Curriculum Vitae of

William Giarè

Research Associate in Theoretical Cosmology

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About me

I am a theoretical cosmologist working at the interface between fundamental physics and observational data. My research focuses on testing extensions of the standard cosmological model through high-precision analyses of cosmic microwave background, large-scale structure, and multi-messenger probes. I specialize in dark-sector phenomenology, cosmological tensions, and early-Universe physics, combining theoretical model building with advanced numerical pipelines and Bayesian inference. My work aims to develop robust frameworks for interpreting emerging anomalies in cosmological data and for probing physics beyond the standard model of cosmology.

Research Appointments

Jan. 2026 – present	**Postdoctoral Research Associate** – University of Hawaii, Department of Physics and Astronomy, Watanabe Hall, 2505 Correa Road, Honolulu, HI, 96822, USA.
Jan. 2023 – Dec. 2025	**Postdoctoral Research Associate** – The University of Sheffield, School of Mathematics and Statistics, Hounsfield Road, Sheffield S3 7RH, United Kingdom.
Jan. 2022 – Dec. 2022	**Postdoctoral Research Fellow** – Galileo Galilei Institute for Theoretical Physics, INFN Center for Advanced Studies, Largo Enrico Fermi, 2, 50125 Firenze, Italy.

Education

2018 – 2021 **Ph.D. in Astronomy and Astrophysics**, "Sapienza" University of Rome

Thesis title: *Relics from the Early Universe: primordial gravitational waves, axions and neutrinos* – Link
Supervisor: Prof. Alessandro Melchiorri

2016 – 2018 **Master's Degree in Theoretical Physics – 110/110 and Laude**, "Sapienza" University of Rome

Thesis title: *Inflation and primordial fluctuations: theoretical aspects and observational constraints*
Supervisor: Prof. Alessandro Melchiorri

2013 – 2016 **Bachelor's Degree in Physics – 110/110 and Laude**, "Sapienza" University of Rome

Thesis title: *Dark Energy*.
Supervisor: Prof. Alessandro Melchiorri

Awards, Grants and Fellowships

2025 ***GGI Workshop Proposal Grant*:** Recipient of a ∼€83k grant to co-organize a 4-week workshop, *"Exploring New Frontiers in Cosmology"*, held in July 2026 at the Galileo Galilei Institute (GGI), Florence, Italy.

2025 **Research Fellowship in Theoretical Cosmology**, The University of Hawaii, USA – [**Accepted**]
– *info:* Postdoctoral position focused on Theoretical Cosmology with PI Prof. Jeremy Sakstein. Started in January 2026.

2024 ***2024 Universe Travel Award*:** Grant awarded by the journal Universe (CHF 800) – Link

Awards, Grants and Fellowships (continued)

2023 **Research Fellowship in Theoretical Cosmology**, The University of Sheffield, UK – [**Accepted**]
– *info:* Postdoctoral position focused on Early Universe Cosmology with PI Prof. Carsten van de Bruck.

2023 **E-COST Grant:** Short Term Scientific Mission (STSM) Grant awarded by the European Cooperation in Science and Technology (COST), Action: CA21136, for the research project "New physics in light of the current tensions between Cosmic Microwave Background and Weak Lensing surveys" (1800 EURO)

2022 **Research Fellowship in Theoretical Cosmology**, The University of Sheffield, UK – [**Accepted**]
– *info:* Postdoctoral position focused on cosmological tensions with PI Dr. Eleonora Di Valentino.

2021 **Boost Postdoctoral Research Fellowship**, GGI - Florence, Italy – [**Accepted**]
– *info:* 1-year research fellowship (∼€22k) to carry out independent research on "Theory of the Fundamental Interactions."

2021 **Junior Postdoc fellowship in Astroparticle Physics**, INFN Naples, Italy – [**Declined**]
– *info:* 2-year Junior Postdoctoral fellowship in "Characterization of cosmological and astrophysical effects due to Dark Matter particles, neutrinos and axions."

2016 – 2018 **Distinguished Student Award –** ranked *first* among the top 5% of physics department master's students – Regolamento Studenti 2017-2018 ART.27.2, Sapienza University of Rome – Link

Teaching Experience

October 2024 Lecturer at the CosmoVerse Online Training School, "From Fundamental Physics to Data Analysis in Cosmology", online school, 3 October 2024 – Lecture material

May 2024 Lecturer at the CosmoVerse Training School, "From Fundamental Physics to Data Analysis in Cosmology", Corfu, 13–18 May 2024 – Link – Lecture material

Student Mentorship

2023–present Current and former PhD, Master, and undergraduate students I supervise, mentor, or collaborate with:

- **Jonathan Betts** (PhD student at the University of Sheffield) – 1 joint publication
- **Mariaveronica De Angelis** (former PhD student at the University of Sheffield) – 5 joint publications
- **Luis A. Escamilla** (former PhD student at UNAM) – 2 joint publications
- **Elisa Fazzari** (PhD student at Sapienza University) – 2 joint publications
- **Matteo Forconi** (former PhD student at Sapienza University) – 3 joint publications
- **Dong-Ha Lee** (PhD student at the University of Sheffield) – 1 joint publication
- **Tian-Nuo Li** (PhD student at Northeastern University) – 1 joint publication
- **Tariq Mahassen** (PhD student at the University of Sheffield) – 1 joint publication
- **Mahdi Najafi** (PhD student at Sapienza University) – 2 joint publications
- **Emre Özülker** (former PhD student at Istanbul Technical University) – 4 joint publications
- **Davide Pedrotti** (PhD student at the University of Trento) – 2 joint publications
- **Adam Smith** (PhD student at the University of Sheffield) – 1 joint publication
- **Enrico Specogna** (PhD student at the University of Sheffield) – 5 joint publications
- **Kira Xu** (undergraduate student, University of Hawai'i)
- **Yuejia Zhai** (PhD student at the University of Sheffield) – 3 joint publications

Membership in Working Groups and Collaborative Initiatives

2025–present Co-Proposer for the NEXTCOSMO COST Action

Membership in Working Groups and Collaborative Initiatives (continued)

2024–present	Member of the COST Action CA21106 (CosmicWISPers)
2023–present	Member of the COST Action CA21136 (CosmoVerse)
2023–2026	Member of the CMB-S4 collaboration
2021–2022	Member of the SNOWMASS collaboration investigating cosmic tensions

Academic Service and Organizational Commitments

2026	LOC and principal organizer of the GGI workshop *"Exploring New Frontiers in Cosmology"*.
2026	Convener, PaSCOS 2026 (parallel session on Cosmological Tensions), Sheffield, UK.
2025	*Invited* guest editor of a topical collection with Discover Space, Springer Nature.
2025–present	Member of the editorial board of the journal Discover Physics, Springer Nature.
2024–present	Member of the editorial board of the journal Discover Space, Springer Nature.
2024	*Invited* guest editor of the special issue "Footprints of fundamental symmetries in cosmology" for the journal Symmetry – Link
2022–2024	Organizer of the "GGI Theory Lectures by Young Researchers" – Link
September 2022	LOC of the GGI workshop *"Machine Learning at GGI"*.
June 2022	LOC of the GGI workshop *"Reconstructing the Gravitational Hologram with Quantum Information"*.
2021–present	Referee for scientific journals including (but not limited to) *Nature Astronomy*, *ApJ Letters*, *MNRAS Letters*, *JHEAp*, *Physics Letters B*, *Physics of the Dark Universe*, *European Physical Journal C*, *Universe*, and *10+*. I have also served as a referee for review articles and book proposals. [Total documents refereed since 2021: 100+]
2020–2021	Founder and organizer of Sapienza's Astrophysics Journal Club – Link – Results
2018–2019	LOC of Sapienza's "Astrophysics Workshop", 2019 edition (17–19 September 2019, Rome).

Recent and Upcoming Talks

June 2026	*Invited* Speaker at PaSCOS 2026, Sheffield, UK.
May 2026	*Invited* Speaker at Vulcano 2026, Ischia, Italy.
May 2026	*Invited* Speaker at the CosmoVerse Online Seminars – [Video]
April 2026	Speaker at Dark Energy from Home – [Video]
March 2026	*Invited* Speaker at the Cosmology Seminar, Presidency University, Kolkata, India.
February 2026	*Invited* Speaker at the Cosmology Seminar, University of Hawai'i at Mānoa, Honolulu, USA.
December 2025	*Invited* Speaker at "Strings and Cosmology Meeting", Annecy, France.
November 2025	*Invited* Speaker at "TeVPA", Valencia, Spain.
September 2025	*Invited* Speaker at "Luxembourg Meeting on Quantum Analogues and Analogues of Gravity", Luxembourg.
September 2025	*Invited* Keynote Speaker at "Workshop on Tensions in Cosmology", Corfu, Greece.
May 2025	*Invited* Speaker at "Round Table on New Avenues in Particle Cosmology", Winchester Guildhall.
April 2025	*Invited* Speaker at the workshop *"New ν Physics: from colliders to cosmology"*, IPPP Durham, UK.
March 2025	*Invited* Speaker at the University of Sheffield, UK.
February 2025	*Invited* Speaker at the University of Science and Technology of China (online talk).
February 2025	*Invited* Speaker at ITP, Heidelberg, Germany.
January 2025	*Invited* Speaker at the Polygonal Seminars series, Madrid.
November 2024	*Invited* Speaker at "The Astroparticle Workshop", Pascal Institute of Paris-Saclay University, France.
October 2024	*Invited* Speaker at Southampton High-Energy Physics seminars, Southampton, UK.

Recent and Upcoming Talks (continued)

October 2024	*Invited* Speaker at ICG, Portsmouth, UK.
September 2024	*Invited* Speaker at the international conference The Dark Side of the Universe (DSU 2024), 8–14 September 2024, Corfu, Greece.
July 2024	Speaker at the CosmoVerse annual meeting, CosmoVerse@Kraków, Kraków, Poland (selected contribution funded by the COST Action CosmoVerse).
July 2024	*Invited* Speaker at the University of Lancaster, Lancaster, UK.
June 2024	*Invited* Speaker at the Majorana-Raychaudhuri seminar series (online seminar).
June 2024	*Invited* Speaker at the Center for Cosmology, Particle Physics and Phenomenology (CP3), Catholic University of Louvain, Belgium.
May 2024	Lecturer at the CosmoVerse Cosmology Training School, "From Fundamental Physics to Data Analysis in Cosmology", Corfu, 13–18 May 2024.
March 2024	*Invited* Speaker at the cosmology seminar, Laboratoire Univers et Particules de Montpellier, Montpellier, France.
March 2024	Speaker at the CRAG seminar, University of Sheffield, Sheffield, UK.
February 2024	Speaker at "UniVersum 2024", Sapienza University of Rome, Rome, Italy.
November 2023	*Invited* Speaker at Queen Mary University of London, London, UK.
September 2023	Keynote Speaker at "Workshop on Tensions in Cosmology", 23rd Hellenic School on Elementary Particle Physics and Gravity, Corfu, Greece.
July 2023	Speaker at MIAPbP Workshop "Extragalactic Distance Scale", Munich, Germany.
June 2023	*Invited* Speaker at SISSA-ICTP workshop on "Cosmological Tensions and their Implications for Concordance Cosmology", IFPU, Trieste, Italy.
May 2023	Speaker at "CosmoVerse@Lisbon", Lisbon, Portugal.
May 2023	Speaker at "UK Cosmo at Cambridge", DAMTP, Cambridge, UK.
December 2022	Speaker at "GGI Postdoc Day", Galileo Galilei Institute for Theoretical Physics – [Video]
September 2022	*Invited* Speaker at "Workshop on Tensions in Cosmology", 22nd Hellenic School on Elementary Particle Physics and Gravity, Corfu, Greece.
May 2022	*Invited* Speaker at the University of Florence, Florence, Italy.
September 2021	Speaker at Sapienza's "Astrophysics Workshop", Rome, Italy.
September 2020	*Invited* Speaker at Lorentz Institute for Theoretical Physics, Leiden University (remotely due to COVID-19).
September 2020	Speaker at Sapienza's "Astrophysics Workshop", Rome, Italy.
February 2020	Speaker at the Astrophysics Journal Club, Sapienza University.
September 2019	Speaker at Sapienza's "Astrophysics Workshop".

Publications Overview

Overview: A full list of my publications is available on my INSPIRE, Google Scholar, and personal website profiles (the latter also includes paper-by-paper contribution statements). My published work includes articles in Nature Astronomy (1), Physical Review Letters (2), Astrophysical Journal Letters (1), Physical Review D (20+), JCAP (10+), MNRAS / MNRAS Letters (5+), Physics of the Dark Universe (5+), and Physics Letters B (1).

Bibliometric metrics: 63 works (2 within collaborations, 5 single-author works); h-index = 34 (from INSPIRE).

Research Software and Codes

- `wgcosmo` – A curated collection of numerical tools, code snippets, and methodological resources for cosmological analyses (500+ documents), supporting reproducible research and advanced training in cosmology, statistical methods, and data analysis.
- `PostModes` – An open-source package for geometric comparison of n-dimensional posterior distributions through covariance eigenmodes.
- `Slow-Roll-Inflation` – a symbolic algorithm that, for both canonical single-field inflation and k-inflation, computes Primordial spectra and consistency relations at arbitrary order.
- `class_ddr` – An open-source modified version of the CLASS Boltzmann solver developed to test distance–duality and distance-scaling relations in cosmology.
- `BiblioGrant` – Open-source software that converts BibTeX bibliographies into clean, grant-ready plain-text reference lists. Available both as a Python package and command-line tool.
- Alongside these publicly available codes, I have developed more than ten modified versions of `CLASS` and `CAMB` to implement and test cosmological models used in my published research.

Press Coverage and Media Appearances

A selection of our papers that have garnered media and press coverage, to the best of my knowledge, includes:

- Our work *"**A solution to the S8 tension through neutrino–dark matter interactions**"* **(** **Nature Astronomy (2026)** **)**, covered by:
  - **Physics World**: *Interactions between dark matter and neutrinos could resolve a cosmic discrepancy*
  - **Media INAF**: *Se neutrini e materia oscura si parlano*
  - **ScienceAlert**: *Ghost Particles Interacting With Dark Matter Could Solve a Huge Cosmic Mystery*
  - **Universe Today**: *A New Study Finds a Subtle Dance Between Dark Matter and Neutrinos*
  - **40+ additional international science news outlets, blogs and podcasts**
- Our work *"**Interacting Dark Energy after DESI BAO**"* **(** **Phys. Rev. Lett. 133 (2024) 25, 251003** **)**, covered by:
  - **New Scientist**: *Invisible dark radiation may explain a big problem with dark energy*
  - **Astrobites**: *So, how's it going with the Hubble tension?*
  - University of Sheffield press release: *Dark matter and dark energy: A cosmic handshake?*
  - **Brazilian Physical Society**: *Interação no setor escuro pode resolver enigma na taxa de expansão do universo*
- Our work *"**Neutrino cosmology after DESI: tightest mass upper limits, preference for the normal ordering, and tension with terrestrial observations**"* **(** **JCAP 01 (2025) 153** **)**, covered by:
  - **Scientific American**: *Something Is Wrong with Dark Energy, Physicists Say*
  - **Science News**: *A neutrino mass mismatch could shake cosmology's foundations*
- Our work *"**New insights on νDM interactions**"* **(** **Mon. Not. Roy. Astron. Soc. 527, no.1, L122–L126 (2023)** **)**, covered by:
  - **Astrobites**: *Dark matter and neutrinos walk into a (nano)barn: can we observe ν–DM interactions in the CMB?*

Professional References

◇ **Eleonora Di Valentino** – University of Sheffield

◇ **Sunny Vagnozzi** – University of Trento

◇ **Carsten van de Bruck** – University of Sheffield

◇ **Jeremy Sakstein** – University of Hawai'i at Mānoa