

# Andrey Vayner

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Department of Physics and Astronomy  
Johns Hopkins University, Maryland  
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Citizenship: Canadian  
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**RESEARCH INTERESTS** High-Redshift Universe, Galaxy Formation & Evolution, Active Galactic Nuclei (AGN), Quasars, AGN Feedback, Adaptive Optics, High Contrast Imaging, Radio Interferometry.

**EDUCATION** Ph.D. Physics, 2015-2019  
Advisor: Shelley A. Wright  
Thesis: Quasar hosts unveiled by high angular resolution techniques  
University of California, San Diego

M.Sc. Astronomy & Astrophysics, 2013-2015  
Advisors: Paola Rodriguez-Hidalgo, Shelley A. Wright  
Research projects: 1) Constraining the Causes of Dramatic Variability in Newly Emerged Quasar Outflows & 2) Multi-Wavelength Observations of Radio Loud AGN  
University of Toronto, Ontario, Canada

H.B.Sc. high distinction Physics & Astronomy w/ Minor in Mathematics, 2009-2013  
Advisor: Shelley A. Wright  
Thesis: "Resolving Host Galaxies of  $z\sim 2$  Quasars using Adaptive Optics and Integral Field Spectroscopy"  
University of Toronto, Ontario, Canada

**HONORS AND AWARDS** ALMA ambassador, 2020  
The Royal Astronomical Society of Canada Gold Medal, 2013  
Dunlap Institute for Astronomy & Astrophysics Graduate Student Scholarship, 2013  
Professor C.A Chant Scholarship for Astronomy, 2012  
Natural Science and Engineering Research Council of Canada (NSERC) Undergraduate Student Research Award, 2012

**RESEARCH EXPERIENCE** *Postdoctoral Fellow* 2019-Present  
Department of Physics and Astronomy, Johns Hopkins University

- JWST early release science.
- Near-infrared integral field spectroscopy of extremely red quasars, mapping the most extreme outflows detected in the distant Universe.
- ALMA observations of molecular outflows at  $z\sim 2$ .
- Using the Keck Cosmic Web Imager to map the circumgalactic medium around massive  $z\sim 2$  galaxies to understand their subsequent evolution from cosmic noon to present day.

*Graduate Student Researcher* 2015-2019  
Department of Physics, UC San Diego

- Using laser guide star adaptive optics observation in combination with integral field spectroscopy to resolve host galaxies of distant quasars, to study the co-evolution of supermassive black holes and the galaxies that harbour them.
- Constraining molecular gas reservoirs of distant quasar host galaxies through CO spectroscopy with Atacama Large Millimeter/Submillimeter Array (ALMA)

*Graduate Student Researcher* 2012-2015  
Department of Astronomy & Astrophysics, University of Toronto

- Using high-resolution optical spectroscopy of high-redshifts quasars to monitor the origin and evolution of winds from the vicinity of the black hole.
- Multiwavelength observations of radio-loud quasars with VLA, HST, Chandra, Herschel, SDSS. Constructing sample for follow up observations with laser guide star adaptive optics and integral field spectroscopy.

*Summer undergraduate research assistant* Summers 2012-2013  
Dunlap Institute for Astronomy and Astrophysics, University of Toronto

- Resolving Host Galaxies of  $z \sim 2$  Quasars using Adaptive Optics and Integral Field Spectroscopy
- Reduced and analyzed data from the Keck & Gemini telescopes. Wrote routines for PSF subtraction to disentangle the bright unresolved quasar emission from the faint underlying host galaxy.

**REFEREED PUBLICATIONS** **Vayner A.**, Zakamska N., Wright S. A., Armus L., Murray N., Walth G., *Multi-phase outflows in high redshift quasar host galaxies*, 2021, ApJ, 923, 59

**Vayner, A.** and Wright, S. A. and Murray, N. and Armus, L. and Boehle, A. and Cosens, M. and Larkin, J. E. and Mieda, E. and Walth, G. *A Spatially-Resolved Survey of Distant Quasar Host Galaxies: I. Dynamics of galactic outflows*, 2021, ApJ, 919, 122

**Vayner, A.** and Zakamska, N. L. and Riffel, Rogemar A. and Alexandroff, R. and Cosens, M. and Hamann, F. and Perrotta, S. and Rupke, D. S. N. and Storchi Bergmann, T. and Veilleux, S. and Walth, G. and Wright, S. and Wylezalek, D. *Powerful winds in high-redshift obscured and red quasars*, 2021, MNRAS, 504, 4445

Ishikawa, Y. and Goulding, A. D. and Zakamska, N. L. and Hamann, F. and **Vayner, A.** and Veilleux, S. and Wylezalek, D. *X-ray analysis of SDSS J165202.60+172852.4, an obscured quasar with outflows at peak galaxy formation epoch*, 2021, MNRAS 502, 3769

**Vayner, A.** and Wright, S. A. and Murray, N. and Armus, L. and Boehle, A. and Cosens, M. and Larkin, J. E. and Mieda, E. and Walth, G. *A Spatially Resolved Survey of Distant Quasar Host Galaxies. II. Photoionization and Kinematics of the ISM*, 2021, ApJ, 910, 44

Lockhart, K. E. and Do, T. and Larkin, J. E. and Boehle, A. and Campbell, R. D. and Chappell, S. and Chu, D. and Ciurlo, A. and Cosens, M. and Fitzgerald, M. P. and Ghez, A. and Lu, J. R. and Lyke, J. E. and Mieda, E. and Rudy, A. R. and **Vayner, A.** and Walth, G. and Wright, S. A. *“Characterizing and Improving the Data Reduction Pipeline for the Keck OSIRIS Integral Field Spectrograph”*, 2018, AJ, 157, 75

Cosens, M. Wright, S. A., Mieda, E., Murray, N., Armus, L., Do, T., Larkin, J. E.,

Larson, K., Martinez, G., Walth, G., **Vayner, A.** “*Size-Luminosity Scaling Relations of Local and Distant Star Forming Regions*”, 2018, ApJ, 869, 11

**Vayner, A.**, Wright, S. A., Murray, N., Armus, L., Larkin, J. E., Mieda, E. “*Galactic Scale Feedback Observed in the 3C 298 Quasar Host Galaxy*”, 2017, ApJ, 851, 126

**Vayner, A.**, Wright, S. A., Do, T., Larkin, J., Armus, L., Gallagher, S. C. “*Providing stringent star formation rate limits of  $z \sim 2$  QSO host galaxies at high angular resolution*” , 2016, ApJ, 821, 64

**NON-REFEREED PUBLICATIONS**

Ragland, S., Dupuy, T. J., Jolissaint, L., Wizinowich, P. L., Lu, J. R., van Dam, M. A., Berriman, G. B., Best, W., Gelino, C. R., Ghez, A. M., Liu, M. C., Mader, J. A., **Vayner A.**, Witzel, G., Wright, S. A. “*Status of point spread function determination for Keck adaptive optics*”, 2018, SPIE, 10703, 13

**Vayner, A.**, Wright, S., Murray, N. W., Armus, L., Larkin, J. E. “*QUART: Quasar hosts Unveiled by high Angular Resolution Techniques*”, 2016, American Astronomical Society 228<sup>th</sup> Meeting, 400.02

**Vayner, A.**, Wright, S., Do, T., & Larkin, J.E. “*Resolving Host Galaxies of  $z=2$  Quasars Using Adaptive Optics and Integral Field Spectroscopy*”, poster, 2013, American Astronomical Society 221<sup>st</sup> Meeting, 339.30

**Membership & Services**

Astrocoffee event organizer, Johns Hopkins University Physics & Astronomy  
2020 - present  
Referee, The Astrophysical Journal, MNRAS, 2018 - present  
ALMA Ambassador 2020  
Thirty Meter Telescope (TMT) Infrared Imaging Spectrograph (IRIS)  
Science Team Junior Member 2018 - present  
Graduate Student Representative, Dunlap Institute Management Committee 2014  
American Astronomical Society, Junior member 2013 - Present

**TEACHING & PUBLIC OUTREACH**

**University of California, San Diego**  
Teaching Assistant PHYS 164: Observational Astrophysics Winter 2017, 2018  
Leading tutorials, marking, telescope observing sessions Fall 2018  
Professional Development Program, UC Santa Cruz Winter-Spring 2017

As part of the Professional Development Program, I attended the Institute for Scientist & Engineer Educators (ISEE) inquiry and design institute, where I led a team to design an inquiry-based activity for summer undergraduate researchers. Students focused on the STEM practice of designing and carrying out investigations. The content of the two-day activity focused on statistics and signal to noise ratio calculation with an introduction to future astronomical observatories.

**University of Toronto**  
Teaching Assistant AST101: The Sun and its Neighbours Fall 2013-2015  
Leading tutorials, planetarium operator & marking

Teaching Assistant AST201: Stars and Galaxies Winter 2014  
Leading tutorials, planetarium operator & marking

Teaching Assistant PMU199: Great Astronomical Issues Winter 2015  
Assisting students with astronomical observations using remote telescopes

Free Monthly Astronomy Public Tours 2013-2015  
Media Relations Director: overlook monthly advertisements, prepare posters and website graphics, communicate with advertisers and send monthly newsletters to the public.

Free Monthly Astronomy Public Tours 2012-2013  
Telescope operator: 8", 10" and 16" telescope guide for public observing.

Sidewalk Astronomy Summers 2013 and 2014  
Assisted in operating solar telescopes for observing sessions once a week during lunch hour in downtown Toronto.

Physics undergraduate mentoring program 2013-2014  
Mentored senior undergraduate physics & astronomy student

Astronomy graduate student mentorship program 2015-2016  
Organized and ran mentorship program for incoming astronomy graduate students

**Student Supervision**

Yuzo Ishikawa, 2019 - present, co-supervision with Prof. Nadia Zakamska, Johns Hopkins University  
Sanchit Sabhlok, 2019 - present, co-supervision with Prof. Shelley Wright, UC San Diego

**Telescope Proposals and Research Grants**

W.M Keck Observatory (KCWI), NASA 22A - PI  
1 night, \$17K - *Winds in the circumgalactic medium of extremely red quasars.*

James Webb Space Telescope, PI, Cycle 1  
Approved for 21 hours - *Extreme quasar feedback at the peak of the galaxy formation epoch*

James Webb Space Telescope, CoI, Cycle 1  
Approved for 24.6 hours - *Zooming into the monster's mouth: tracing feedback from their hosts to circumgalactic medium in z=3.5 radio-loud AGN*

James Webb Space Telescope, CoI, Cycle 1  
Approved for 8.8 hours - *Quasar Feedback in Action: The Multiphase and Multiscale Outflow of the Most Luminous Quasar in the Local Universe*

NASA, Astrophysics Data Analysis Program, CoI, 2020  
\$435K - *Feeding and feedback in the circumgalactic medium at the peak epoch of quasar activity.*

Gemini North Observatory, PI, 2020A  
Approved for 3 hours - *Extreme quasar feedback at the peak of the galaxy formation epoch*

Atacama Large Millimeter/Submillimeter Array (ALMA), PI, Cycle 2  
60.88 minutes observed - *Probing The Star Burst Phase of Quasar Host Galaxies*

Atacama Large Millimeter/Submillimeter Array (ALMA), PI, Cycle 3  
79 minutes observed - *Unique high resolution & multi-wavelength study of a  $z=1.4$  quasar host galaxy*

Atacama Large Millimeter/Submillimeter Array (ALMA), PI, Cycle 5  
Approved for 18 hours (Grade B) - *Searching for feedback with 3D multi-phase interstellar medium study in  $z\sim 2$  quasar host galaxies*

W.M Keck Observatory (OSIRIS-LGS), CoI [Ph.D. Thesis], 2015-2017  
9.5 nights total - *Resolving Star Formation and Nebular Line Ratios in Host Galaxies of High-Redshift Quasars*

W.M Keck Observatory (KCWI), CoI [Ph.D. Thesis], 2017-2020  
6.5 night - *Resolving distant quasar host galaxies and their environments*

### Observing Experience

W.M Keck Observatory:  
Keck I (OSIRIS-LGS/NGS): 15.5 nights  
Keck II (NIRC2-LGS/NGS): 4.0 nights  
Keck II (KCWI): 6 nights

Lick Observatory:  
Nickel: 2 nights

### Data Experience & Skills

#### Instrument Data reduction & Analysis:

W.M Keck Observatory: OSIRIS, NIRC2, LRIS, KCWI  
Gemini: NIFS

ALMA: Experience reducing mm interferometric data with CASA

Chandra Space Observatory: CIAO, ChaRT, MARX

Extensive analysis of optical and near-infrared spectroscopic data. Experience with mid/far-infrared photometry and SEDs

#### Languages & Software:

Python, IDL, LaTeX

#### Working Groups:

Q3D software development for JWST integral field unit data analysis 2019 - present

OSIRIS data reduction pipeline team 2014-present

Keck PSF-R commissioning science team 2016-present

**SEMINARS & INVITED TALKS** University of Maryland, CTC Seminar, November 2021, College Park, Maryland  
*“Extremely red and obscured quasars with JWST integral field spectroscopy”*

Space Telescope Science Institute, JHU/STScI JWST Science Symposium, October 2021, Baltimore, Maryland  
*“Extremely red and obscured quasars with JWST integral field spectroscopy”*

Johns Hopkins University, Department Seminar, September 2019, Baltimore, Maryland  
*“Quasar host galaxies and their environments with multi-wavelength 3D spectroscopy”*

UC Irvine, Astronomy Seminar, October 2018, Irvine, California, *“Quasar host galaxies and their environments with multi-wavelength 3D spectroscopy”*

Carnegie Observatories, Lunch Talk, October 2018, Pasadena, California, *“Quasar*

*host galaxies and their environments with multi-wavelength 3D spectroscopy*”

UC Berkeley, Lunch Talk, October 2018, Berkeley, California, “*Quasar hosts Unveiled by high Angular Resolution Techniques*”

UC Los Angeles, Astronomy Seminar, November 2017, Los Angeles, California, “*Quasar hosts Unveiled by high Angular Resolution Techniques*”

California Institute of Technology Astronomy Tea Talk, November 2017, Pasadena, California, “*Quasar hosts Unveiled by high Angular Resolution Techniques*”

**CONFERENCE  
TALKS AND  
POSTERS**

Talk, IAU Symposium 359: Galaxy Evolution and Feedback Across Different Environments (GALFEED), Bento Goncalves, RS, Brazil “*Distant quasar host galaxies and their environments with multi-wavelength 3D spectroscopy*”

Talk, Center for Adaptive Optics Fall Retreat, November 2018, Lake Arrowhead, California, “*Challenges for flux calibrating AO-assisted integral field spectroscopy observations*”

Poster, Keck Science Meeting, 2018, Caltech, California, “*OSIRIS and KCWI reveal feeding and feedback in distant Quasar Host Galaxies*”

Talk, Center for Adaptive Optics Fall Retreat, October 2017, Lake Arrowhead, California, “*Quasar host galaxies and point spread function reconstruction*”

Talk, Keck Science Meeting, 2017, Santa Cruz, California, “*Quasar hosts Unveiled by high Angular Resolution Techniques (QUART)*”

Poster, Keck Science Meeting, 2016, Caltech, California, “*Resolving distant quasar host galaxies with high angular resolution techniques*”

Poster, Mapping the Pathways of Galaxy Transformation Across Time and Space, 2016, Catalina Island, California, “*Resolving distant quasar host galaxies with high angular resolution techniques*”

Talk, American Astronomical Society 228<sup>th</sup> Meeting, 2016, San Diego, California, “*QUART: Quasar hosts Unveiled by high Angular Resolution Techniques*”

Poster, Powerful AGN conference, 2014, Port Douglas, Queensland, Australia, “*Providing stringent star formation rate limits of  $z \sim 2$  QSO host galaxies at high angular resolution*”

Talk, Canadian Astronomical Society Annual General Meeting, 2014, Quebec City, Quebec, Canada, “*Constraining the Causes of Dramatic Variability in Newly Emerged Quasar Outflows*”

Poster, American Astronomical Society 221<sup>st</sup> Meeting, 2013, Long Beach, California “*Resolving Host Galaxies of  $z=2$  Quasars Using Adaptive Optics and Integral Field Spectroscopy*”

**Media coverage**

Newsweek magazine, “*Supermassive black hole hiding at the heart of a galaxy changes the whole neighborhood*”, December 21, 2017.

[www.newsweek.com/supermassive-black-hole-finally-caught-influencing-stars-across-its-](http://www.newsweek.com/supermassive-black-hole-finally-caught-influencing-stars-across-its-)

galaxy-755271

Engadget, "Supermassive black holes may control galaxy formation",  
December 21, 2017  
<https://www.engadget.com/2017/12/21/quasars-may-control-galaxy-formation/>

Big Island Now, "Study Suggests Black Holes can Control Galaxy Formation"  
December 24, 2017  
[www.bigislandnow.com/2017/12/24/study-shows-black-holes-may-control-creation-of-galaxies/](http://www.bigislandnow.com/2017/12/24/study-shows-black-holes-may-control-creation-of-galaxies/)