origin of Diffuse Radio Sources*, July 2014
- Invited Colloquium, Physics Department, University of Helsinki, Finland, *Mergers, Shocks, and the Dynamical State of Clusters of Galaxies*, September 2015
- Invited Colloquium, SRON, Utrecht, the Netherlands, *Mergers, Shocks, and the Dynamical State of Clusters of Galaxies*, November 2015
- Invited Colloquium, Department of Astronomy, University of Amsterdam, the Netherlands, *Mergers, Shocks, and the Dynamical State of Clusters of Galaxies*, November 2015
- Invited Discussion, XMM-Newton — The Next Decade conference, Madrid, Spain, *The Future of XMM-Newton*, May 2016
- Invited talk, The Physics of Clusters of Galaxies workshop, COSPAR General Assembly, Istanbul, Turkey, *Mergers, Shocks, and the Dynamical State of Clusters of Galaxies*, July 2016, meeting cancelled due to terrorism and political instability
- Invited talk, Galaxies and Cosmology Seminar, Harvard-Smithsonian Center for Astrophysics, Cambridge, Massachusetts, *Mergers, Shocks, and the Dynamical State of Clusters of Galaxies*, October 2016

Craig L. Sarazin

TEACHING EXPERIENCE

Undergraduate Teaching

Introductory Physics Laboratory, Teaching Assistant, Princeton University, 1972-1975, text: *Physics*, Halliday and Resnick.

University Seminar on the Violent Universe, USEM 170, University of Virginia, 1992, text: *The X-Ray Universe*, Tucker and Giacconi; *Black Holes and the Universe*, Novikov.

Introduction to the Sky and Solar System, ASTR 121, University of Virginia, 1978, 1984-1985, 1987-1988, 1994-1995, 1997, 2000-2001, 2008; renumbered ASTR 1210, 2010; text: *Astronomy: The Cosmic Journey*, Hartmann, (1978); *The Dynamic Universe*, Snow (1984-1985); *Essentials of the Dynamic Universe*, Snow (1987-1988); *Universe*, Kaufmann (1994-1995), *Discovering the Universe*, Kaufmann and Comins (1997); *Voyages through the Universe*, Fraknoi, Morrison, and Wolff (2000-2001); *Foundations of Astronomy*, Seeds (2008); *The Cosmic Perspective*, Bennett et al. (2010,2013).

Introductory Astronomy (Stellar and Galactic Astronomy), ASTR 124, University of Virginia, 1983-1984, 1987, 1990, 1993-1994, 1999 text: *The Dynamic Universe*, Snow (1983-1984); *Essentials of the Dynamic Universe*, Snow (1987); *Astronomy: The Cosmic Journey*, Hartmann (1990), *Universe*, Kaufmann, (1993-1994), *Voyages through the Universe*, Fraknoi, Morrison, and Wolff (1999, 2002).

General Astronomy I, ASTR 211, University of Virginia, 1977-1982, 1986, 1990; renamed and renumbered: Introduction to Astrophysics I, ASTR 2110, 2009-2010, 2014, 2016, text: *Introduction to Astronomy and Astrophysics*, Smith and Jacobs (1977-1981); *The Physical Universe*, Shu (1982,1986); *Astronomy: A Physical Perspective*, Kutner (1990); *Fundamental Astronomy*, Karttunen et al. (2005,2007); *Foundations of Astrophysics*, Ryden and Peterson (2009-2016).

General Astronomy, ASTR 212, University of Virginia, 1978-1983, 1987, 1989, 1991, 1996, 2004, 2006, 2009; renamed and renumbered: Introduction to Astrophysics II, ASTR 2120, 2011-2014, 2016-2017, text: *Introduction to Astronomy and Astrophysics*, Smith and Jacobs (1978-1982); *The Physical Universe*, Shu (1983,1987,1989,2002,2003); *Astronomy: A Physical Perspective*, Kutner (1991); *Introductory Astronomy & Astrophysics*, Zeilik, Gregory, and Smith (1996); *An Introduction to Modern Astrophysics*, Carroll and Ostlie (2004); *Fundamental Astronomy*, Karttunen et al. (2006), *Astronomy: A Physical Perspective*, Kutner (2009), *Foundations of Astrophysics*, Ryden and Peterson (2010-2017).

Interstellar Medium and High Energy Astrophysics, ASTR 127C, University of California-Berkeley, 1979, text: class notes.

Physics Independent Study, PHYS 393, University of Virginia, 2009, Chandra Observation of Low Mass X-ray Binaries in the Lenticular Galaxy NGC 2768

Astronomy Tutorials, ASTR 395, University of Virginia, renumbered ASTR 4993, topics of individual tutorials have included: Accretion Disks; Black Hole Thermodynamics; Blackholes and Wormholes, 1989; Binary X-ray Sources (4 times); Broad-Line Emission Regions in Quasars; Clusters of Galaxies, 1996, 1999, 2002, 2003, 2005, 2006, 2007, 2008; Cosmology (6 times); Energy Extraction from Rotating Black Holes; Interstellar Molecules; Neutrino Astrophysics; Observational Properties of Black Holes, 1978-1987; Pulsars (3 times); Quasars (5 times); SS433; X-ray Astronomy, 2007; X-ray Binary Stars, 2008, 2014-2015; X-ray Emission from Clusters of Galaxies, 1990, 2012-2017; Numerical Simulations of Galaxies and Clusters, 2016; Text: assorted articles and reference works.

Senior Thesis in Astronomy, ASTR 498, University of Virginia, renumbered ASTR 4998, 1983, 1984, 1986, 1987, 1988, 1991, 1992, 1994, 1996, 1997, 2003, 2005, 2006, 2008, 2009, 2013, 2014, 2015, 2016, 2017

Undergraduate Senior Thesis Supervision

Richard Patterson, *Line Locking in SS433*, 1984.

Boris Starosta, *The Space Distribution of Galaxies in the Lynx-Ursa Major and Perseus-Pisces Superclusters*, 1984.

Michael Dinniman, *Quasars and Gravitational Lensing*, 1987.

Gregory Ashe, *Cooling Flow Models for Elliptical Galaxies*, 1988.

Michael Rilee, *Coronal Line Emission in Cooling Flows*, 1988.

Rose Finn, *A Search of Intragroup Gas*, 1992.

Sean Hendrick, *A Mass Determination for the Cluster A4059 from X-Ray Emissions*, 1994.

Richard Scalzo, *Gas Stripping from Elliptical Galaxies*, 1997.

Justin Spring, *Chandra X-ray Observation of AWM7: An Analysis of the Dependency of Central Galaxy Cluster Structure on Current Radio Source Activity*, 2003.

Kalin Kanov, *Chandra X-ray Observation of the Radio/X-ray Interaction in the Core of Abell 2063*, 2006.

Kellen Eilerts, *X-ray, Radio, and Optical Images of Merging Clusters of Galaxies*, 2008.

Randall Harris Haynes, *Chandra Observation of Low Mass X-ray Binaries and an Ultra-Luminous X-ray Source in the Lenticular Galaxy NGC 1380*, 2009.

Kai S. Chang, *Chandra Observations of the Merging Cluster of Galaxies Abell 119*, 2009.

Wesley T. Regimbal, *Chandra Observation of Low Mass X-ray Binaries in the Lenticular Galaxy NGC 2768*, 2009.

Taylor G. Hogge, *The Merger Dynamics of Abell 2061 and the Origin of the Diffuse Radio Sources*, 2013

Michael A. Viray, *Chandra Observations of the Unusual Radio Source in Abell 2626*, Director, 2015.

Avery P. Bailey, *The Merger Dynamics of Abell 2061*, Director, 2016.

Renato Mazzei, *The Effect of Galaxy Ram Pressure Stripping on the Abundances in Clusters of Galaxies*, Director, 2017

Graduate Teaching

Graduate Statistical Mechanics, Teaching Assistant, Princeton University, Princeton University, 1973-1974, text: *Statistical Mechanics*, Huang.

Interstellar Medium, ASTR 216, University of California–Berkeley, 1979, text: *Physical Processes in the Interstellar Medium*, Spitzer.

Extragalactic Astronomy, ASTR 540, University of Virginia, 1996, text: journal articles, team-taught with other faculty.

Interstellar Medium, ASTR 542, University of Virginia, 1981, 1997, 1999, 2001, 2003, 2005, text: *Physical Processes in the Interstellar Medium*, Spitzer, and *Astrophysics of Gaseous Nebulae and Active Galactic Nuclei*, Osterbrock.

High Energy Astrophysics, ASTR 545, University of Virginia, 1988, 1996, 1998, 2002, 2004, 2006, 2008 text: *High Energy Astrophysics*, Longair (1988-2006), *Introduction to High-Energy Astrophysics*, Rosswog and Brüggén (2008)

Fundamental Concepts in Astronomy: The Solar System, ASTR 571, University of Virginia, 1994, 2001, text: *Universe*, Kaufmann.

Clusters of Galaxies, Astro Mundus Special Course 706918, University of Innsbruck, 2011, text: *X-ray Emission from Clusters of Galaxies*, Sarazin (13 students).

Current Topics in Astrophysical Research, ASTR 836, University of Virginia, 1978,1989,1990, text: journal articles.

Current Astronomical Topics, ASTR 8500, 2014, test: journal articles.

Non-Topical Graduate Research, ASTR 898, 1994–1997, 2002–2006.

Directed Graduate Research, ASTR 995, 1978–2006; renamed and renumbered, Supervised Research (Independent Study), ASTR 9995, 2010-2012.

Non-Topical Graduate Research, ASTR 997, 1996-1997.

Non-Topical Graduate Research, ASTR 999, 1978–2009; renumbered ASTR 9999, 2009-2011.

Graduate Thesis Supervision

E. James Wadiak, Masters thesis, Astronomy Department, *Radio Recombination Lines from Quasars*, Director, 1983

Andrew J. S. Hamilton, Ph.D. thesis, Astronomy Department, *X-Ray Emission from Supernova Remnants*, Director, 1984

Raymond E. White, III, Ph.D. thesis, Astronomy Department, *Cooling Flows and Star Formation in Clusters of Galaxies*, Director, 1986

Michael W. Wise, Masters thesis, Astronomy Department, *Charge Transfer and X-ray Emission from Supernova Remnants*, Director, 1989

Prudence N. Foster, Masters thesis, Astronomy Department, *Gravitational Lensing of the Cosmic Microwave Background*, Director, 1989

Chris Graney, Masters thesis, Astronomy Department, *Optical Coronal Emission Lines from Astrophysical Cooling Flows*, Director, 1990

Michael W. Wise, Ph.D. thesis, Astronomy Department, *Opacity Effects in Cooling Flows*, Director, 1992

Noella L. D’Cruz, Masters thesis, Astronomy Department, *Expected Emission from the Hyperfine Radio Line of Lithium-like ^{57}Fe in Cluster Cooling Flows*, Director, 1994

William W. Dalton, Ph.D. thesis, Astronomy Department, *Massive Binary Star Evolution: Theory and Observational Consequences*, Director, 1995

- James Irwin, Masters thesis, Astronomy Department, *ROSAT X-Ray Observations of the 2A 0335+096 Cluster of Galaxies*, Director, 1995
- Jeffrey Breen, Masters thesis, Astronomy Department, *Excess Soft X-Ray Absorption in Cooling Flow Clusters*, Director, 1996
- Chih-Yueh Wang, Masters thesis, Astronomy Department, *ROSAT X-ray Observations of the Elliptical Galaxy NGC 1404*, Director, 1997
- Franz Bauer, Masters thesis, Astronomy Department, *X-ray Properties of the Abell 644 Cluster of Galaxies*, Director, 1997
- Jimmy Irwin, Ph.D. thesis, Astronomy Department, *X-Ray Emission in Early-type Galaxies*, Director, 1997
- Jeffrey Crane, Masters thesis, Astronomy Department, *ASCA X-ray Spectral of the Elliptical Galaxy NGC 1395*, Director, 1997
- Donald Horner, University of Maryland, Department of Astronomy, Ph.D. thesis, *X-ray Scalling Laws for Galaxy Clusters and Groups*, Reader, 2001
- Zhenping Huang, Ph.D. thesis, Astronomy Department, *X-ray and Radio Structures in Cooling Flow Clusters*, Director, 2002
- Josh Kempner, Ph.D. thesis, Astronomy Department, *X-Ray and Radio Emission from Clusters Undergoing Mergers*, Director, 2002
- Dustin McNulty, Ph.D. thesis, Physics Department, *A Precise Measurement of the Spin Structure Functions g_2^p and g_2^d from SLAC Experiment E155X*, Reader, 2002
- Yelena Prok, Ph.D. thesis, Physics Department, *Measurement of the Spin Structure Function $g_1(x, Q^2)$ of the Proton in the Resonance Region*, Reader, 2004
- John Silverman, Ph.D. thesis, Astronomy Department, *Cosmological Evolution of X-ray Emitting Active Galactic Nuclei*, Reader, 2004
- Scott Randall, Ph.D. thesis, Astronomy Department, *Processes Affecting the Dynamics and X-ray Emission of Galaxies and Clusters of Galaxies*, Director, 2004
- Jeffrey Carlin, Masters research, Astronomy Department, *Chandra Observations of the X-ray Bright Elliptical Galaxy NGC 533*, Director, 2004
- John Shields, Ph.D. thesis, Physics Department, *The Search for the Emission of a CP-Violating $E1$ Photon in the $K_L \rightarrow \pi^+\pi^-\gamma$ Decay*, Reader, 2004

- Alexander Golossanov, Ph.D. thesis, Physics Department, *Measurements of CP Violation and K^0 Charge Radius Using $K_L \rightarrow \pi^+ \pi^- e^+ e^-$ Decays*. Reader, 2005
- Marios Chatzikos, Masters research, Astronomy Department, *Chandra Observation of Abell 2065: An Unequal Mass Merger?*, Director, 2005
- Ka-Wah Wong, Masters research, Astronomy Department, *XMM-Newton and Chandra Observations of Abell 2626*, Director, 2005
- Gregory Sivakoff, Ph.D. thesis, Astronomy Department, *Low-Mass X-ray Binaries, Diffuse Gas, and Globular Clusters in Early-Type Galaxies*, Director, 2006
- David G. Phillips, Ph.D.-thesis, Physics Department, *Search for a New Neutral Boson in the Rare Decay $K_L \rightarrow \pi^0 \pi^0 \mu^+ \mu^+$* , Reader, 2009
- Ka-Wah Wong, Ph.D. thesis, Astronomy Department, *The Role of Nonequilibrium Processes in Galaxy Clusters*, Director, 2010
- Daniel Wik, Ph.D. thesis, Astronomy Department, *Inverse Compton Scattering in Galaxy Clusters*, Director, 2010
- Eric Finster, Ph.D.-thesis, Mathematics Department, *Stabilization of Homotopy Limits*, Reader, 2010
- Ori Fox, Ph.D. thesis, Astronomy Department, *Supernovae in the Near Infrared*. Reader, 2010
- Michael Balazs, Ph.D. thesis, Physics Department, *Search for Experimental Evidence of Supersymmetry at the Large Hadron Collider*. Reader, 2011
- Ryan Lynch, Ph.D. thesis, Astronomy Department, *The Hunt for New and Interesting Pulsars with the Green Bank Telescope*. Reader, 2011
- Adi Zitrin, Ph.D. thesis, School of Physics & Astronomy, Tel Aviv University, *Mass Distributions of Galaxy Clusters from Measurements of Gravitational Lensing*. Reader, 2012
- Marios Chatzikos, Ph.D. thesis, Astronomy Department, *The Physics and Observational Signatures of Galaxy Cluster Mergers*, Director, 2012
- Rachel Yohay, Ph.D. thesis, Physics Department, *A Search in the Two-Photon Final State for Evidence of New Particle Production in pp Collisions at $\sqrt{s} = 7$ TeV*, Reader, 2012
- Anya Bilous, Ph.D. thesis, Astronomy Department, *Single-Pulse Study of Radio Pulsars*, Reader, 2012

- Carolyn Yarnall, Ph.D. thesis, Mathematics Department, *The Slices of $S^n \wedge H\mathbf{Z}$ for Cyclic p -Groups*, Reader, 2013
- Charles Romero, Ph.D. thesis, Astronomy Department, *MUSTANG High Resolution SZE Observations of Clusters of Galaxies*, Reader, 2015
- Brian Francis, Ph.D. thesis, Physics Department, *A Search for Evidence of New Particle Production in pp Collisions at $\sqrt{s} = 8$ TeV in the Lepton, Jets, and Photons Final State*, Reader, 2015
- Kimmo Kettula, Ph.D. thesis, Department of Physics, University of Helsinki, *X-Ray and Weak Lensing Measurements of Galaxy Groups and Clusters*, Reader, 2016
- Norbert Werner, Habilitation thesis, Institute for Theoretical Physics and Astrophysics, Masaryk University, Brno, Czech Republic, *From Supermassive Black Holes to the Large-Scale Structure of the Universe*, Reader, 2016
- Siraprapa (Tuck) Sanpa-arsa, Ph.D. thesis, Astronomy Department, *Searching for the New Millisecond Pulsars with the GBT on Fermi Unassociated Sources*, Reader, 2016
- Chris Irwin, Ph.D. thesis, Astronomy Department, *Long-Duration, Low-Luminosity Gamma-Ray Bursts: Towards a Comprehensive Model of the Weakest Engine-Driven Explosions*, Reader, 2016
- Thankful Cromartie, Ph.D. thesis, Astronomy Department, *Millisecond Pulsars*, Reader, in progress