

JONATHAN CRASS

Ph.D., MPhys, FRAS, AMInstP

RESEARCH

DEPARTMENT OF PHYSICS, UNIVERSITY OF NOTRE DAME, USA

July 2017 –

Research Assistant Professor

I lead the development of the *iLocator* instrument which is under construction for the Large Binocular Telescope (LBT), AZ, USA. *iLocator* is a next-generation radial-velocity instrument and is one of the first to use adaptive optics (AO) to feed light to a spectrograph for the detection and study of exoplanets. I am the instrument scientist for the project and am responsible for overall instrument performance and design. I serve as the principal project liaison with the Large Binocular Telescope Observatory, NASA Goddard Space Flight Center, other instrument teams and vendors.

Concurrently with this work, I am pursuing future technologies and missions to support exoplanet studies. This includes studies of next-generation photonic devices and supporting NASA funded concept studies for future space-based missions, specifically *EarthFinder*.

September 2014 – June 2017

Postdoctoral Research Associate (Supervised by Prof. Justin Crepp)

I led the development and prototyping of several components of the *iLocator* instrument. This work included the design, development and construction of two components of the instrument: an acquisition camera to couple light from the AO corrected beams of the LBT into single-mode optical fibers and the design of an ultra-stable spectrograph housed within the instrument cryostat. I led the successful on-sky single-mode fiber coupling of a demonstration system in April 2016.

INSTITUTE OF ASTRONOMY, UNIVERSITY OF CAMBRIDGE, UK

October 2010 – June 2014

PhD, Astronomy (Supervised by Prof. Craig Mackay)

My PhD. research was undertaken as part of the Optics Group at the Institute of Astronomy working on the Adaptive Optics Lucky Imager (AOLI) instrument. This instrument delivered diffraction-limited imaging in the visible on large ground-based telescopes by combining adaptive optics with high-speed imaging and post-processing techniques (lucky imaging). Work on the project included simulation, optical design and commissioning of the non-linear Curvature Wavefront Sensor (nlCWFS) component of the instrument.

DEPARTMENT OF PHYSICS, UNIVERSITY OF CALIFORNIA SANTA BARBARA, USA

January 2009 – September 2010

Undergraduate Research (Supervised by Prof. Philip Lubin)

SCHOOL OF PHYSICS & ASTRONOMY, UNIVERSITY OF MANCHESTER, UK

October 2006 – June 2010 (Third Year: University of California Santa Barbara, USA)

MPhys (Hons), Physics with Astrophysics – First Class with Honours

MPhys Research Project: A Remote-Controlled Optical Telescope – project supervised by Dr. Tim O'Brien from the Jodrell Bank Centre for Astrophysics. The project included photometry and analysis of a binary star system in addition to the commissioning of a remote-controlled optical telescope at the Jodrell Bank Observatory, Cheshire, UK.

EDUCATION

INSTITUTE OF ASTRONOMY, UNIVERSITY OF CAMBRIDGE, UK

October 2010 – June 2014

PhD, Astronomy (Supervised by Prof. Craig Mackay)

SCHOOL OF PHYSICS & ASTRONOMY, UNIVERSITY OF MANCHESTER, UK

October 2006 – June 2010 (Third Year: University of California Santa Barbara, USA)

MPhys (Hons), Physics with Astrophysics – First Class with Honours

RYTON COMPREHENSIVE SCHOOL, RYTON, TYNE & WEAR, UK

September 1998 – July 2005

2005 *GCE A-LEVEL*

Physics (A), Mathematics (A), Further Mathematics (A) and Geography (A).

2003 *GCSE*

10 subjects at grade A-A* including Mathematics (A*), Double-Award Science (A*A*), English Language (A), English Literature (A), ICT (A) and German (A).

PROFESSIONAL SERVICE

- Reviewer for the National Science Foundation
2021 -
- Co-editor for NASA/NSF Extreme Precision Radial Velocity (EPRV) Working Group
February 2021 – June 2021
- Invited member of NASA/NSF Extreme Precision Radial Velocity (EPRV) Working Group
June 2019 – June 2021
- Session Chair at the Third Workshop on Extremely Precise Radial Velocities
The Pennsylvania State University, USA – August 2017
- Referee for the Monthly Notices of the Royal Astronomical Society
February 2015 -

AWARDS AND GRANTS

- 2021 – 2023 National Science Foundation Advanced Technologies and Instrumentation Program
Characterization and Commissioning of the iLocater Spectrograph
\$1.14M – Principal Investigator
- 2021 Notre Dame - Resilience and Recovery Grant
- 2019 Notre Dame International - International Research Travel Grant
- 2014 SPIE Outreach Grant to support a public use telescope, University of Cambridge, UK
- May 2011 Best Poster & Presentation – EIROforum School on Instrumentation
- 2011 UK Science and Technology Facilities Council Studentship
- 2008 – 2009 Dean’s Honours, University of California Santa Barbara, USA

PROFESSIONAL ORGANISATIONS

- Fellow, Royal Astronomical Society
- Member, American Astronomical Society
- Member, SPIE
- Associate Member, Institute of Physics

TEACHING AND ADVISING

- Summer 2021 Lecturer for ‘Descriptive Astronomy’ summer session course to non-science majors.
- September 2014 - Supervising of 10+ undergraduate students from physics, computer science and engineering as part of the development and construction of the *iLocater* instrument.
- September 2014 - 2019 Advising of graduate student Andrew Bechter with Ph.D. completion in summer 2019.
- October 2011 – 2014 Supervisions (tutorials in groups of 2-3) for Mathematical Methods in Part IA (1st year) of the Natural Sciences Tripos, University of Cambridge.
- October 2012 – 2013 Masters project supervision of Peter Aisher in the development of the non-linear curvature wavefront sensor.
- January – May 2011 Supervisions (tutorials in groups of 2-3) for Structure and Evolution of Stars in Part II (3rd year) of the Natural Sciences Tripos, University of Cambridge.
- Fall 2008 Teaching Assistant in Physics at San Marcos High School and Santa Barbara High School, Santa Barbara, California, USA.

EXPERIENCE

Technical/Astronomy

- Single-mode fiber coupling and adaptive optics operation, Large Binocular Telescope, Arizona, USA, July & November 2019 (6 nights).

- Installation and commissioning of the iLocator SX single-mode fiber injection system, Large Binocular Telescope, Arizona, USA - June 2019 (20 days).
- Single-mode fiber coupling and adaptive optics operation, Large Binocular Telescope, Arizona, USA - May 2016 (6 nights).
- Installation and commissioning of the iLocator single-mode fiber coupling demonstration system, Large Binocular Telescope, Arizona, USA - May 2016 (12 days).
- Diffraction-limited visible imaging using the SHARK forerunner instrument, Large Binocular Telescope, Arizona, USA - June 2015 (4 nights).
- High-contrast imaging of exoplanet candidates using the LMIRCam instrument with the AO system of the Large Binocular Telescope, Arizona, USA in October 2014 and March 2015 (6 nights).
- Commissioning run with the AOLI instrument on the William Herschel Telescope, La Palma during September 2013 (2 nights).
- On-site observing at the Carlos Sánchez Telescope, Tenerife using the Fastcam instrument in May 2011 (1 night).
- Analysis and reduction of astronomical images using Starlink software suite.
- Optical design and propagation simulations using C++ and MATLAB.
- Vacuum system design and commissioning.
- Experience in commissioning optical setups including testing of optical components.

Computing

- CAD experience using Solidworks for 3D design and simulation.
- Programming in C and C++ for simulation and control system work using multiple connection methods.
- Development of instrument control software with the Instrument Neutral Distributed Interface (INDI) and Python.
- Use of the scientific package MATLAB for data analysis, simulations and hardware control.
- Professional web design in HTML/CSS. Advanced scripting in PHP and experience with content management systems.
- Administration of Linux servers (including professional web hosting servers) including UNIX scripting.
- Use of Windows and Linux/UNIX operating systems, Microsoft Office (including advanced spreadsheet use) and LaTeX.

SELECTED PRESENTATIONS

Contributed Conference Talks

- iLocator: Moving from design to fabrication
Fourth Workshop on Extremely Precise Radial Velocities, Grindelwald, Switzerland – March 2019
- iLocator
The Pennsylvania State University, USA – August 2017

- The Adaptive Optics Lucky Imager: Diffraction limited imaging at visible wavelengths with large ground-based telescopes
American Astronomical Society Meeting 225, Seattle, USA – January 2015
- The AOLI low-order non-linear curvature wavefront sensor: laboratory and on-sky results
SPIE Astronomical Telescopes and Instrumentation, Montreal, Canada – June 2014
- High-resolution imaging in the visible on large ground-based telescopes
SPIE Astronomical Telescopes and Instrumentation, Montreal, Canada – June 2014
- The AOLI low-order non-linear curvature wavefront sensor: a method for high sensitivity wavefront reconstruction
SPIE Astronomical Telescopes and Instrumentation, Amsterdam, Netherlands – July 2012
- AOLI: Adaptive Optics Lucky Imager – Diffraction limited imaging on large ground-based telescopes
National Astronomy Meeting 2012, Manchester, UK – March 2012

Invited Seminars and Colloquia

- Finding Earth-like planets among the noise - Achieving precision radial velocity measurements with single-mode fibers
Stars & Planets Seminar, Center for Astrophysics, Harvard & Smithsonian, Cambridge, MA, USA – February 2020
- Finding Earth-like planets among the noise - Achieving precision radial velocity measurements with single-mode fibers
Astro Tech Talk, MPLA, Heidelberg, Germany – October 2019
- Next Generation Science using Adaptive Optics
Physics Colloquia, Department of Physics, University of Notre Dame, USA – March 2017
- iLocator: Precision Radial Velocity Measurements at the LBT
Astrophysics Seminars, Department of Physics, University of Notre Dame, USA – November 2016
- iLocator: Breaking the 1m/s radial velocity precision barrier
Institute of Astronomy Seminars, University of Cambridge, UK – June 2016
- iLocator: Breaking the 1m/s radial velocity precision barrier
Institute of Astronomy Seminars, University of Cambridge, UK – June 2016
- At the diffraction-limit: Next generation science using Adaptive Optics
Astronomy & Physics Colloquia, Saint Mary's University, Halifax, Nova Scotia, Canada – October 2015
- Cutting-edge astronomy: Exploiting the power of adaptive optics
Teledyne Imaging Sensors, Camarillo, CA, USA – August 2015
- Adaptive Optics: Paving the way to high-resolution astronomy from the ground
Astrophysics Seminars, Department of Physics, University of Notre Dame, USA – February 2015
- The Adaptive Optics Lucky Imager: Obtaining diffraction-limited visible imaging on the ground
Centre for Advanced Instrumentation, Durham University, UK – July 2014

- High sensitivity wavefront sensing for the AOLI Project
Institute of Astronomy Seminars, University of Cambridge, UK – January 2013

PUBLIC OUTREACH

- I am the founder and coordinator of Our Universe Revealed, the public talk series of the Department of Physics, University of Notre Dame. Founded in 2015, this biweekly series offers the public a chance to engage with current research being undertaken at the University. Additionally, ‘all-ages’ events run as part of this series have attracted audiences of 500+ attendees.
- Member of the Outreach Committee, Department of Physics, University of Notre Dame (2015 – 2019). Efforts include coordinating outreach efforts and effectively engaging broad audiences.
- Royal Astronomical Society Guest Speaker on-board Cunard’s Queen Mary 2. Responsibilities include delivering a public lecture series to audiences of 300, planetarium shows and stargazing.
- Lectures given to public audiences of 180-270 on topics including high-resolution imaging in astronomy, solar system exploration and building the biggest telescopes.
- Talks given in local secondary schools (ages 11-18) on the topics of astronomy, telescopes and instrumentation.
- Public observing evenings at the Institute of Astronomy, Cambridge, including stargazing and tours and demonstrations of historic telescopes.

PUBLICATIONS

- Final Design and On-Sky Commissioning of the iLocator Acquisition Camera
Jonathan Crass, Andrew Bechter et al., 2021, MNRAS, 501, 2, 2250-2267
- Studying the Impact of Optical Aberrations on Diffraction-Limited Radial Velocity Instruments
Eric Bechter, Andrew Bechter, Justin Crepp, Jonathan Crass, 2021, JATIS, Accepted
- Mitigation of Polarization Effects in Single-mode Fiber Spectrographs
Andrew Bechter, Eric Bechter, Justin Crepp, Ryan Ketterer, Jonathan Crass, 2020, PASP, 132, 1015
- Characterization of Single-Mode Fiber Coupling at the Large Binocular Telescope
Andrew Bechter, Jonathan Crass et al., 2020, PASP, 132, 1007
- Assessing the suitability of H4RG near-infrared detectors for precise Doppler radial velocity measurements
Eric Bechter, Andrew Bechter, Justin Crepp, Jonathan Crass, 2019, JATIS, 5, 038004
- Instrument Simulator and Data Reduction Pipeline for the iLocator Spectrograph
Eric Bechter, Andrew Bechter, Justin Crepp, Jonathan Crass, David King, 2019, PASP, 131, 996, 024504
- Focal Plane Tip-Tilt Sensing for Improved Single-Mode Fiber Coupling using a 3D-printed Microlens-Ring
Philipp Hottinger, Robert Harris, Philipp-Immanuel Dietrich, Matthias Blaicher, Andrew Bechter, Jonathan Crass et al., 2019, Proc. AO4ELT6

- A radial velocity error budget for single-mode Doppler spectrographs
*Andrew Bechter, Eric Bechter, Justin Crepp, David King, **Jonathan Crass**, 2018, Proc. SPIE 10702*
- The iLocator cryostat: design and thermal control strategy for precision radial velocity measurements
***Jonathan Crass**, Louis G. Fantano, Frederick R. Hearty et al., 2016, Proc. SPIE 9908*
- On-sky single-mode fiber coupling measurements at the Large Binocular Telescope
*Andrew Bechter, **Jonathan Crass**, Ryan Ketterer, Justin R. Crepp et al., 2016, Proc. SPIE 9909*
- iLocator: A Diffraction-limited Doppler Spectrometer for the Large Binocular Telescope
*Justin R. Crepp, **Jonathan Crass**, David King, Andrew Bechter et al., 2016, Proc. SPIE 9908*
- Design of the iLocator Acquisition Camera Demonstration System
*Andrew Bechter, **Jonathan Crass**, Ryan Ketterer, Justin R. Crepp, David King et al., 2015, Proc. SPIE 9605*
- High spatial resolution optical imaging of the multiple T Tauri system LkH α 262 / LkH α 263
*Sergio Velasco, et al. including **Jonathan Crass**, 2016, MNRAS, 460 (4), 3519-3528*
- The AOLI low-order non-linear curvature wavefront sensor: laboratory and on-sky results
***Jonathan Crass**, David King, Craig MacKay, 2014, Proc. SPIE 9148*
- High-resolution imaging in the visible on large ground-based telescopes
*Craig Mackay, Rafael Rebolo-López, **Jonathan Crass**, David King, 2014, Proc. SPIE 9147*
- The AOLI Non-Linear Curvature Wavefront Sensor: High sensitivity reconstruction for low-order AO
***Jonathan Crass**, David King, Craig Mackay, 2013, AO4ELT3 Conference Electronic Proceedings*
- Wavefront phase retrieval with non-linear curvature sensors
*Peter Aisher, **Jonathan Crass**, Craig Mackay, 2013, MNRAS 429, 2019-2031*
- The AOLI low-order non-linear curvature wavefront sensor: a method for high sensitivity wavefront reconstruction
***Jonathan Crass**, Peter Aisher, Bruno Femenia, David King, Craig Mackay et al., 2012, Proc. SPIE 8447*
- AOLI: Adaptive Optics Lucky Imager: diffraction limited imaging in the visible on large ground-based telescopes
*Craig Mackay, Rafael Rebolo-López, Bruno Femenia Castellá, **Jonathan Crass**, David King, Lucas Labadie, Peter Aisher et al., 2012, Proc. SPIE 8446*

WHITE PAPERS & REPORTS

- Extreme Precision Radial Velocity Working Group Final Report
***Jonathan Crass** et al., 2021, NASA/NSF NN-EXPLORE Program*

- EarthFinder Probe Mission Concept Study: Characterizing nearby stellar exoplanet systems with Earth-mass analogs for future direct imaging
*Peter Plavchan et al. including **Jonathan Crass**, 2020, NASA Probe Mission Concept White Paper for the Decadal Survey on Astronomy and Astrophysics*
- The need for single-mode fiber-fed spectrographs
***Jonathan Crass et al.**, 2019, Decadal Survey on Astronomy and Astrophysics, APC white papers, no. 122; Bulletin of the American Astronomical Society, 51, 7, 122*
- Extreme Precision Radial Velocity Working Group
*Scott Gaudi et al. including **Jonathan Crass**, 2019, Decadal Survey on Astronomy and Astrophysics, APC white papers, no. 232; Bulletin of the American Astronomical Society, 51, 7, 232*
- Enabling the next generation of scientific discoveries by embracing photonic technologies
*Nemanja Jovanovic et al. including **Jonathan Crass**, 2019, Decadal Survey on Astronomy and Astrophysics, APC white papers, no. 270; Bulletin of the American Astronomical Society, 51, 7, 270*
- EarthFinder: A Precise Radial Velocity Probe Mission Concept for the Detection of Earth-Mass Planets Orbiting Sun-like Stars
*Peter Plavchan et al. including **Jonathan Crass**, 2018, White Paper submitted to the National Academies Exoplanet Science solicitation*
- The need for single-mode fiber-fed spectrographs
***Jonathan Crass et al.**, 2018, White Paper submitted to the National Academies Exoplanet Science solicitation*