Craig O. Heinke

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Research Interests

Understanding neutron stars, black holes, white dwarfs, and how they accrete matter in binary systems; the interior physics of neutron stars; and how stars interact in dense clusters, through observations at multiple wavelengths (X-ray, optical, ultraviolet, infrared, and radio).

Education

Ph.D. Astronomy, Harvard University, Cambridge, MA, June 2004, advisor J. E. Grindlay

M.A. Astronomy, Harvard University, Cambridge, MA, June 2002

B.A. Physics, Carleton College, Northfield, MN, June 1997, *Magna Cum Laude*

Positions

Professor	July 2018–
Dept. of Physics, U. of Alberta	Edmonton, AB, Canada
Associate Professor	July 2012–June 2018
Dept. of Physics, U. of Alberta	Edmonton, AB, Canada
Assistant Professor	July 2008–June 2012
Dept. of Physics, U. of Alberta	Edmonton, AB, Canada
Research Associate	Aug. 2007–June 2008
Supervisor C. L. Sarazin, U. of Virginia	Charlottesville, VA, USA
Lindheimer Postdoctoral Fellow	Sept. 2004–Aug. 2007
Dept. of Physics & Astronomy, Northwestern U.	Evanston, IL, USA

Honors

NSERC Discovery Accelerator Supplement Award, 2016

Faculty of Science Research Award, University of Alberta, 2015

Alexander von Humboldt Fellow, Bonn, Germany, 2015

Martha Cook Piper Research Prize, University of Alberta, 2012

Avenue Edmonton "Top 40 Under 40", 2012

Ingenuity New Faculty, Alberta Innovates, 2010-2013

Lindheimer Postdoctoral Fellowship, Northwestern University, 2004-2007

Certificate of Distinction in Teaching (Graduate School of Arts and Sciences, Harvard Univ.), 2004

Fireman Award for Best Doctoral Dissertation (Astronomy Dept., Harvard Univ.), 2004

Supervision

Postdocs:

Liliana Rivera Sandoval, 2020–2021 (Avadh Bhatia Fellow, Gruber Foundation Fellow), (#196,184,179 in Publication List). Now Asst. Prof. at University of Texas, Rio Grande Valley

Aarran Shaw, 2016–2019. (#132,136,138,141,154,160,165,166, 170, 174, 179, 187). Now postdoc at University of Nevada, Reno.

Chengkui Li, (International Fellow, Chinese Academy of Sciences) 2015–2016. Now Postdoctoral Fellow at Institute for High Energy Physics, Chinese Academy of Sciences, Beijing. (#137)

Nathan Leigh (NSERC Fellow), 2013–2014. Now Assoc. Prof. at Universidad de Concepcion, Chile. (#93,96,166)

Jeanette Gladstone, (A. Bhatia Fellow; High-Energy Astrophysics Division's Dissertation Prize winner) 2009–2014. Now Public Outreach Coordinator at University of Alberta. (#73,75,76,77,84,89)

Graduate students:

Margaret Ridder MSc 2019–2021, PhD 2021–now.

Zhao Jiaqi (Jake) MSc 2019–2021, PhD 2021–now (182, 197).

Pavan Hebbar MSc 2017–2019, PhD 2019–now. (#154,163,177)

Zhao Yue (Cory) MSc/PhD 2016–2021. (#143,150,160,167,169,171,176,182,184,185,188,192,198). Now postdoc, University of Southampton, UK.

Asma Hattawi MSc 2016–2019. Physical trainer.

Reuben Gazer MSc 2015–2017. Thesis on using GALEX ultraviolet data to constrain the nature of Galactic Bulge Survey X-ray sources. Now data scientist, AltaML, and educator. (#119,130)

Arash Bahramian PhD (transfer from MSc program) 2012–2016, thesis on behaviour of X-ray binaries, and their formation in globular clusters. Now Research Fellow at Curtin University, Perth, Australia. (#63,73,84,86,89,92,98,103,104,108,112,114,126,137)

Khaled Elshamouty MSc 2010–2012, PhD 2012–2016, thesis on neutron star cooling and simulating the effects of hot spots on neutron stars. Now Data Scientist at Navut, Montreal. (#60,81,99,115,123)

Mizan Chowdhury, MSc 2009–2011, thesis on searching for quiescent X-ray binaries in the Small Magellanic Cloud. Now working for Federal Gov't of Canada.

Undergraduate researchers: 18 students during 12 semesters, 20 students over 6 summers.

George Coomber summer 2009 (NSERC USRA), winter 2009. Software Developer, Bioware. (#59).

Clifton Price summer 2009, fall 2009. MWD Field Engineer at Ensign Energy Services.

Sonia Budac summer 2009, winter 2010. Barista, Table Top Cafe. (#46, 68).

Will Stacey summer 2010 (NSERC USRA), summer 2011, fall 2011. Video Game Economy Designer, Waterloo. (#57, 63).

Rhys Chouinard winter 2010. Senior Corporate Analyst, City of St. Albert. (#123).

Taylor Cartwright fall 2010, summer 2011. Pilot, Canadian Armed Forces. (#75,76,77).

Johannes (Hans) Berger winter 2011. (#75).

Andrei Catuneanu, winter 2012, summer 2012 (NSERC USRA). PhD student, U. Toronto. #71).

Siobhan Crothers, winter 2012. Solutions architect, Hitachi ID Systems. (#166).

James Sikora, winter 2012. PhD student, Queen's.

Megan Engel summer 2011 (NSERC USRA), winter 2012, summer 2012. Rhodes Scholar, Oxford; now postdoc, U. Alberta. (#60, 75, 76).

Lindsay Forestell, summer 2012, summer 2013 (NSERC USRA). PhD student, UBC. (#90, 132).

Tyler Naffin, fall 2012.

Robin Arnason fall 2012. Senior Scientist, Interface Fluidics. (#102).

Sam Rowe, winter 2013, summer 2013.

Eric Koch summer 2013 (NSERC USRA). Postdoc, Harvard U. (#92,166).

N. Thomas Denman winter 2013, summer 2013. PhD candidate, U. Toronto.

R. Lee Pavelich fall 2013. PhD candidate in Engineering, U. Alberta.

C.J. Parr winter 2014. (#166).

Curtis Brown winter 2016.

Souradeep Bhattacharya summer 2016 (MITACS). Postdoc at IUCAA, Pune, India. (#133).

Pavan Hebbar summer 2016 (UARE). PhD student, U. Alberta.

Asma Hattawi summer 2016. Physical trainer.

Mario Ivanov summer 2017, summer 2018. Junior optical engineer. (#166).

Tetiana Kozynets summer 2017. PhD student, Aarhus U., Denmark.

Chinmaya Verma summer 2017 (UARE).

Sean McClure summer 2017 (NSERC USRA). PhD student, U. Alberta. (#179).

Tianyin Luo fall 2017, 2018, winter 2019.

Quinlan Ede winter 2018.

Su Fu fall 2018, winter 2019. PhD student, U. Alberta.

Riley Andrews fall 2018 (#166).

Samarveer Singh Rai fall 2018.

Oliver Boodram summer 2019, winter 2021.

Yumna Arshad summer 2019.

Vishwangi Shah summer 2019.

Summary: 50 papers published (or in press) involving graduate & undergraduate students, 17 grad student first-author, 10 undergrad student first-author. Five NSERC USRA summer students (**Coomber**, **Engel**, **Catuneanu**, **Forestell** & **Koch**) have subsequently won NSERC MSc-level scholarships; **Forestell** won a Killam Doctoral Scholarship at UBC; **Engel** has also won a Rhodes Scholarship, a Sir James Lougheed Award, and an Alberta Science & Technology Leadership (ASTech) Award. **Bahramian** has won the Andrew Stewart Memorial Graduate Prize, a CASCA Best Student Poster Award, and a Graduate Student Teaching Award; **Gazer** won 2nd Prize Talk at the U. of A. Grad Physics Research Symposium; **Hebbar** won Best Oral Presentation and Best Poster, Grad Physics Research Symposium; the Valerie Jagoldas Award of U. Alberta, and an AGES award from the Physics Dept; **Zhao, Y.** won an AGES award from the Physics Dept; **Zhao, J.** won a China Scholarship Council PhD scholarship.

External Awards of Research Funding as Principal Investigator

2016: NSERC Discovery Accelerator Supplement, $120,000 over 3 years.

2014: Alexander von Humboldt Fellow, €22,916 for a 6-month fellowship.

2010: Alberta Ingenuity New Faculty Award, $279,000 over 3 years.

2008, 2011, 2016: NSERC Discovery Grants, $27,486/year (2008-2010), $28,000/year (2011-2015), $74,000/year (2016-2022).

Awards of Observing Time on Astronomical Telescopes

PI on approved telescope proposals: 9 *Chandra* X-ray (82 hours total, & analysis funds), 2 Hubble (13.5 hrs total, & funds), 7 XMM-Newton X-ray (107 hrs total, & funds), 10 Gemini optical/IR (55 hrs total), 2 VLA radio (12 hrs total), 2 VLBA radio (80 hrs), 38 Swift X-ray (16 hrs), 1 NuSTAR X-ray (28 hrs), 1 AstroSAT (11 hrs). PhD student **Bahramian** PI of multiple approved XMM-Newton, Swift, & Gemini proposals. Postdoc **Shaw** PI of NuSTAR (250 hrs!), CFHT, Gemini, XMM-Newton, and many Swift; PhD student **Y. Zhao** PI of 2 XMM proposals; Postdoc **Rivera Sandoval** PI of 4 HST, 1 TESS proposal.

Lead organizer of Swift Key Project, "Swift Bulge Survey" in 2017, 2019, 2021; 55, 60, 60 hrs of Swift X-ray/UV observations of Galactic Bulge to detect transients (I was not formal PI to allow NASA to fund co-PI in Texas). Project also awarded 10 hrs VLA time each round, and time on Gemini, SOAR, CFHT, and VLT telescopes.

Co-I on many successful telescope proposals, acquiring >1000 hrs of *Chandra* time under >12 different PIs, on 8 proposals acquiring >130 hrs of Hubble imaging, and on many successful proposals for JWST, RXTE, Swift, Suzaku, XMM-Newton, and NuSTAR (X-ray), Gemini, TNG, VLT, CFHT (optical and near-infrared), Herschel (far infrared), ATCA and VLA (radio).

Scientific Service–Peer Review

Member of NSERC Discovery Grants Physics Evaluation Group (2018-2021)

Member of NSERC Scholarships & Fellowships Committee (2014-2017).

SuperChair (2012-2013) of CanTAC (which allocates time on overseas Canadian telescopes); Galactic Panel Chair 2012, member of CanTAC 2011-2013.

Member of Time Allocation Committees (TACs) for National Radio Astronomy Observatory (2 yr SRP member, then 3 yr SRP chair; now Chair of full TAC), Rossi X-ray Timing Explorer (3 yr), *Chandra* X-ray Observatory (3 yr), XMM-Newton (2 yr).

Chair of CFHT Large Program TAC 2018; member of CFHT Canada TAC 2018.

External referee for Gemini, CFHT, AstroSAT, HST proposals.

External referee for funding proposal requests to NSERC, NSF, NASA, the Royal Society (UK), NWO (Netherlands), Ireland.

External referee for 5 PhD theses, at McGill University, U. Calgary, U. of Sydney, U. of Manitoba.

Referee for Nature, Nature Astronomy, Nature Communications, Astrophysical Journal (including Supplement & Letters), Astronomical Journal, Astronomy & Astrophysics, and Monthly Notices of the Royal Astronomical Society, averaging 10 papers/year.

Scientific Service–Organizations and Meetings

Chair (2021–) of Gemini Science and Technology Advisory Committee (member 2018–).

Reviewer, NRAO Conceptual Design Review for Telescope Time Allocation Tools program.

Red-team reviewer, Program Execution Plan for $26M "Gemini in the Era of Multi-Messenger Astronomy" proposal.

Chair of Local Organizing Committee, and lead organizer, for *CASCA 2017* (Edmonton, Canada). (Annual meeting of Canadian Astronomical Society, drawing 200 scientists from across Canada.)

Chair of CASCA Ground-Based Astronomy Committee (2016-2017).

Member of CASCA's Long-Range Plan Implementation Committee (LRPIC, 2016-2017).

Chair of Gemini Observatory Users' Committee, 2014-2015; member 2012-2015.

Member of Scientific Organizing Committee for *CASCA 2017*; *Compact Binaries in Globular Clusters*, Leiden, Netherlands, 2012; *Physics of Neutron Stars 2014*, *Physics of Neutron Stars 2017*, *Physics of Neutron Stars 2020-¿2022*, St. Petersburg, Russia; *The Physics of Neutron Stars, and All That Jazz*, Montreal, Canada, 2015; COSPAR session E1, Istanbul, Turkey, 2016 (cancelled).

Co-organizer of *MODEST-6, Modeling Dense Stellar Systems* conference (Northwestern U., 2005).

Scientific Service–Planning for Future Telescopes

Lead author of the white paper "Accretion Powered Compact Objects: Theory and Observations" (Heinke et al. 2010), delivered to Canadian Astronomical Society, for the Canadian Long Range Plan decadal review of astrophysical research in Canada.

Coauthor of white paper "The Future of X-ray Astronomy in Canada" (Gallo et al. 2010), also for Canadian Long Range Plan.

Member of (Canadian) High-Energy Astrophysics Disciplinary Working Group, and coauthor of report to Canadian Space Agency on high-energy astrophysics research (Kaspi et al. 2009). This report helped influence the CSA to invest in the Japanese Astro-H X-ray satellite telescope.

Member of collaborations developing the case for the "Lynx X-ray Surveyor" and "Strobe-X" X-ray telescope mission concepts under consideration by NASA (USA), and "Colibrì", an X-ray telescope mission concept under consideration by the CSA.

University Service

Associate Chair for Graduate Studies, Physics Department, 2018–.

Associate Chair for Research, Physics Department, 2015-2018.

Focus Area Coordinator for Astrophysics, Physics Strategic Planning Committee, 2012–.

Member of 6 Physics Dept. new faculty hiring committees; 2007-08, 2009-10, 2012, 2012-13, 2014, 2021. Member of Physics Dept. Chair Search committee 2020-2021.

Colloquium organizer for U. Alberta Physics Dept., 2009-2011.

Member of Harvard University Astronomy Department Curriculum Review Committee, 2004

Invited Colloquium/Seminar Talks since July 2008

Penn State Astro Colloquium, Sept. 2021

U. Alberta Physics Dept. Seminar, "Planning Remote Teaching of a Large Lecture", July 2020

Oregon State University Physics Colloquium, Nov. 2018

NYU Abu Dhabi Physics Seminar, Abu Dhabi, United Arab Emirates, April 2018

U. Manitoba Physics & Astronomy Colloquium, Jan. 2018

U. Alberta Physics Colloquium, Edmonton AB, Sept. 2017

McGill Space Institute Astronomy Seminar, Montreal QC, Canada, Feb. 2017

Michigan State University Astro seminar, Lansing MI, USA, Jan. 2017

Univ. of Southampton AstroGrav Seminar, Southampton, UK, June 2015

Univ. of Exeter Astrophysics Seminar, Exeter, UK, May 2015

Univ. of Birmingham Astrophysics Seminar, Birmingham, UK, May 2015

ASTRON Colloquium, Dwingeloo, Netherlands, May 2015

Anton Pannekoek Institute Astrophysics Colloquium, Amsterdam, Netherlands, May 2015

University Wroclaw Nuclear Physics Institute Seminar, Wroclaw, Poland, April 2015

Tuebingen University Astrophysics Seminar, Tuebingen, Germany, April 2015

Radboud University Astrophysics Colloquium, Nijmegen, Netherlands, March 2015

Leiden University Astrophysics Colloquium, Leiden, Netherlands, March 2015

Max Planck Institut für Astrophysics, Seminar, Garching Germany, March 2015

Max Planck Institut für Extraterrestrische Physik, Seminar, Garching Germany, March 2015

Max Planck Institut für Radioastronomie, Colloquium, Bonn Germany, February 2015

Max Planck Institut für Radioastronomie, Seminar, Bonn Germany; February 2015

U. Alberta Physics Colloquium, Edmonton AB, March 2014

Harvard Astrophysics Colloquium, Cambridge MA, May 2012

U. Wisconsin-Milwaukee Physics Colloquium, Milwaukee WI, March 2012

Northwestern U. Astrophysics Seminar, Evanston IL, March 2012

U. Alberta Physics Colloquium, Edmonton AB, Sept. 2011

Texas A&M University Astrophysics Seminar, College Station TX, Feb. 2011

UBC Astronomy Colloquium, Vancouver BC, Feb. 2011

Canadian Institute for Theoretical Astrophysics Seminar, Toronto ON, Oct. 2010

McGill Joint Astrophysics Colloquium, Montreal QC, Oct. 2010

UBC TRIUMF Colloquium, Vancouver BC, July 2010

Nat'l Observatory of Athens, Institute of Astron. & Astrophysics Seminar, Athens Greece, July 2010

UBC Astronomy Colloquium, Vancouver BC, October 2009

University of Toronto Astrophysics Colloquium, Toronto ON, Nov. 2008

Invited Conference Talks since July 2008

JINA-INT Workshop on Neutron Star Cooling, Feb. 2022

HEAD Frontier Seminar, July 2020

"Neutron Stars as Multi-messenger laboratories for dense matter", Italy, May 2020 (cancelled for COVID)

CRAQ, May 2020, declined

XCALIBUR 2019: The Future of High-Resolution X-ray Spectroscopy, Winchester, UK, July 2019

EWASS 2019, Lyon, France, June 2019

Investigating Crusts of Neutron Stars, Amsterdam, Netherlands, April 2019

COSPAR 2018, Pasadena, CA, US, July 2018

MODEST-18: Dense Stellar Systems in the Era of Gaia, LIGO, and LISA, Santorini, Greece, June 2018

STROBE-X Science Definition Meeting, Lubbock, TX, US, Sept. 2017

La Gomera Accretion Week, La Gomera, Canary Islands, Spain, Sept. 2017

New Compstar annual meeting, Warsaw, Poland, March 2017

Neutron Stars: A Cosmic Laboratory, Bad Honnef, Germany, Oct. 2016

COSPAR 2016, Istanbul, Turkey, Aug. 2016 (cancelled due to a coup)

EWASS 2016, Athens, Greece, July 2016 (declined)

Neutron Stars in the Multi-Messenger Era, Athens, Ohio, US, May 2016

Modeling and Observing Dense Stellar Systems 2015, Kobe, Japan, Dec. 2015 (declined)

The Many Faces of Neutron Stars, Munich, Germany, Sept. 2015

The Zoo of Accreting Compact Objects, Leiden, Netherlands, Aug. 2015

Fourteenth Marcel Grossman Meeting, Rome, Italy, July 2015 (declined)

The Neutron Star Radius and All That Jazz, June 2015

Science & Future of Gemini, Toronto, Canada, June 2015

ISSI Workshop on Transitional Millisecond Pulsars, Bern, Switzerland, March 2015

CASCA 2014, Quebec City, Canada, June 2014

Neutron Star Signals and Structure, Florence, Italy, March 2014

European Week of Astronomy & Space Science 2013, Turku, Finland, July 2013 (declined)

X-ray Binaries 13, Bormio, Italy, Jan. 2013

Compact Binaries in Globular Clusters, Leiden, Netherlands, Sept. 2012

Neutron Stars and Pulsars: Challenges & Opportunities after 80 Years, Beijing, Aug. 2012 (declined)

Extreme Quantum Chromodynamics, Georgetown U., Washington DC, Aug. 2012

Astrophysical Transients, Institute for Nuclear Theory, Seattle WA, July 2011

Physics of Neutron Stars, Ioffe Institute, St. Petersburg, Russia, July 2011

Canadian Astronomical Society (CASCA) 2011, London ON, May 2011

Canadian Institute for Advanced Research (Cosmology & Gravity), Whistler BC, Apr. 2011

Modeling Dense Stellar Systems-10, KIAA/NAOC, Beijing, China, Sept. 2010

Binary Star Evolution: Mass Loss, Accretion, and Mergers, Mykonos, Greece, June 2010

Neutron Star Atmosphere Workshop, KITP, Santa Barbara CA, April 2010

Defining the Neutron Star Crust, Los Alamos National Laboratory, Santa Fe NM, May 2009

Formation and Evolution of Globular Clusters, KITP, Santa Barbara CA, Jan. 2009

Outreach Leadership

Arranged creation of scale model of solar system for west atrium of U. Alberta CCIS (science) building (http://www.ualberta.ca/∼stars/planets.html), 2009-2011.

Co-investigator on U. of Alberta TLEF project "Enhancing Astronomy Education through On-Campus Telescopes", $55,507 over two years (2011-2013).

Co-coordinator of Physics Open Houses at Northwestern U. (outreach for area junior high students), spring 2005, 2006; PI of successful 2006 grant proposal for $2000.

Public Talks since July 2008

CESD 73 high school, Innisfail, Dec. 2021

Science FUNDay, Edmonton, March 2021

Science FUNDay, Edmonton, Feb. 2020

DiscoverE Summer Camp, Edmonton, August 2018

DiscoverE Summer Camp, Edmonton, July 2018

Calgary Academy High School, May 2018

Holyrood School, Edmonton, April 2018

RASC Winnipeg, Jan. 2018

U. of Alberta Observatory, Nov. 2017

Team Up Science, Edmonton, July 2017

DiscoverE Summer Camp, Edmonton, July 2017

J. H. Picard High School, Edmonton, Jan. 2017 (3 talks)

DiscoverE Summer Camp, Edmonton, Aug 2016

Royal Astronomical Society of Canada, Edmonton Centre, May 2016

U. of Alberta Observatory, Oct. 2015

U. of Alberta Observatory, Oct. 10, 2014

Hands-on Physics (high schoolers), Aug. 6, 2014

Austin O'Brien High School, Edmonton, Nov. 12, 2013 (2 talks)

U. of Alberta Alumni Weekend, Sept. 28, 2013

W. P. Wagner High School, Edmonton, Dec. 14, 2012

Royal Astronomical Society of Canada, Edmonton Centre, Dec. 10, 2012

Northern Alberta Physics Teachers Meeting, Edmonton, Dec. 7, 2012

U. Alberta Alumni Weekend, Edmonton, Sept. 22, 2012

ELLA (Edmonton Lifelong Learners Association), May 2011.

E.W. Stokes Primary School, Washington DC, May 2011.

Garneau School 5th/6th grade students, June 10, 2010.

Royal Astronomical Society of Canada, Edmonton, May 10, 2010.

Talk to Strathcona High School students on "Neutron Stars" at U of A, Jan. 27, 2010.

Visiting undergrad CUPC students (& judged talks), Oct. 3, 2009.

Presentation to high-school students (from Grandview Heights) at U of A, March 24, 2009.

Northern Alberta Physics Teachers Meeting, Edmonton, Dec. 2008

"Stellar Exotica in Globular Clusters", Northern Prairies Starfest, Sept. 2008

Media Interviews

Interview for CBC Radio One program "Silver and Exact" on mirrors, Dec. 2011.

Gave interviews for several print, electronic, and radio (CBC Quirks & Quarks, CBC Edmonton Radio Active) news sources relating to discovery of superfluidity in neutron star cores, Feb. 2011.

Gave 11 interviews for radio (CBC Quirks & Quarks), TV (City TV Edmonton, French CBC Edmonton), web-based (e.g. Space.com) and print (Edm. Journal, Edm. Sun-Times, Canadian Press, Physics World, Sky & Telescope) media relating to Nature paper, Nov. 2009.