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RESEARCH INTERESTS

Active Galactic Nuclei (AGN) demography and triggering processes; co-evolution of galaxies and supermassive black holes; multi-wavelength galaxy surveys; role of AGN in galaxy formation/evolution; the cosmic X-ray background; X-ray imaging and spectroscopy instruments & missions

EDUCATION

Yale University, New Haven, CT, USA

Doctor of Philosophy, Astronomy 06/2010 (expected)

- Thesis: Probing Hidden Populations of Supermassive Black Holes
- Advisor: Professor C. Megan Urry, Chair, Dept. of Physics

Master of Philosophy, Astronomy 2007

Master of Science, Astronomy 2005

University of Waterloo, Waterloo, Ontario, Canada

Bachelor of Science, Honours Physics & Minor in Mathematics 1996

Bachelor of Arts, Philosophy

PUBLICATIONS

4 first-author research papers and **7 second or third-author** research papers published in peer-reviewed scientific journals like The Astrophysical Journal and The Astronomical Journal

7 first-author technical research papers and **5 second-author** technical research papers published in scientific journals like SPIE – The International Society for Optical Engineering

HONORS & AWARDS

Boris Garfinkel Prize Fellowship, Yale University, 2009

Chambliss/AAS Astronomical Achievement Award Medal, January 2009

Natural Sciences & Engineering Research Council of Canada (NSERC) Postgraduate Scholarship, 2006-2009

Sigma Xi Grants-in-Aid of Research Fellowship, 2006

Beatrice Tinsley Prize, Yale University, 2005

Yale University Graduate Fellowship, 2004-2006

Chandra X-ray Observatory Special Act Award, 2003

The Smithsonian Institution Certificate of Award, 2003

NASA Group Achievement Award, Chandra Science Mission Planning, 2003

For outstanding service and dedication provided in effectively and efficiently scheduling the science mission observations of the Chandra X-ray Observatory.

NASA Group Achievement Award, Chandra/ACIS CTI Team, 2003

For outstanding achievement in identifying, addressing and mitigating the ACIS CTI effect on the Chandra X-ray Observatory mission.

NASA Group Achievement Award, Chandra/ACIS CTI Team, 2001

For outstanding achievement in identifying and addressing the ACIS CTI effect during the first year of the mission.

**HONORS &
AWARDS
CONT'D**

NASA Group Achievement Award, Chandra Radiation Environment Team, 2001
For outstanding effort in analyzing, understanding and defining the Chandra radiation environment and using that to constructively influence present and future missions.

NASA Group Achievement Award, Chandra Science Operations Team, 2001
For exemplary performance and significant contributions to the scientific requirements and the science integrity of the design, development, testing, and operations of the Chandra X-ray Observatory.

Chandra X-ray Observatory Special Act Award, 2001

The Smithsonian Institution Certificate of Award, 2000

Chandra X-ray Observatory Special Act Award, 2000

**RESEARCH
EXPERIENCE**

Graduate Student, Department of Astronomy, Yale University, New Haven, CT, 2004–present

PROJECT #1: An Unbiased Census of AGN in the Local Universe

- Responsible for carrying out one of the deepest extragalactic surveys done at hard X-rays to perform an unbiased census of AGNs in the local Universe
- Reduced and analyzed 3 Msec of data from the INTEGRAL observatory using standard data analysis software (OSA) developed for INTEGRAL data
- Discovered 15 new hard X-ray detections of AGNs, 2 sources are perhaps heavily obscured (*i.e.*, Compton-thick) – a lower number of CT candidates than was expected from models that attempt to explain the cosmic X-ray background (CXR); paper describing survey results is in preparation for publication in *The Astrophysical Journal*
- Broke the degeneracy between the space density of Compton-thick (CT) AGN and the Compton reflection component that are key ingredients of population synthesis models that explain the CXRB; paper published in *The Astrophysical Journal*
- Authored successful observing proposals to follow-up these new identifications with the Chandra X-ray Observatory and the Suzaku Observatory
- Awarded approximately **\$185k in funding** from various agencies to carry out the scientific goals of this deep survey

PROJECT #2: Probing X-ray Emission in the Extended Chandra Deep Field-South

- Reduced all 9 Chandra/ACIS observations of the Extended Chandra Deep Field-South (ECDFS); one of the largest & deepest X-ray surveys performed
- Produced the final X-ray source catalog of all sources in 3 different energy bands in the ECDFS; identified sources for follow-up optical spectroscopy with the 6.5m Magellan Baade/Clay telescopes and the 10m VLT
- First author of catalog paper published in *The Astronomical Journal*
- Co-authored successful follow-up spectroscopic proposals at Magellan/IMACS, Magellan/LDSS3, and VLT/VIMOS; assisted with 2 observing runs at the Magellan Telescopes in Las Campanas, Chile; paper on the optical identifications of the X-ray sources in the ECDFS published in the *The Astrophysical Journal*

RESEARCH
EXPERIENCE
CONT'D

- Identified a sample of very red AGNs in the ECDFS that may be high- z candidates ($z > 6$); co-authored successful observing proposals for time at Gemini/GNIRS, VLT/SINFONI, Subaru/MOIRCS, and Keck/NIRSPEC to obtain near-infrared spectroscopy and hence derive redshifts for these unique sources
- Co-supervised and worked closely with several Yale undergraduate students on related research projects in the ECDFS for their senior theses

Data Analyst, Chandra X-ray Observatory Science Center (CXC)/Smithsonian Astrophysical Observatory, Cambridge, MA 1999–2004

- Developed real-time software tools for monitoring the health and safety of the Advanced CCD Imaging Spectrometer (ACIS) instrument during communication contacts (<http://asc.harvard.edu/acis/RT/acis-mean.html>)
- Wrote several PERL software scripts to monitor the radiation environment of the Chandra X-ray Observatory 24 hours a day and alert senior personnel via pagers and cell phones should a problem arise; convened and participated in tele-conferences to decide if intervention with the spacecraft is necessary to protect the ACIS instrument from radiation damage and cease operations
- Analyzed, modeled, and published technical research papers regarding the Chandra X-ray Observatory's particle radiation environment and the resulting charge transfer inefficiency (CTI) degradation to ACIS
- Aided and assisted with ACIS flight calibration efforts to mitigate the CTI degradation of the primary instrument on-board Chandra
- Aided with the development of the Chandra Radiation Model and used it to define a new operating procedure that can result in up to an additional 500,000 seconds of observing time per year made available to guest observers

Research Assistant, Department of Physics and Astronomy, York University, Toronto, Ontario 1996–1999

- Analyzed broad-band B and R images of a large sample of Seyfert 1 and 2 galaxies culled from the CfA Redshift Survey
- Developed PSF-subtraction technique and wrote software to remove the AGN component from the host galaxy light
- Examined surface-brightness profiles of host Seyfert 1 & 2 galaxies, as well as a large sample of control (non-active) galaxies, to understand the role of interactions and mergers in inciting the AGN phenomenon
- First author of the resulting paper which presented the results of this investigation; published in *The Astronomical Journal*
- Co-authored successful CFHT proposal to image a sample of Narrow-Line Seyfert 1 galaxies to apply my point source subtraction technique to measure host galaxy bulge luminosities, and hence, black hole masses; paper published in the *The Astrophysical Journal*

RESEARCH
TALKS

- “An Unbiased Census of AGN in the Local Universe: The 3 Ms Ultra-deep INTEGRAL Survey of the XMM-LSS Field”, CASCA 2009: Annual Meeting of the Canadian Astronomical Society, University of Toronto, May 27, 2009
- “An Unbiased Census of AGN in the Local Universe: The 3 Ms Ultra-deep INTEGRAL Survey”, 19th NERQUAM, Brandeis University, Waltham, MA, May 20, 2009

RESEARCH
TALKS CONT'D

- “Obscured AGNs at High Energies: An Unbiased Census of AGN in the Local Universe”, Institute for Astronomy, University of Hawaii, Honolulu, HI, January 15, 2009
- “Probing X-ray emission in the Extended Chandra Deep Field-South”, Yale-Chile MUSYC Collaboration Meeting, Yale University, New Haven, CT, May 20, 2008
- “Searching for Compton-Thick AGNs with INTEGRAL”, European Southern Observatory, Santiago, Chile, October 7, 2007
- “New EXOs in the MUSYC Survey”, 16th NERQUAM, Massachusetts Institute of Technology, Cambridge, MA, May 2006.
- “The Extended Chandra Deep Field-South Survey: Preliminary Results”, 1st Annual Yale Graduate Student Research Conference, Yale University, June 2005.
- “Chandra Measurement of the X-Ray Spectrum of a Quasar at $z = 5.99$ ”, 35th COSPAR Scientific Assembly, Paris, France, July 2004.
- “A possible meteoroid impact on the Chandra X-Ray Observatory during the 2003 Leonids”, 35th COSPAR Scientific Assembly, Paris, France, July 2004.
- “The Chandra X-Ray Spectrum of the $z=5.99$ Quasar SDSSJ1306+0356”, 14th NERQUAM, Brandeis University, Waltham, MA, May 2004.

ALLOCATED
OBSERVING
TIME

Observatory		Instrument	Role	Time
Chandra X-ray Obs.	Cycle 11	ACIS	PI	40 ks
W. M. Keck Obs.	2009B	NIRSPEC	First Co-I	1.0 night
WIYN Obs.	2009B	MiniMo	First Co-I	3.0 night
W. M. Keck Obs.	2009A	NIRSPEC	First Co-I	0.5 night
Suzaku X-ray Telescope	Cycle 4	XIS+PIN	First Co-I	75 ks
Suzaku X-ray Telescope	Cycle 4	XIS+PIN	First Co-I	200 ks
XMM-Newton	Cycle 8	MOS+EPIC-PN	First Co-I	37 ks
Subaru Telescope	2008B	MOIRCS	First Co-I	0.5 night
Very Large Telescope	2008B	SINFONI	First Co-I	7 hours
Very Large Telescope	2008A	SINFONI	First Co-I	16 hours
INTEGRAL	Cycle 5	ISGRI+IBIS	PI	1 Ms
Suzaku X-ray Telescope	Cycle 2	XIS+PIN	First Co-I	80 ks
Magellan Telescope	2006B	IMACS	Co-I	15 hours
Gemini-South Telescope	2006B	GNIRS	First Co-I	20 hours
Very Large Telescope	2006B	SINFONI	Co-I	26 hours
Magellan Telescope	2006A	LDSS3	Co-I	4 nights
Gemini-South Telescope	2005B	GNIRS	First Co-I	15 hours
CFHT	2002B	CFHT-IR	First Co-I	2 nights

EXTERNAL
FUNDING

- Determining the Nature of the Faintest Hard X-ray Selected AGN with Chandra, \$45.2k, Chandra/NASA Guest Observer Grant, PI, 2009*
- The Nature of the Faintest Hard X-ray Selected AGN, \$23.5k, Suzaku/NASA Guest Observer Grant, 2009*
- How fast can an AGN shut down? Suzaku observation of IC 2497, \$22.7k, Suzaku/NASA Guest Observer Grant, first Co-I, 2009*
- How fast can an AGN shut down? XMM-Newton observation of IC 2497, \$56k, XMM-Newton/NASA Guest Observer Grant, First Co-I, 2008*
- A Complete AGN Census at High Energies with INTEGRAL, \$49.5k, INTEGRAL/NASA Guest Observer Grant, PI, 2007*
- Understanding Feedback and Galaxy Evolution: Chandra Data leveraged by a deep medium band survey, \$44.7k, Chandra/NASA Archive Grant, Co-I, 2007*

EXTERNAL
FUNDING
CONT'D

Supermassive Black Holes at High Energy and High Redshift: Unveiling the Compton-Thick AGN Population, **\$63,000, Natural Sciences & Engineering Research Council Post-graduate Scholarship, PI, 2006-2009**

Supermassive Black Holes at High Energy and High Redshift: Testing the AGN Unification Paradigm, **\$3,500, Sigma Xi Grants-in-aid-of-Research, PI, 2006**

Searching for Compton-Thick AGN with INTEGRAL, \$250, Yale University Conference Travel Fund, PI, 2005

Host Galaxies Morphologies and SEDs of High Luminosity AGN, \$85,568, HST/NASA Archive Grant, Co-I, 2005

The Extended Chandra Deep Field-South: Survey Catalog, \$1,000, Yale University Tinsley Award, PI, 2005

The Chandra Multiwavelength Project (ChaMP): A Serendipitous X-Ray Survey With Archival Data, \$200,000, CHANDRA/NASA Archive Grant, Co-I, 2001

PI on 6 proposals totaling ~\$163k; co-I on 6 proposals awarded ~\$433k

TEACHING
EXPERIENCE

Yale University, *Residential College Mathematics & Science Tutor*, Branford College, 2007–2008 academic year; <http://www.yale.edu/mstutor/>

Yale University, *Teaching Fellow*, 2004–2008

- Astronomy 110: “Stars and Planets” with Dr. Michael Faison
- Astronomy 120: “Galaxies and the Universe” with Professor Jeffrey Kenney
- Astronomy 130: “Life in the Universe” with Professor Sabatino Sofia
- Astronomy 170: “Introduction to Cosmology” with Prof. Priya Natarajan

Harvard University, *Head Teaching Fellow*, Spring 2001

- Science A-35: “Matter in the Universe” with Professor R. P. Kirshner

York University, *Tutor*, 1996–1998

- NATS 1900A: “Extraterrestrial Life”
- NATS 1720: “Exploration of the Universe”
- NATS 1770: “Technology and the Environment”
- MATH 1550: “Mathematics with Management Applications”

University of Waterloo, *Tutor*, 1994–1995

- Physics 125: “Physics for Engineers”
- Physics 115: “Mechanics”
- Physics 112 & 122: “Mechanics, Wave Motion, and Heat 2”

MENTORING
EXPERIENCE

Yale University, Department of Astronomy, June 2008 – May 2009

Mentored and co-supervised the work of Severin Knudsen for his undergraduate thesis entitled “*X-ray Stacking Of 70 μ m Detected Sources In The Chandra-COSMOS Field*”

Yale University, Department of Astronomy, June 2008 – May 2009

Mentored and co-supervised the work of Elissa Burwick for her undergraduate thesis entitled “*X-ray Properties of Sub-millimeter Galaxies in the Extended Chandra Deep Field-South*”

Yale University, Department of Astronomy, June 2005 – May 2006

Mentored and co-supervised the work of Yale senior Alexander Richardson for his undergraduate thesis entitled “*X-ray Properties of Star-forming Galaxies in the MUSYC Survey*”

 MENTORING
EXPERIENCE
CONT'D

Harvard-Smithsonian Center for Astrophysics, REU, Summer 2000
Mentored and co-supervised the work of Princeton undergraduate Deborah Freedman for her REU research project entitled "*An Analysis of Point Sources in Two Chandra Deep Fields*"

EDUCATION &
PUBLIC
OUTREACH

Contribute Scientific "Blog" entries on the Galaxy Zoo "Citizen Science" Blog
Galaxy Zoo is a Citizen Science project that has enlisted the help of over 250,000 members of the public in astrophysics research over the internet

Public Lecture on Supermassive Black Holes, Fall 2009
30 min research presentation prior to public observing and planetarium show at Yale's Leitner Family Observatory & Planetarium

Advanced Topics in Science Teaching, McDougal Graduate Teaching Center, 2009
Participated in a 5-week program to improve science course design, delivery, and to better engage students through active learning and peer instruction.

Yale Planetarium Show Operator, Spring, Summer & Fall 2009
Trained to use and operate Spitz's SciDome HD digital planetarium system and presented shows at Yale's Leitner Family Observatory & Planetarium during public observing nights

Achievement First – Elm City College Preparatory Middle School, Grades 5, New Haven, CT, March 20, 2009
Taught unit on Lunar Phases/Cycle; led Project ASTRO demonstration

Achievement First – Elm City College Preparatory Middle School, Grades 5 & 8, New Haven, CT, January 20, 2009
Organized and led an observing session and planetarium show at Yale's Leitner Family Observatory & Planetarium for 2 charter school groups

Yale Peabody Museum of Natural History, New Haven, CT, August 15, 2008
Organized & presented Starlab planetarium presentation on the summer night sky for elementary school students attending summer camp at the Museum.

Project ASTRO Teacher-Astronomer Workshop, July 17-18, 2008, Wesleyan University, Middletown, CT
Innovative, inquiry-based, science education program that links astronomers with 4th–9th grade educators to inspire their students through the excitement of scientific discovery.

Lawrence School, Grade 5, Brookline, MA, April 8, 2005
Taught unit on Lunar Phases/Cycle; led Project ASTRO demonstration

PROFESSIONAL
ACTIVITIES

Referee for The Astronomical Journal, MNRAS
Observing With ALMA Workshop, McMaster University, Hamilton, Ont. 2009
Penn State Astro-Statistics Workshop, Penn State Univ., State College, PA 2006
1st Annual Yale Astronomy & Astrophysics Graduate Student Conference, 2005
◦ Originator and Chair of Science Organizing Committee
3rd International X-ray Astronomy School, Wallops Flight Facility, VA 2003
ACIS Technical Reviewer for the Chandra AO-5 Observing Cycle, 2003
ACIS Technical Reviewer for the Chandra AO-4 Observing Cycle, 2002
ASP Science Symposium: The High Energy Universe at Sharp Focus, 2002,
◦ Member of Science Organizing Committee; AGN and XRBs Session Chair
ACIS Technical Reviewer for the Chandra AO-3 Observing Cycle, 2001
ACIS Technical Reviewer for the Chandra AO-2 Observing Cycle, 2000

**MEMBERSHIP OF
PROFESSIONAL
SOCIETIES**

American Astronomical Society
High Energy Astrophysics Division/AAS
Canadian Astronomical Society
Sigma Xi: The Scientific Research Society

**TECHNICAL
SKILLS**

Programming: FORTRAN, Pascal, BASIC, PERL, IDL, HTML, Shell scripts
Operating Systems: Mac OS X, UNIX, Linux, MS DOS, MS Windows
Software Packages: CIAO, XSPEC, FTOOLS, OSA, TeX/LaTeX, IRAF
Graphics/Visualization: IDL, SM, Xfig, XV, GIMP

Software Development: Considerable experience developing software for both real-time data collection, analysis, monitoring, and limit-checking, as well as to accomplish various research goals. For example see: <http://asc.harvard.edu/mta/RT/acis/www/acis-mean.html>
<http://asc.harvard.edu/acis/Fluence/current.dat>
These two websites in particular I developed to monitor the health and safety of the primary instrument on-board the Chandra X-ray Observatory. Should a value exceed its pre-established limit, alerts are issued to senior personnel and a tele-conference is immediately convened to discuss the alert and whether ground intervention is necessary. Much of my recent experience has been with mathematical analysis and modeling using PERL and IDL.