

# Tom Waggg

Flatiron Research Fellow at the Center for Computation Astrophysics

## Academic Interests

I am broadly interested in constraining binary stellar evolution, particularly with the use of kinematics of stars and compact objects. I'm also passionate about designing and using open-source software. My work combines these joint interests in developing, and applying, self-consistent population synthesis and galactic dynamics simulations.

## Funding, Fellowships and Awards

<b>NASA Astrophysics Theory Program Grant, Science PI</b>	2024-2026
“A Galaxy of Binaries: Evolving Kicked Populations Through Galactic Potentials”, <b><u>\$545,000</u></b>	
<b>CCA Pre-Doctoral Fellowship</b> for a self-proposed project at the Flatiron Institute ( <i>Simons Foundation</i> )	2023
<b>Kavli Summer Fellowship</b> for a project on asteroseismic imprints of mass transfer ( <i>Kavli Foundation</i> )	2023
<b>Provost Scholar Fellowship (\$15k)</b> for outstanding academic achievement ( <i>University of Washington</i> )	2021
<b>Alex G. Booth Fellowship (~\$5k)</b> awarded to recent graduates for a research project ( <i>Harvard University</i> )	2020
<b>Haase Fellowship (~\$5k)</b> awarded for summer research project in Physics ( <i>Harvard University</i> )	2018
<b>Distinguished Dissertation Award</b> for outstanding and exceptional scholarship and research ( <i>UW</i> )	2025
<b>Guinness World Record</b> for youngest person to discover an exoplanet ( <i>Guinness World Records</i> )	2024
<b>Graduate Research Prize</b> for an exceptional research project ( <i>University of Washington</i> )	2022
<b>Leo Goldberg Prize</b> for the best astronomy senior thesis ( <i>Harvard University</i> )	2020
<b>Bloomberg creative science prize</b> for most insightful thesis in natural sciences ( <i>Harvard University</i> )	2020
<b>Distinction in Teaching</b> awarded for excellence in teaching ( <i>Harvard University</i> )	2019

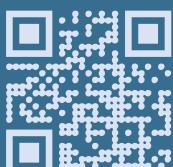
## Education

<b>University of Washington</b>	2021 – 2025
Ph.D. in Astrophysics, M.S. in Astrophysics (March 2023)	
<b>Harvard University</b>	
A.B. in Physics and Astrophysics, Secondary in Computer Science	2016 – 2020
Cum laude with Highest Honors in Field	

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## First-author Publications

[ADS Search Results](#)

1. **Wagg, T.**, Dalcanton, J., et al. (2025), *Delayed and Displaced: The Impact of Binary Interactions on Core-Collapse Supernova Feedback*, [AJ, 170, 192, Interactive Plots](#)
2. **Wagg, T.**, Hendriks, D., Renzo, M., Breivik K. (2025), *Stellar ejection velocities from the binary supernova scenario: A comparison across population synthesis codes*, [OJA, 8, 85](#)
3. **Wagg, T.**, Breivik, K., Renzo, M., Price-Whelan, A. (2025), *cogsworth : a Gala of COSMIC proportions combining binary stellar evolution and galactic dynamics*, [ApJS, 276, 16, JOSS, Documentation](#)
4. **Wagg, T.**, Broekgaarden, F. (2024), *Streamlining and standardizing software citations with The Software Citation Station*, [submitted], [arXiv link](#), [Software Citation Station](#)
5. **Wagg, T.**, Juric, M., Yoachim, P., Kurlander, J., et al. (2025), *Expected Impact of Rubin Observatory LSST on NEO Follow-up*, [AJ, 169, 6](#)
6. **Wagg, T.**, Johnston, C., et al. (2024), *The Asteroseismic Imprints of Mass Transfer: A case study of a binary mass-gainer in the SPB instability strip*, [A&A, 687, 14, Interactive plots](#)
7. **Wagg, T.**, Broekgaarden, F.S., de Mink, S.E., et al. (2022), *Gravitational wave sources in our Galactic backyard: Predictions for BHBH, BHNS and NSNS binaries detectable with LISA*, [ApJ, 937, 118](#)
8. **Wagg, T.**, Breivik, K., de Mink, S.E. (2022), *LEGWORK: A python package for computing the evolution and detectability of stellar-origin gravitational-wave sources with space-based detectors*, [ApJS, 260, 52, JOSS, Package documentation](#), [Applied in 23 papers](#)

## Co-author publications

[ADS Search Results](#)

9. Suissa, G., **Wagg, T.** et al., *Improved estimates of the planetary radius valley using constraints from multi-transiting transiting systems*, [in prep.]  
*Contribution:* I advised the first-author on the project and created the setup for fitting multi-transiting systems based on Kepler and TESS data.
10. Merritt, J., (9 co-authors, incl. **Wagg, T.**), *Implications of modern mass-loss rates for massive stars*, [in-review], [arXiv link](#)  
*Contribution:* I participated in discussions deciding which mass-loss prescriptions to use and how to implement them in COMPAS.
11. Wainer, T., Davenport, J., Tovar, G., Feinstein, A., **Wagg, T.**, 2024, *Searching for Stellar Activity Cycles using Flares: The Short and Long Timescale Activity Variations of TIC-272272592*, [AJ, 168, 8](#)  
*Contribution:* I created a pipeline for processing TESS observations of stars to characterize their flare activity and the completeness of observations.
12. Stegmann, J., Vigna-Gomez, A., Rantala, A., **Wagg, T.**, et al., 2024, *Close Encounters of Wide Binaries Induced by the Galactic Tide: Implications for Stellar Mergers and Gravitational-Wave Sources*, [ApJL, 972, L19](#)  
*Contribution:* I helped design the initial conditions of the simulations and to derive the detection rates.
13. Vigna-Gomez, A. (**Wagg, T.** 5<sup>th</sup> of 10 co-authors), 2024, *Constraints on Neutrino Natal Kicks from Black-Hole Binary VFTS 243*, [PRL, 132, 19](#)  
*Contribution:* I performed simulations that investigated how the galactic orbit of VFTS 243 would vary for different neutrino natal kicks.

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# Co-author publications (continued)

13. Wainer, T., Zasowski, G., Pepper, J., **Wagg, T.**, et al., 2023, *Catalog of Integrated-light Star Cluster Light Curves in TESS*, [AJ, 166, 3](#)  
*Contribution:* I co-wrote the analysis pipeline for this paper with the first-author, which we then generalized and published as the python package ELK.
14. Broekgaarden, F.S., et al. (incl. **Wagg, T.**), 2022, *Impact of Massive Binary Star and Cosmic Evolution on Gravitational Wave Observations II: Double Compact Object Rates and Properties*, [MNRAS, 516, 4](#)  
*Contribution:* I participated in discussions interpreting the properties of detectable systems.
15. van Son, L.A.C (**Wagg, T.** 5<sup>th</sup> of 9 co-authors), 2022, *The redshift evolution of the binary black hole merger rate: a weighty matter*, [ApJ, 931, 1](#)  
*Contribution:* I tested the robustness of our predictions by repeating the simulations for a series of binary physics variations.
16. Team COMPAS (incl. **Wagg, T.**), 2022, *Rapid stellar and binary population synthesis with COMPAS*, [ApJS, 258, 2 & JOSS](#)  
*Contribution:* I implemented the mass-loss rates for the code and wrote Section 3.5. I also created Figures 5, 6, 7, and 8.
17. Hellier, C., et al. (incl. **Wagg, T.**), 2017, *WASP-South transiting exoplanets: WASP-130b, WASP-131b, WASP-132b, WASP-139b, WASP-140b, WASP-141b and WASP-142b*, [MNRAS, 465, 3](#)  
*Contribution:* I discovered WASP-142b and estimated the parameters of the system.
18. Maxted, P., et al. (incl. **Wagg, T.**), 2016, *Five transiting hot Jupiters discovered using WASP-South, Euler, and TRAPPIST: WASP-119 b, WASP-124 b, WASP-126 b, WASP-129 b, and WASP-133 b*, [A&A, 591, A55](#)  
*Contribution:* Performed MCMC fits to the planetary systems and created Figures 2-6.

## Software Development

### Primary author

**cogsworth**, A Python package for performing self-consistent population synthesis and galactic dynamics, [GitHub](#), released 2024

**The Software Citation Station**, A [website](#) for standardizing and streamlining software citations, [arXiv link](#), released 2024, [used in 78+ papers so far](#)

**LEGWORK**, A Python package for calculating gravitational-wave strains, performing binary orbital evolution and computing SNRs for space-based gravitational-wave detectors, [GitHub](#), [JOSS](#), released 2022

### Developer/Contributor

**COSMIC**, A rapid binary population synthesis suite with a special purpose of generating realistic compact binary populations, [GitHub](#), contributed since 2023

**COMPAS**, Compact Object Mergers: Population Astrophysics & Statistics – a rapid population synthesis code, [GitHub](#), [JOSS](#), contributed since 2020

**Gala**, A Python package for Galactic and gravitational dynamics, [GitHub](#), contributed since 2023

## Talks

### Invited Conference Talks

<b>AstroNuc 2026</b> – Practical session – Tracking enrichment sites in galaxies with cogsworth	April 2026
<b>GWANW 2024</b> – Review - Science with the Laser Interferometer Space Antenna	June 2024

### Invited Seminars

<b>IAS seminar</b> – Combining population synthesis & galactic dynamics to understand binary stars	Apr 2026
<b>Berkely TAC Seminar</b> - Charting the Galactic underworld of Milky Way black holes	Mar 2026
<b>Caltech Tea Talk</b> – Applying cogsworth to constrain binary stellar evolution	Nov 2024
<b>Harvard HEAD seminar</b> ( <a href="#">recording</a> ) – The impact of binary interactions on supernova feedback	Oct 2024
<b>Columbia THEA seminar</b> – Predictions for type II SNe feedback from binary stars	Oct 2024
<b>CIERA Observers Group</b> – cogsworth: a code combining population synthesis & galactic dynamics	Oct 2024
<b>Yale Data-science x Astrophysics Seminar</b> - Stellar-origin GW sources in LISA	Jan 2024
<b>CCA SPA Group</b> – The asteroseismic imprints of mass transfer	Oct 2023
<b>LISA Early Career Scientist Software Series</b> – LEGWORK python package	Dec 2021
<b>LISA Community Telecon</b> – Stellar-origin GW sources in LISA	Nov 2021
<b>SESTAS Seminar at Max Planck Institute, Garching</b> – Stellar-origin GW sources in LISA	Nov 2021
<b>TianQin Research Center for Gravitational Physics</b> – LEGWORK python package	May 2021
<b>CCA Gravitational Wave Group</b> – Stellar-origin GW sources in LISA	Feb 2021

### Contributed Talks

<b>LIAC41</b> - Combining binary evolution and galactic dynamics to understand runaway stars	July 2024
<b>GWANW 2024</b> – Using LEGWORK to make predictions for LISA	June 2024
<b>AAS 241</b> – NEO Follow-up in the era of LSST	Jan 2023
<b>LSST@Europe4</b> – A hybrid solar system object catalogue	Oct 2022
<b>14<sup>th</sup> LISA Symposium</b> – Stellar-origin gravitational wave source in LISA	July 2022
<b>EAS 2021</b> – Stellar-origin gravitational wave source in LISA	May 2021
<b>13<sup>th</sup> LISA Symposium</b> – Black hole-Neutron Star binaries in LISA	Sep 2020

## Professional services

### Scientific Meetings

Lead Organiser – <b>COSMIC Development Workshop</b> – Hackathon-style workshop on improving COSMIC, connecting to METISSE, and discussing future direction of the code. <i>I obtained funding, designed the workshop, brought together experts in population synthesis, stars, and dynamics</i>	May 2026
SOC Member – <b>Software Citation Workshop</b> – Discussion based workshop on future <a href="#">Software Citation Station</a> development and citation policies for the field.	Apr 2026

### Peer reviewer

Served as a peer reviewer for: *Month Notices of the Royal Astronomical Society (MNRAS)*, *Astronomy & Astrophysics (A&A)*, *The Astrophysical Journal Letters (ApJL)*

## Research Advising

### PhD Students

<b>David Wang, University of Washington</b>	2025-2026
Project: Can the kinematic distribution of observed XRBs constrain aspects of binary evolution?	
Co-advisor: Eric Bellm	

### Undergraduate Students

<b>Frank Prince, Carnegie Mellon University</b>	2025-now
Project: Improving the identification of stellar-origin binaries in LISA using their kinematics	
Co-advisor: Katie Breivik	
<b>Kira Baasch, Adler planetarium and Butler University</b>	2025-now
Project: Predictions for dual-band detections of stellar-origin binaries in LISA and DECIGO	
Co-advisor: Mike Zevin	
<b>Jorie McDermott, The Ohio State University and CIERA</b>	2025-now
Project: Prospects for joint constraints from LISA and SKA on the Galactic electron density field	
Co-advisors: Debatri Chattopadhyay, Katie Breivik	
<b>Samanvita Singhania, Carnegie Mellon University</b>	2024-2025
Project: Simulating the distribution of offsets of short gamma-ray bursts from their host galaxies	
Co-advisor: Brendan O'Connor	
<b>Hannah Kahn &amp; Cavin Ehlert, University of Washington</b>	2024
Project: Exploring the impact of binary interactions on the spatial distribution of galactic BHs & NSs	
<b>Allison Payne, University of Washington</b>	2023
Project: Improved estimates of the radius valley using constraints from multi-transiting systems	
Co-advisor: Eric Agol	
<b>Emma Bacarra, Miguel Varanda &amp; Elizabeth Pawelka, University of Washington</b>	2023
Project: A search for self-lensing BH-star binaries in TESS	
Co-advisor: Andy Tzanidakis	

## Departmental Leadership

### **UW Department Roundup Talks Founder**

2024–now

I created a new monthly talk series to highlight departmental research, aiming to foster collaboration and community. Most attended non-colloquium seminar. Each month I solicit and select talks (1 graduate student, 1 postdoc, 1 faculty per session), balancing subject matter. I host the sessions, introducing each speaker and handling questions.

### **UW Graduate Student Representative**

2022–24

As the elected graduate student representative in the department, I have worked to improve the department community and culture, in particular regarding graduate student activities.

- Organised weekly faculty-grad lunches for graduates to interact with faculty in a casual manner and form stronger intra-departmental connections
- Helped to implement guidelines and safeguards for expectations regarding TA work to address issues of inequity across different classes
- Represented graduate students on assistant professor hiring committee

## Outreach

### **eSTEAM: UW Prison Outreach Program**

2022–now

eSTEAM is a program in which we educate and mentor incarcerated youth in Washington. I designed and built the [website](#) for the program, which hosts publicly available resources.

### **UW Planetarium Presenter**

2021–now

Perform weekly planetarium shows for local schools and homeschool groups on the solar system and the Milky Way using WorldWideTelescope in the UW planetarium

### **Astronomy on Tap Presenter**

2022–now

Presented talks on gravitational waves and NEOs to the general public, ~2 per year

## Teaching

### **ASTR 150A & 150E: The Planets, University of Washington**

2021–2022

General education course on various topics related to the solar system and its planets. Taught 3 weekly sections, held office hours and designed exam mark scheme with Toby Smith

### **CS61: Systems Programming and Machine Organization, Harvard**

2019

Course for computer science majors teaching the fundamentals of systems programming with C with Eddie Kohler. Taught weekly sections & held office hours

### **CS50: Introduction to Computer Science, Harvard**

2018

Class introducing computer science to undergraduates through C, Python and JavaScript with David Malan. Taught weekly sections & held office hours

## References

**Katie Breivik**

Carnegie Mellon University

*Collaborator on population synthesis & LISA*

[kbrevik@andrew.cmu.edu](mailto:kbrevik@andrew.cmu.edu)

**Julianne Dalcanton**

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Max Planck Institute for Astrophysics

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**Eric Bellm**

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