



Maria Paola Vaccaro

Born on July 11th, 1997

in Larino (CB), Italy

Currently in Heidelberg, Germany

✉ mariapaolavaccaro@gmail.com

🔗 mariapaolavaccaro.github.io

☎ +39 320 031 2701

Scientific interests

- Computational astrophysics
- Gravitational waves sources
- Stellar evolution
- Black holes dynamics
- Stellar clusters
- Hydrodynamics

Numerical tools

Python ●●●●

C/C++ ●●●○

Matlab ●●●○

Operating systems

Linux/Unix ●●●○

Windows ●●●○

Languages

Italian (mother tongue)

English (fluent, level C1)

Spanish (basic, level A2)

German (basic, level A1)

Education

Sep. 2023 – 2027 PhD in Astronomy and Cosmic Physics

At Institute for Theoretical Astrophysics (ITA), ZAH,

Heidelberg University in Heidelberg, Germany.

Supervisor: Prof. Michela Mapelli - Thesis title: "Binary Black Hole population in the Local Universe"

Oct. 2020 – Sep. 2022 Master degree in Astrophysics

At Università degli Studi di Padova in Padua (PD), Italy. Final grade: 110/110 *cum laude*, GPA: 29.4/30

Supervisor: Prof. Michela Mapelli - Thesis title: "Hierarchical Black Holes Mergers in Active Galactic Nuclei"

Sep. 2019 – Jul. 2020 Master course in Matter Physics

At Università di Pisa in Pisa (PI), Italy - GPA: 28.8/30

Sep. 2016 – Sep. 2019 Bachelor degree in Physics

At Università di Pisa in Pisa (PI), Italy.

Final grade: 110/110 *cum laude*, GPA: 28.6/30

Supervisor: Prof. Pier Giorgio Prada Moroni - Thesis title: "Cooling evolution of white dwarfs and cosmochronology"

Sep. 2011 – Jul. 2016 High school diploma

At Liceo Scientifico Alfano da Termoli in Termoli (CB), Italy.

Final grade: 100/100 *cum laude*

Aug. 2014 – Jul. 2015 High school exchange year

At Mead High School in Mead, Colorado, USA.

GPA: 4.0/4 - ACT score: 33/36

Current activity

I am a computational astrophysicist working in the field of gravitational-wave astronomy, currently pursuing a PhD in Astronomy and Cosmic Physics at Heidelberg University, as a fellow of the 19th generation of the International Max Planck Research School (IMPRS). My research investigates the formation channels of gravitational-wave sources, with a focus on hierarchical black hole mergers and the potential formation of intermediate-mass black holes (IMBHs) in dense environments. I am the lead developer of a semi-analytical code that models the active galactic nucleus (AGN) disk scenario, capturing the dynamical evolution and growth of black holes. This tool is now integrated into the FASTCLUSTER framework and contributes to understanding black hole dynamics, source populations, and their observational signatures.

Funding and affiliations

Member of the Einstein Telescope collaboration ([October 1st, 2023 – Present](#)), Division 3

Member of the Young Research Convent ([October 1st, 2023 – Present](#)) of the Heidelberg Cluster of Excellence STRUCTURES. Program funded by the German Excellence Strategy fund.

Travel grant ([July 2025](#)). Participation in the IAU Symposium 398 and MODEST-25 hosted by the Seoul National University in Seoul, South Korea sponsored by the International Astronomical Union.

Travel grant ([July 2024](#)). Participation in the International HPC Summer School hosted by the RIKEN Center in Kobe, Japan sponsored by the EuroHPC Joint Undertaking via the HPC SPECTRA project.

Pre-doctoral fellowship ([February 1st – August 31st, 2023](#)) in DEMOBLACK ERC Team at Università degli Studi di Padova, Padua (PD), Italy. Supervisor: Prof. Michela Mapelli. Research project: "Hierarchical evolution of stellar-sized binary black holes in active galactic nuclei".

Internship in GW group ([October 1st – December 31st 2022](#)) at IFAE-UAB, Barcelona, Spain. Supervisors: Dr. Lluïsa-Maria Mir i Martínez and Prof. Mario Martínez Pérez

Scientific publications

As first author

Impact of gas hardening on the population properties of hierarchical black hole mergers in AGN disks

M. Paola Vaccaro, Michela Mapelli, Carole Péroigis, et al., *A&A*, 685, A51 (2024)

Astrophysics: a modern discipline with a Newtonian origin

M. Paola Vaccaro 2025, *Phil. Trans. R. Soc. A* 383: 20230294. One contribution of 16 to a theme issue ‘Newton, *Principia*, Newton Geneva Edition (17th–19th) and Modern Newtonian Mechanics: Heritage, Past & Present’.

As co-author

The Science of the Einstein Telescope

Adrian Abac, Raul Abramo, et al. (incl. M. Paola Vaccaro), 2025, arXiv:2503.12263

The boring history of Gaia BH3 from isolated binary evolution

Giuliano Iorio, Alessandro A. Trani, et al. (incl. M. Paola Vaccaro), *A&A*, 690, A144 (2024)

Hierarchical binary black hole mergers in globular clusters: mass function and evolution with redshift

Stefano Torniamenti, Michela Mapelli, et al. (incl. M. Paola Vaccaro), *A&A*, 688, A148 (2024)

GW190521: a binary black hole merger inside an active galactic nucleus?

Sophia Morton, Stefano Rinaldi, et al. (incl. M. Paola Vaccaro) 2023, *Phys. Rev. D*, 108, 123039

The hitchhiker’s guide to the galaxy catalog approach for gravitational wave cosmology

Jonathan R. Gair, Archisman Ghosh, Rachel Gray, et al. (incl. M. Paola Vaccaro), 2022, *AJ*, 166, 22

Teaching experience and academic service

- Tutor for the block course "Introduction to Astronomy and Astrophysics" Summer Semesters 2024, 2025
Conducted daily exercise tutorials, corrected student submissions, and provided detailed feedback.
- Reviewer for *Astronomy & Astrophysics (A&A)* since 2025
- Co-supervisor of bachelor student Yannick Seif October 1st, 2024 – March 26th, 2025
Thesis titled "Pair Up of Binary Black Holes in Active Galactic Nuclei"
- Volunteer staff member at EAS annual meeting: July 1st–5th, 2024
Supported registration, guided attendees, and coordinated session logistics
- Co-supervisor of bachelor student Jona Alexander Schubert April 1st–August 19th, 2024
Thesis titled "The mass ratio of binary black holes: impact of mass transfer"

Conferences and workshops

- **Contributed Talk | MODEST-25 & IAU Symposium 398** Seoul National University, Seoul, South Korea
Talk title: "Hierarchical Black Hole Mergers in AGN Disks". June 16th–20th, 2025
- **Contributed Talk | Dynamix** Institute of Astronomy, Cambridge, UK
Title: "Hierarchical BH Mergers in AGN Disks: Tracing MBH Growth Across Cosmic Time". June 2nd–6th, 2025
- **Poster Presentation | MODEST-24** Warsaw, Poland
(Remote attendance) August 19th–23rd, 2024
- **Invited Talk | New ideas on the origin of black hole mergers** Niels Bohr Institute, Copenhagen, Denmark
Talk title: "Specks of light from AGNs as possible indicators of the dynamical formation of binary black holes". August 12th–16th, 2024
- **Contributed Talk | EAS annual meeting** Congress Center, Padova, Italy
Session: "S1: Unveiling black hole Growth across Cosmic Time in the JWST and LISA era". July 1st–5th, 2024
Talk title: "Hierarchical Black Hole Mergers in Active Galactic Nuclei Disks".
- **Poster Presentation | EAS annual meeting** Congress Center, Padova, Italy
Session: "SS2: Spacetime ripples and light from compact binary mergers: Lessons learned from O4 so far, and a look at the future". Poster title: "Specks of light from AGNs as possible indicators of dynamical formation of BBHs". July 1st–5th, 2024
- **Contributed Talk | Massive Black Holes in the First Billion Years** University College Cork, Cork, Ireland
Talk title: "Possible constraints on the SMBH mass distribution from hierarchical BBH mergers in AGN discs". April 29th – May 3rd, 2024
- **Contributed Talk | RESCEU-NBIA workshop on GW sources** University of Tokyo, Tokyo, Japan
Talk title: "The impact of Gas Hardening on Hierarchical Black Hole Mergers in Active Galactic Nuclei Disks". Contribution to the [discussion panel](#) "Many-Body Systems". December 7th–15th, 2023
- **Flash Talk | Workshop "GwPopNext"** University of Milano Bicocca, Milan, Italy
Talk title: "Semi-analytical Models for Hierarchical Binary Black Hole Mergers". July 10th–14th, 2023
- **Poster Presentation | Renaissance of Stellar Black-Hole Detections** Lorentz Center, Leiden, Netherlands
Invited participation June 26th–30th, 2023
- **Invited Talk | Physics of Data Workshop** Venetian institute of science, literature and art, Venice, Italy
Talk title: "How do black holes grow? Active galactic nuclei as a breeding ground for intermediate-mass black holes" April 19th–21st, 2023

Colloquia

- Physics of Stellar Objects Group Meeting HITS, Heidelberg, Germany | April 16th, 2025
- Gravitation and Cosmology Group Meeting GSSI, L'Aquila, Italy | December 9th, 2024
- ITP Cosmology Seminar ITP, Heidelberg, Germany | October 29th, 2024
- Einstein telescope monthly meeting (online) ET-OSB Div3 | October 25th, 2024
- "Astroscopicini" Seminar (online) GSSI, L'Aquila, Italy | April 26th, 2024
- Galaxy Group Meeting ITA-ZAH, Heidelberg, Germany | March 27th, 2024
- Planet Formation Group Meeting ITA-ZAH, Heidelberg, Germany | February 20th, 2024

Schools and workshops attendance

- "ML4ASTRO, Machine Learning in Astrophysics" workshop hosted by HITS in Heidelberg July 8th, 2025
- International HPC Summer School hosted by the RIKEN Center in Kobe, Japan July 7th-12th, 2024
- "ML4ASTRO, Machine Learning in Astrophysics" workshop hosted by HITS in Heidelberg June 25th, 2024
- "360° approach to Common Envelope Evolution: From Binary Progenitors to Remnants" hosted by Institut de Ciències del Cosmos of the Universitat de Barcelona (remote attendance) June 10th-14th, 2024
- 4th G2Net Training School "A network for Gravitational Waves, Geophysics and Machine Learning" hosted by Aristotle University of Thessaloniki (remote attendance) March 28th-30th, 2023
- Python Course (level advanced) hosted by ICFO in Barcelona, Spain November 24th-30th, 2022
- GW Open Data Workshop hosted by GWOSC (online event) May 23rd-25th, 2022
- IPAM Workshop III: Source inference and parameter estimation in Gravitational Wave Astronomy (remote attendance) November 15th-19th, 2021

Outreach

- Co-organizer for the workshop "A dance of stars and black holes" of the Girl's Day program April 3rd, 2025
- "Physik hautnah!" for school-aged students April 25th, 2024
- Co-author (with Giuliano Iorio and Erika Korb) of a pamphlet about stellar evolution, distributed to 13th-grade high schoolers in the school Liceo Volta (Reggio Calabria, Italy) by Scholé April 2024
- Speaker and staff member at the 2023 Scholé Summer School titled "PHYSIS" ("Nature"). Talks:
 - "Understanding Nature with Quantum Mechanics" with Prof. Giancarlo Cella (Pisa, Italy) July 25th, 2023
 - "The concept of space from Newton to Einstein" with Prof. Paolo Bussotti (Udine, Italy) July 29th, 2023
- Member of the organizing committee for the Scholé "School of Physics" for high schoolers since 2022
- Staff member of the cultural association Scholé based in Roccella Jonica (RC), Italy since 2020

Awards and other activities

- Don Peppe Presutto award from Circolo CFR Serracapriola for academic achievements 2016, 2020, 2023
- Aupair program in Cork, Ireland for language enhancement 2018
- Lions Club Tifernus award and 1000€ scholarship for educational achievements 2016
- Internship in the local newspaper Termolionline in Termoli (CB), Italy 2014