JAMILA PEGUES

5th-Year Graduate Student at the **Center for Astrophysics | Harvard & Smithsonian**
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EDUCATION

Harvard University, Cambridge, MA, USA — *August 2016 - Present*
Ph.D Candidate in `Astronomy`
Master of Science in `Computational Science and Engineering`

Princeton University, Princeton, NJ, USA — *September 2012 - May 2016*
Bachelor of Arts in `Astrophysical Sciences` — GPA: 3.30/4.00
Certificate of Proficiency in `Applications of Computing`
Certificate of Proficiency in `Robotics and Intelligent Systems`

TECHNICAL SKILLS

Computer Languages	Python, Java, MATLAB, R
Software & Tools	LaTeX, GitHub | CASA
Linguistic Languages	English *(Fluent)* | Japanese *(Intermediate)*

FOCUSES AND INTERESTS

Astrophysics	Protoplanetary disks, planet formation, astrochemistry
Computer Science	Programming, applications, software development
Artificial Intelligence	Utility, logic and decision-making, intelligent design
Outreach	Equity and inclusion, science communication, informal education

CURRENT RESEARCH AND FIRST-AUTHOR PUBLICATIONS

Astrochemical M-Star Disk Models
Adviser: Dr. Karin Öberg, Center for Astrophysics | Harvard & Smithsonian
Research in progress

- Currently developing a fiducial astrochemical model of a low-mass ($\sim$0.2M$_\odot$) M-star protoplanetary disk. This model will describe how the chemistry of a typical low-mass M-star disk evolves as a function of radius, height, and time.
- Will systematically vary the parameters of this model to determine how low-mass M-star disk chemistry depends on initial conditions, such as disk structure, C/N/O enhancements, and UV irradiation.
- Will analyze the similarities and differences between the chemistry predicted by the suite of low-mass M-star disk models and the chemistry predicted by T Tauri disk models in other studies.

Dynamical Masses and Stellar Evolutionary Model Predictions of M-Stars
Co-Authors: I. Czekala, S. M. Andrews, et al.
Submitted to ApJ (September 2020)

- Dynamically measured the stellar masses for a small sample of protoplanetary disks around low-mass ($\leqslant$0.5M$_\odot$) M-stars using the Markov-Chain Monte Carlo (MCMC)-based software `DiskJockey`.
- Evaluated the performance of stellar evolutionary models, which predict stellar mass based on secondary stellar properties, that assumed different underlying stellar physics. This evaluation was carried across a combined sample of low-mass stars (from this work and from the literature) with dynamically-measured stellar masses and precise distance measurements from *GAIA*.

An ALMA Survey of Chemistry in Disks around M4-M5 Stars
Co-Authors: K. I. Öberg, J. B. Bergner, et al.
Submitted to ApJ (June 2020); currently in review

- Systematically performed individual data reduction on ALMA observations towards five protoplanetary disks for a suite of molecular lines and dust continuum in the millimeter regime. Data reduction was performed using the Common Astronomy Software Applications package (CASA).
- Used data analysis techniques to compare the emission morphologies and fluxes between M4-M5 star disks in this work and T Tauri disks from previous works.
- Used a Markov-Chain Monte Carlo (MCMC) approach and linear algebra techniques to fit models of the hyperfine structure of C_2H and HCN molecular lines and to extract excitation temperatures, column densities, and optical depths for the molecules and disks.

An ALMA Survey of H_2CO in Protoplanetary Disks
Co-Authors: K. I. Öberg, J. B. Bergner, et al.
Published in ApJ (Feb. 2020)

- Performed individual data reduction on ALMA observations of multiple transition lines of H_2CO, along with observations of CO, towards 15 protoplanetary disks in total, using the Common Astronomy Software Applications package (CASA).
- Wrote a Python module that theoretically calculates masks for a protoplanetary disk's emission at all velocities, given that disk's stellar and geometric properties, and assuming a turbulence structure and that the disk is Keplerian. This module is available on my GitHub page: https://github.com/jpegues/kepmask.
- Statistically summarized the H_2CO and CO emission of each disk in several ways, including through channel maps, integrated emission maps, radial profiles, and spectral histograms.

GRADUATE CODING AND SOFTWARE EXPERIENCE

Master of Science Independent Semester-Long Research Project
Interpolation as an Asset to Ray-Tracing *Spring 2020*
Harvard University: John A. Paulson School of Engineering and Applied Sciences
Primary Adviser: Dr. Cecilia Garraffo

- Worked independently to explore and evaluate methods of computational geometry and interpolation to speed up standard ray-tracing while still maintaining accuracy in the final image product.
- Implemented the best methods in a Python module and tutorial. Future work could perhaps implement the methodology in a coding language more suited to fast computation (e.g., Julia). The code can be found on my GitHub page: https://github.com/jpegues/modRT.

Software Development and Modeling Summer Internship
Python Redesign and Optimization of RADLite *Summer 2019*
Space Telescope Science Institute (STScI)
Adviser: Dr. Klaus Pontoppidan

- Used the ray-tracer `RADLite` in junction with the radiative transfer code `RADMC` to model a grid of protoplanetary disks for different molecular lines and stellar masses.
- Based on these models, predicted photon counts for observations of various protoplanetary disks with the proposed Origins Space Telescope (OST).
- Designed a new object-oriented, multi-processing, Python interface for `RADLite` (written in IDL). This new Python interface (`pyradlite`) simplified and expanded the user interface, allows flexible introduction of new attributes and derived (aka, inheriting) classes, streamlined the underlying code and function calls, and significantly decreased the time required to run the ray-tracing algorithm. Updates to `pyradlite` can be found on the `RADLite` GitHub page: https://github.com/pontoppi/radlite, or linked from my GitHub page: https://github.com/jpegues/radlite.

Semester Software Development Project
Python Auto-Differentiation Package *Fall 2018*
Harvard University: John A. Paulson School of Engineering and Applied Sciences

- Planned, wrote, developed, and tested a software package in Python with a team of three other people. This package is available at https://pypi.org/project/autodiffpy/.
- Package applications: automatic differentiation; forward and backward propagation; gradient descent with standard loss functions.
- Associated graduate course: 'Systems Development for Computational Science'.

RELEVANT GRADUATE COURSE WORK

Astronomy Courses	**Computer Science Courses**
Radiative Astrophysics	Advanced Machine Learning
Stellar Astrophysics	Advanced Optimization
Noise & Data Analysis in Astrophysics	Systems Development (Software Development)
Interstellar Medium & Star Formation	Computing Foundations (Parallelization)
Radio Astronomy	Advanced Scientific Computing: Numerical Methods

GRADUATE TALKS, CONFERENCES, AND AWARDS

- *UChicago Exoplanet Journal Club Seminar*: gave a virtual research seminar on November 16, 2020. Remote seminar, hosted by the astronomy and geophysics departments at the University of Chicago, IL, USA.
- *UCSC Planetary Lunch Seminar*: gave a virtual research seminar on November 9, 2020. Remote seminar, hosted by the astronomy and planetary science departments at the University of California Santa Cruz, CA, USA.
- *Origins Seminar Series*: gave a virtual research seminar on September 14, 2020. Remote seminar, hosted by the astronomy departments at the University of Arizona, AZ, USA.
- *Astrochemical Frontiers Conference*: gave a virtual research talk on June 15, 2020. Remote conference, hosted by the IAU Commission H2 Steering Committee.
- *American Astronomical Society 235th Meeting*: gave a research talk on January 8, 2020. HI, USA.
- *CfA Exoplanet Lunch*: gave a research talk on December 3, 2019. Center for Astrophysics | Harvard & Smithsonian, MA, USA.
- *STScI Exoplanet/Stars and Planet Formation Seminar*: gave a research seminar on August 12, 2019. Space Telescope Science Institute, MD, USA.
- *International Astronomical Union Symposia (IAUS) 332*: presented a research poster in March 2017. Puerto Varas, Chile.
- *NSF GRFP Fellowship Award*: was honored with the 5-year National Science Foundation (NSF) Graduate Research Fellowship Program (GRFP) fellowship.

VOLUNTEERING AND OUTREACH (NON-EXHAUSTIVE LIST)

Organizing Committee Member for the ComSciCon 2020 Conference Held in June 2020

- Helped organize, prepare for, and run the virtual ComSciCon 2020 conference, a science communication conference run by grad students for grad students.
- Took the lead on graphically designing and writing the ComSciCon 2020 program, as well as on running the virtual poster session.

Organizing Committee Member for the Equity and Inclusion Journal Club Spring 2019, Spring 2020

- Helped select, organize, and host speakers for the Equity and Inclusion Journal Club (EIJC). During EIJC, speakers gave presentations and led discussions for the Center for Astrophysics (CfA) at Harvard on various issues relating to equity and inclusion both at the CfA itself and within the broader astronomy community.
- Helped moderate and cultivate open discussion during these weekly meetings.

Volunteer for Cambridge Explores the Universe April 2017, 2018, 2019

- Helped set up and clean up for the public Cambridge Explores the Universe event at the Center for Astrophysics.
- Served as an astronomer for 'Ask an Astronomer' events, and ran activity stations ('Moon Jump', 'Pocket Solar System', etc.) throughout the event geared towards visiting children.

Writer and Editor for Astrobites January 2017 - December 2018

- About once a month, took an astronomical paper published recently on arXiv.org. Wrote an article on the paper that translated the paper's scientific and technical jargon to be more accessible to the general public (particularly high school students and undergraduates). Posted the article to astrobites.org.
- About once a month, read and provided editing feedback on the article of another astrobites writer preparing to post their own article.

Academic/Peer Mentor for the Banneker and Aztlán Institute Summers 2017, 2018

- Served as academic mentor, peer mentor, and all-around general resource for students in the Banneker and Aztlán Institute.
- Acted as a teaching assistant for the students' coding lessons.
- Served on panels with other graduate students about life as a graduate student.
- Participated in weekly readings and discussions on various topics of social justice and inequity.
- Banneker and Aztlán Institute: a summer research program that prepares undergraduate students, all of whom are underrepresented minorities in astronomy, for thriving in graduate school, performing research, and navigating social and institutional biases in the world at large.

GSAS-OLAH Team Member Spring 2017

- Helped organize events for the first-ever Graduate Students of Arts and Sciences - Open Labs at Harvard (GSAS-OLAH) Science Cafe (Apr. 28, 2017).
- Volunteered at the first-ever GSAS-OLAH Science Cafe itself.

REFERENCES

Dr. Karin Öberg
Center for Astrophysics | Harvard & Smithsonian, Cambridge, MA, USA

- Professor of Astronomy, Harvard University
- koberg@cfa.harvard.edu

Dr. David Wilner
Smithsonian Astrophysical Observatory (SAO), Cambridge, MA, USA

- Senior Astrophysicist; Associate Director of the Radio and Geoastronomy Division at the Center for Astrophysics | Harvard & Smithsonian
- dwilner@cfa.harvard.edu

Dr. Klaus Pontoppidan
Space Telescope Science Institute (STScI), Baltimore, MD, USA

- JWST Project Scientist, STScI
- pontoppi@stsci.edu

Dr. Cecilia Garraffo
Institute for Applied Computational Science (IACS) at Harvard University, MA, USA

- Research Associate in Computational Science, IACS
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