

# MAGDALENA SIWEK

Center for Astrophysics | Harvard & Smithsonian  
B-301, 60 Garden Street, Cambridge, MA 02138  
Professional Website  
magdalena.siwek@cfa.harvard.edu · 929-204-2781

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## ACADEMIC INTERESTS

I develop hydrodynamic simulations of **Circumbinary Disks** (CBD) and population synthesis models that trace the evolution of **Massive Black Hole Binaries** (MBHBs) across cosmic time. My main research interest is in **Multi-Messenger signatures of MBHBs**: as a full member of the **NANOGrav** collaboration I quantify the impact of CBD accretion on the Gravitational Wave Background (GWB), the statistical properties of the observable MBHB population and the electromagnetic variability of binary AGN. I designed and executed the **largest to-date (2023) suite of hydrodynamic simulations investigating binary evolution in CBDs**, discovering a relationship between mass ratio and eccentricity evolution. I apply my hydrodynamic models to binaries on all scales; tracing the impact of CBD driven evolution on MBHBs and **binary AGN feedback** models, **binary star formation and LIGO compact object mergers**.

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## EDUCATION

Harvard University  
2018-present

**PhD Candidate in Astronomy** with a focus on Computational Astrophysics. Advisor: Lars HERNQUIST · [lhernquist@cfa.harvard.edu](mailto:lhernquist@cfa.harvard.edu)

University of  
Glasgow 2016-2017

**MSc Physics and Astronomy**. Thesis: Hydrodynamic Simulations of AGN Outflows. Advisors: Ramesh NARAYAN · [rnarayan@cfa.harvard.edu](mailto:rnarayan@cfa.harvard.edu), Graham WOAN · [Graham.Woan@glasgow.ac.uk](mailto:Graham.Woan@glasgow.ac.uk)

University of  
Glasgow 2012 - 2016

**BSc Physics and Astronomy**. Thesis: Measuring General Relativistic effects around pulsar PSR B0329+54. Advisors: Graham WOAN · [Graham.Woan@glasgow.ac.uk](mailto:Graham.Woan@glasgow.ac.uk)

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## RESEARCH POSITIONS

Harvard University  
2018 - present

**Research Assistant**. Developing high resolution hydrodynamic simulations of circumbinary disks using the moving-mesh code AREPO.

Center for  
Computational  
Astrophysics, 2019

**Summer School Student**. Improving convergence in C++ Hydrodynamics simulations to 5th order using the WENO method: <https://github.com/mssiwek/WENO>. Advisor: Jonathan ZRAKE · [jonathan.zrake@gmail.com](mailto:jonathan.zrake@gmail.com)

New York University  
Jan - July 2018

**Research Assistant**. Statistical Analysis of Supernovae resulting in a highly cited publication: **Host galaxies of type Ic/Ic-BL supernovae from the Palomar Transient Factory: Implications for Jet production**. Advisor: Maryam MODJAZ · [mmodjaz@nyu.edu](mailto:mmodjaz@nyu.edu)

Harvard University  
Jun - Sep 2016

**Research Assistant**. Development of numerical simulations studying winds from accretion disks, leading to a publication: **Numerical Simulations of ULX outflows with KORAL**. Advisors: Ramesh NARAYAN · [rnarayan@cfa.harvard.edu](mailto:rnarayan@cfa.harvard.edu), Aleksander SADOWSKI · [asadowski@mit.edu](mailto:asadowski@mit.edu)

University of  
Glasgow Aug - Sep  
2015

**Research Assistant**. Statistical analysis of Time-Series data in H Ly- $\alpha$  in Solar flares. Development of Solar Flare Detection Algorithms in GOES 15 data. Advisor: Nicolas LABROSSE · [Nicolas.Labrosse@glasgow.ac.uk](mailto:Nicolas.Labrosse@glasgow.ac.uk)

Swinburne  
University May -  
Aug 2015

**Research Assistant**. Statistical Analysis of Galactic Morphology and Mergers in 2dFLENs data. Implications for and Detection of Strong Gravitational Lensing in Galaxies. Advisor: Chris BLAKE · [cblake@swin.edu.au](mailto:cblake@swin.edu.au)

European Space  
Agency Jun - Sep  
2014

**ESA Trainee**. First statistical analysis of the Gaia space telescope. Discovery of a glitch in Gaia's star detection algorithm which was later solved by a spacecraft upgrade. Advisor: Edmund SERPELL · [Edmund.Serpell@esa.int](mailto:Edmund.Serpell@esa.int)

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## FIRST-AUTHOR PUBLICATIONS

**Siwek et al. (2023b):** Orbital Evolution of Binaries in Circumbinary Disks

<https://doi.org/10.1093/mnras/stad1131>

**Siwek et al. (2023a):** Preferential Accretion and Circumbinary Disk Precession in Eccentric Binary Systems <https://doi.org/10.1093/mnras/stac3263>

**Siwek et al. (2020):** The effect of differential accretion on the Gravitational Wave Background and the present day MBH Binary population <https://doi.org/10.1093/mnras/staa2361>

**Siwek et al. (2017):** Optical and X-ray luminosities of expanding nebulae around ultraluminous X-ray sources. <https://doi.org/10.1093/mnras/stx1185>

Full publication record: [ADS](#).

## AWARDS

- 2022 **Harvard University** Derek Bok Center Certificate of Distinction in Teaching
- 2021 **Harvard University** Derek Bok Center Certificate of Distinction in Teaching
- 2018 **Harvard Scholarship Foundation Germany** Merit-based stipend supporting exceptionally gifted graduate students from Germany
- 2017 **University of Glasgow Archibald McAulay Memorial Prize:** Best Combined Physics MSci candidate
- 2016 **University of Glasgow Mackay Smith Prize:** Best Physics and Astronomy MSci candidate
- 2016 **University of Glasgow:** Travel Grant for CUWIP 2016 (Oxford University)
- 2015 **University of Glasgow Tannahill Bequest:** Best Astronomy honours student
- 2015 **Royal Society of Edinburgh:** Cormack Research Scholarship

## TEACHING AND OUTREACH

- 2019 - present **Volunteer, Skype A Scientist:** Hosting live Q&A sessions with classrooms around the world.
- 2021 **Teaching Fellow,** Harvard University, ASTRON17: Galactic and Extragalactic Astronomy. Instructor: Daniel Eisenstein.
- 2020 **Teaching Fellow,** Harvard University, ASTRON17: Galactic and Extragalactic Astronomy. Instructor: Daniel Eisenstein.

## SERVICE AND LEADERSHIP

- 2023 **Blackboard Talk Series, ITC (Harvard):** Initiated a new blackboard talk series focusing on topics in theoretical astrophysics at the ITC.
- 2020 - present **Founder: Harvard University Astronomy Garden:** Founded and lead the Astronomy Garden ([Asgard](#)) at Harvard University, facilitating annual budget proposals and community engagement.
- 2022 **Harvard University Student Focus Group:** Provide critical feedback in reaction to proposals by Harvard University, such as Mental Health and Wellness related campaigns for students.
- 2020-2021 **Harvard University Astronomy Graduate Program Committee:** Advocating for graduate students' interests in academic policy, student wellness, and any other topics of general concern.
- 2019-2021 **Harvard University GSAS Student Center Fellow:** Leadership at the GSAS Student Center, organizing academic and non-academic events for GSAS students.
- 2020-2023 **Harvard University Astronomy Peer Mentoring Program Coordinator:** Matching incoming graduate students with mentors and organizing mentoring events throughout the academic year.
- 2020 **Harvard University Astronomy Admitted Students Visit Coordinator:** Planning and organizing the annual visit of newly admitted graduate students.

## SELECTED CONFERENCE AND SEMINAR TALKS

- April 2023 **Astrophysics and Relativity Seminar at New York University (New York, NY, USA):** Orbital Evolution of Binaries in Circumbinary Disks
- April 2023 **Seminar at Institute for Advanced Study (Princeton, NJ, USA):** Orbital Evolution of Binaries in Circumbinary Disks
- April 2023 **THEA Seminar at Columbia University (New York City, NY, USA):** Orbital Evolution of Binaries in Circumbinary Disks
- March 2023 **Stellar Physics Seminar at Max Planck Insitute for Astrophysics (Garching, Germany):** Orbital Evolution of Binaries in Circumbinary Disks
- March 2023 **Cambridge University Department of Applied Mathematics and Theoretical Physics General Relativity Seminar (Cambridge, UK):** Orbital Evolution of Binaries in Circumbinary Disks
- February 2023 **ITC Lunch Seminar Talk at Harvard University (Cambridge, MA, USA):** Orbital Evolution of Binaries in Circumbinary Disks
- February 2023 **Seminar Talk at Harvard University Research Forum (Cambridge, MA, USA):** Orbital Evolution of Binaries in Circumbinary Disks
- December 2022 **Conference Talk at Gravitational Wave Physics and Astronomy Workshop (Melbourne, Australia):** Orbital Evolution of Binaries in Circumbinary Disks
- July 2022 **Seminar Talk at Clemson University Astronomy Department (virtual):** Accretion Disks around Eccentric Binaries
- July 2022 **Invited Talk at BHI BLack holes Across Space and Time (BLAST) workshop (virtual):** Simulations of Supermassive Binary Black Holes
- December 2021 **Conference Talk at Gravitational Wave Physics and Astronomy Workshop (Hannover, Germany):** Preferential Accretion onto Eccentric Black Hole Binaries
- October 2021 **Conference Talk at NANOGrav Fall Collaboration Meeting (Nashville, TN, USA):** Preferential Accretion in MBHBs on Eccentric Orbits
- April 2021 **Seminar Talk at Harvard University Astronomy Department Research Forum (ADRF):** Retrograde Accretion in Supermassive Black Hole Binaries
- October 2020 **Conference Talk at NANOGrav Fall Collaboration Meeting (virtual):** The effect of differential accretion on the Gravitational Wave Background and the present-day MBHB population.
- May 2019 **Cosmology Seminar at Max Planck Insitute for Astrophysics (Garching, Germany):** Binary accretion and the Gravitational Wave Background.

August 25, 2023