Tom Wagg

PhD Student in Astrophysics at the University of Washington

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

NASA Astrophysics Theory Program Grant, Science PI "A Galaxy of Binaries: Evolving Kicked Populations Through Galactic Potentials", **\$545,000**

CCA Pre-Doctoral Fellowship for a self-proposed project at the Flatiron Institute (Simons Foundation) 2023 Kavli Summer Fellowship for a project on asteroseismic imprints of mass transfer (Kavli Foundation) 2023 Provost Scholar Fellowship (\$15k) for outstanding academic achievement (University of Washington) 2021 Alex G. Booth Fellowship (~\$5k) awarded to recent graduates for a research project (Harvard University) 2020 Haase Fellowship (~\$5k) awarded for summer research project in Physics (Harvard University) 2018

2024-2026

Guinness World Record for youngest person to discover an exoplanet (Guinness World Records)	2024
Graduate Research Prize for an exceptional research project (University of Washington)	2022
Leo Goldberg Prize for the best astronomy senior thesis (Harvard University)	2020
Bloomberg creative science prize for most insightful thesis in natural sciences (Harvard University)	2020
Distinction in Teaching awarded for excellence in teaching (Harvard University)	2019

Education

University of Washington Ph.D. in Astrophysics, M.S. in Astrophysics	(March 2023)			2021 – 2025
Harvard University A.B. in Physics and Astrophysics, Seconda Cum laude with Highest Honors in Field	ry in Computer Scien	ice		2016 – 2020
<u>tomwagg@uw.edu</u> ⊠ <u>tomwagg.com</u> Ç		a	857-253-9571 Physics-Astronomy Bld	lg,

Seattle, WA 98195-1700

github.com/TomWagg



First-author Publications

ADS Search Results

- 1. Wagg. T, Renzo, M., et al., Investigating runaway star categorization using cogsworth [in prep.]
- **2.** Wagg. T, Dalcanton, J., et al. (2024), *Delayed and Displaced: The Impact of Binary Interactions on Type II Supernova Feedback*, [in prep.]
- **3.** Wagg. T, Breivik, K., Renzo, M., Price-Whelan, A. (2024), *cogsworth : a Gala of COSMIC proportions combining binary stellar evolution and galactic dynamics*, [accepted], arXiv link, Documentation
- 4. Wagg. T, Broekgaarden, F. (2024), *Streamlining and standardizing software citations with The Software Citation Station*, [submitted], <u>arXiv link</u>, <u>Software Citation Station</u>
- 5. Wagg. T, Juric, M., Yoachim, P., Kurlander, J., et al. (2024), *Expected Impact of Rubin Observatory LSST on NEO Follow-up*, [in review], <u>arXiv link</u>
- 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, <u>A&A, 687, 14</u>, <u>Interactive plots</u>*
- 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*, <u>ApJ, 937, 118</u>
- 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, <u>ApJS, 260,</u> 52, JOSS, Package documentation, <u>Applied in 23 papers</u>

Co-author publications

ADS Search Results

9. Merritt, J., (9 co-authors, incl. **Wagg, T.**), *Implications of modern mass-loss rates for massive stars*, [in prep.]

Contribution: I participated in discussions deciding which mass-loss prescriptions to use and how to implement them in COMPAS.

- 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.
- 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, [in review] Contribution: I created a pipeline for processing TESS observations of stars to characterize their flare activity and the completeness of observations.
- 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, [accepted]*, <u>arXiv link</u> *Contribution:* I helped design the initial conditions of the simulations and to derive the detection rates.
- Vigna-Gomez, A. (Wagg, T. 5th of 10 co-authors), 2024, *Constraints on Neutrino Natal Kicks from Black-Hole Binary VFTS 243*, <u>PRL</u>, 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)

- Wainer, T., Zasowski, G., Pepper, J., Wagg, T., et al., 2023, *Catalog of Integrated-light Star Cluster Light Curves in TESS*, <u>AJ</u>, <u>166</u>, <u>3</u>
 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*, <u>MNRAS, 516, 4</u> *Contribution:* I participated in discussions interpreting the properties of detectable systems.
- van Son, L.A.C (Wagg, T. 5th of 9 co-authors), 2022, The redshift evolution of the binary black hole merger rate: a weighty matter, <u>ApJ, 931, 1</u> Contribution: I tested the robustness of our predictions by repeating the simulations for a series of binary physics variations.
- Team COMPAS (incl. Wagg, T.), 2022, *Rapid stellar and binary population synthesis with COMPAS*, <u>ApJS, 258, 2</u> & <u>JOSS</u> *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,* <u>MNRAS, 465, 3</u> *Contribution:* I discovered WASP-142b and estimated the parameters of the system.
- 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, <u>A&A</u>, <u>591, A55</u>

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, <u>GitHub</u>, released 2024

The Software Citation Station, A <u>website</u> for standardizing and streamlining software citations, <u>arXiv link</u>, released 2024, <u>used in 17+ papers since release in June</u>

LEGWORK, A Python package for calculating gravitational-wave strains, performing binary orbital evolution and computing SNRs for space-based gravitational-wave detectors, <u>GitHub</u>, <u>JOSS</u>, released 2022

Developer/Contributor

COSMIC, A rapid binary population synthesis suite with a special purpose of generating realistic compact binary populations, <u>GitHub</u>, contributed since 2023

COMPAS, Compact Object Mergers: Population Astrophysics & Statistics – a rapid population synthesis code, <u>GitHub</u>, <u>JOSS</u>, contributed since 2020

Gala, A Python package for Galactic and gravitational dynamics, GitHub, contributed since 2023

Talks

Invited Review Talks

GWANW 2024 - Science with the Laser Interferometer Space Antenna	June 2024
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Invited Seminars

Caltech Tea Talk – Applying cogsworth to constrain binary stellar evolution	Nov 2024
Harvard HEAD seminar – The impact of binary interactions on core-collapse supernova feedback	Oct 2024
CIERA Observers Group – <i>cogsworth: a code combining population synthesis & galactic dynamics</i>	Oct 2024
Yale Data-science x Astrophysics Seminar - Stellar-origin GW sources in LISA	Jan 2024
CCA SPA Group – The asteroseismic imprints of mass transfer	Oct 2023
LISA Early Career Scientist Software Series – LEGWORK python package	Dec 2021
LISA Community Telecon – Stellar-origin GW sources in LISA	Nov 2021
SESTAS Seminar at Max Planck Institute, Garching – Stellar-origin GW sources in LISA	Nov 2021
TianQin Research Center for Gravitational Physics – LEGWORK python package	May 2021
CCA Gravitational Wave Group – Stellar-origin GW sources in LISA	Feb 2021
Contributed Talks	
LIAC41 - Combining binary evolution and galactic dynamics to understand runaway stars	July 2024

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

Research Advising

Samanvita Singhania, Carnegie Mellon University (undergraduate) Project: Simulating the distribution of offsets of short gamma-ray bursts from their host galaxies Co-advisor: Brendan O'Connor	2024-now
Hannah Kahn & Cavin Ehlert, University of Washington (undergraduates) Project: Exploring the impact of binary interactions on the spatial distribution of galactic BHs & N	2024-now Ss
Allison Payne, University of Washington (undergraduate) Project: Improved estimates of the radius valley using constraints from multi-transiting systems Co-advisor: Eric Agol	2023
Emma Bacarra, Miguel Varanda & Elizabeth Pawelka, <i>University of Washington</i> (undergraduate Project: A search for self-lensing BH-star binaries in TESS Co-advisor: Andy Tzanidakis	s) 2023

Departmental Leadership

UW Department Roundup Talks Founder

I created a new monthly talk series to highlight departmental research, aiming to foster collaboration and community. <u>Most attended non-colloquium seminar</u>. 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

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 eSTEAM is a program in which we educate and mentor incarcerated youth in Washington. I designed and built the <u>website</u> for the program, which hosts publicly available resources.	2022-now
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	
	2022–now
Astronomy on Tap Presenter	
Presented talks on gravitational waves and NEOs to the general public, ~2 per year	

Teaching

ASTR 150A & 150E: The Planets , <i>University of Washington</i> General education course on various topics related to the solar system and its planets. Taught	2021-2022
3 weekly sections, held office hours and designed exam mark scheme with Toby Smith	
CS61: Systems Programming and Machine Organization , <i>Harvard</i> Course for computer science majors teaching the fundamentals of systems programming with C with Eddie Kohler. Taught weekly sections & held office hours	2019
CS50: Introduction to Computer Science , <i>Harvard</i> Class introducing computer science to undergraduates through C, Python and JavaScript with David Malan, Taught weekly sections δ, held office hours	2018

2022-24

2024-now

References

Katie Breivik Carnegie Mellon University Collaborator on population synthesis & LISA kbrevik@andrew.cmu.edu

Julianne Dalcanton Center for Computational Astrophysics *Pre-doctoral fellowship advisor* jdalcanton@flatironinstitute.org

Selma de Mink Max Planck Institute for Astrophysics Undergraduate thesis advisor sedemink@mpa-garching.mpg.de Eric Bellm University of Washington Formal PhD Advisor ecbellm@uw.edu

Mathieu Renzo University of Arizona Collaborator on binary stellar evolution mrenzo@arizona.edu

Floor Broekgaarden University of California San Diego Undergraduate thesis advisor fbroekgaarden@ucsd.edu

🖂 tomwagg@uw.edu 💄 tomwagg.com 🎧 github.com/TomWagg 🖀 + 1 857-253-9571