

Joan Alcaide-Núñez

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Languages: English, German, Spanish, Catalan (basic Italian)

Personal Statement

I am Joan Alcaide Núñez (he/him), a Physics BSc student at LMU Munich and a curious, passionate student researcher. My main interests lie in multi-messenger astronomy, that means combining data from telescopes, gravitational wave detectors, and other channels, to deepen our understanding of cosmology, the study of the Universe's origin, evolution, and fate. In particular, I am drawn to questions surrounding dark energy and the ultimate destiny of the cosmos.

Between 2023 and 2025, I pursued a series of summer research projects, beginning with re-computing the Hubble constant using Cepheids and later Type Ia supernovae. More recently, I have explored how together gamma-ray bursts and gravitational waves can help constrain cosmological parameters and models. These projects not only introduced me to cosmology but also strengthened my skills in mathematics, programming, and data analysis.

For me, cosmology is not about immediate application in our daily lives, but about the ultimate pursuit of truth. Who are we? What is our place in the Universe? What is our destiny? Humankind has asked these questions since its beginnings, and I too continue to wonder about them.

Research Experience

GRB cosmography with empirical energy relations

June - July 2025

Osservatorio Astronomico di Brera (OAB-INAF)

5 weeks

Supervisor: Dr. Giancarlo Ghirlanda, Dr. Om Sharan Salafia

- Focus: Multi-Messenger Cosmology: combining Gamma-Ray Burst (GRB) data from $E_{\text{peak}} - E_{\text{iso}}$ relation (Amati relation) and a simulated population of binary neutron star (BNS) mergers detectable by Einstein Telescope
- Research stay at an research institute for 5 weeks during summer 2025.
- Skills: Gamma-Ray Bursts, relativity with photons, and relativistic plasma physics, working in logarithmic scales (leveraged), statistical methods (χ^2 , reduced χ^2 , partial differentiation, and more)
- Other: Engaging in journal clubs, night sky observations at the observatory, discussing research, collaboration with visiting and resident scientists (supervisors & Ricardo Spinelli and Alberto Colombo)
- Supervised by Dr. Giancarlo Ghirlanda and Dr. Om Sharan Salafia ([High-Energy Astrophysics Group](#))
- [Repository](#)

CAPIBARA Collaboration lead

2024-present

CAPIBARA Collaboration

- CAPIBARA is a group of high-school and university students aiming to research the high-energy cosmos. It comprehends two missions (short term pathfinder, long-term transient observatory) focusing on both engineering and scientific research.

- Established strategical partnerships with [PLD Space](#) & [OBA Space](#) among others.
- Leading one of the research initiatives to use Gamma-Ray Burst data from the CAPIGX mission to constrain cosmological parameters and study the Universe at high redshift.
- CAPIGX also should be a useful resource for electromagnetic counterpart follow-ups in the multi-messenger era (2030s)
- Status: [Year 1 Collaboration Status Report](#) on July 2025

Student Internship at German Space Agency

September 2024

Institute for Remote Sensing - German Aerospace Center (IMF-DLR)

2 weeks

- First Week Activities: Worked with the Experimental Methods Department, learned about hyperspectral imaging, conducted outdoor field measurements, and participated in a drone-boat measuring experiments. Visited the [German Space Operation Center](#) (GSOC), where both satellite and human spaceflight are guided; the [Earth Observation Center](#) (EOC).
- Second Week Activities: Worked the Photogrammetry and Image Processing Department, analyzed data using QGIS software and GDAL Python library, and studied temperature variations using Landsat 8 satellite thermal imaging. And visited the [Galileo Competence Center](#) (GK).

Research Stay

June-July 2024

Institute of Space Sciences (ICE-CSIC-IEEC)

2 months

- Focus: Utilizing Type Ia Supernovae in the infrared range as cosmological distance indicators. Analyzed data from ESO observatories (SOFI) and optical data from ATLAS and ZTF surveys to compute supernova distances, and fitted cosmological parameters such as the Hubble constant H_0 and dark energy density parameter Ω_Λ .
- Skills: Supernova Ia, Python, Object-Oriented Programming (OOP), Paper Reading, Networking Aperture photometry, Data Analysis.
- Other: Engaging in journal clubs, seminars of visiting scientists, research discussions, and collaborating with scientists in astrophysics.
- Supervised by Dr. Lluís Galbany, principal researcher of the [Supernova and Stellar Transients Group](#).

Scientific Paper Writing

August - December 2023

Youth and Science Programme

- Writing of a scientific paper: Recomputing the Hubble constant. I became interested in cosmology and Hubble tension, addressing this problem by employed the same methods as 100 years ago with modern data from the NASA-IPAC NED Database and the Konkoly Observatory.
- Supervised by Dr. Ignasi Pérez-Ràfols and Dr. Laia Casamiquela.
- [Repository](#)
- Previously: Research stay in astronomy and astrophysics at MonNatura Pirineus, 10-body student group and 4 researchers; introduction to astronomical observations (16" Schmidt-Cassegrain telescope) and following data collection and analysis, astrophysics from star evolution to gravitational waves; practical demonstrations.

Education

Ludwig-Maximilians-Universität (LMU) Munich

September 2025 – Present

B.Sc. in Physics

German School of Barcelona

September 2017 - May 2025

Dual High School Diploma (Germany + Spain), GPA: 1.0/1.0

Extracurricular Courses

GoPhysics! "Gravity and Black Holes" synchronous course by Perimeter Institute 2025
League of Codes: C++ coding course by Harbour Space 2022/23
ALGOPROG: C++ coding course by Universitat Politècnica de Catalunya (UPC) 2022
Mathematics, Statistics, and Data Science summer course by Universitat Autònoma de Barcelona (UAB) 2022
Adapt: our evolutionary history read in the genome summer course by Universitat Autònoma de Barcelona (UAB) 2022

Work (Projects & Reports)

Gen10: Education tool for genomics [Gen10 website](#) 2023-2025
Package + tutorials for students to tinker with simple commands and apply their genomics knowledge. *Python, Package building, Tests, Python Notebooks*

28M: live local elections statistics [joanalnu/28M](#) April/May 2022
A tool to track and visualise the results of the elections during the night, collaboration with local radio. *Python, HTML, CSS, xlwings, numpy, xlwings*

Awards

- **Silver Honour and National Award Spain International Astronomy & Astrophysics Competition (IAAC) 2025**, presented for the student with most points in the country, reaching the 7% of ~12300 students participating worldwide.
- **Physics Distinction for extraordinary grades by the German Physical Society (DPG)**
- **First Prize and Special Award in Scientific Photography in Jugend Forscht Nordrhein-Westfalen 2025**, forwarding to Final round
- **First Prize in Jugend Forscht Iberia 2025**, project title: "Cosmological distance measurements with Type Ia Supernovae"
- **Silver Honour Final Round of the International Astronomy & Astrophysics Competition (IAAC) 2024**
- **Awarding of internship at German Space Agency (DLR) in Jugend Forscht Nordrhein-Westfalen 2024**
- **First Prize in Jugend Forscht Iberia 2024**, Spain + Portugal level, project title: "Recomputing the Hubble constant"
- **Bronze Honour in Final Round and National Award Spain in the International Astronomy & Astrophysics Competition (IAAC) 2023**, presented for achieving the highest nation-wide score in the final round.

Talks

De l'aula a l'espai: joves, ions i fotons per entendre l'univers d'altres energies (Contributed) March 2025

CosmoXarxa, CosmoCaixa Barcelona's Science Museum

CosmoXarxa is an initiative created by and for Explainers of the science museum (outreach volunteers). I presented the CAPIBARA project, its objectives and status, both technical, scientific and educative, inviting the public to join the efforts. [slides](#)

Introduction to Astrophysics (Invited)

May/June 2024

German School of Barcelona

Double session (3h) about an naive introduction to astronomy and astrophysics for 11th graders, covered some cosmology (Big Bang theory), star evolution, galaxy morphology and massive bodies (neutron stars and black holes as extreme cases of star evolution). [slides](#)

L'Exploració Espacial (Invited)

October 2023

Escola Canigó

Presentation to pre-school students about human space travel and solar system exploration. Focused on hands-on learning with models and didactic, entertaining content. [slides](#)

Summary of Coding & CS Skills

Languages: Python, C++, HTML/CSS/JS suite

Tools/Frameworks: Git, GitHub, L^AT_EX, Markdown

Libraries: matplotlib, numpy, pandas, scipy, astropy

Core Skills: data analysis, parameter estimation and model fitting, bayesian inference, mathematical & cosmological functions

Coming: emcee, gwtc & gwcosmos, pytorch

Volunteering & Socials

Cycling Without Age

2024-2025

Accompanying cycling "walks" around the village and enjoying sharing time with elderly.

Explainers at CosmoCaixa Museum

2022-2023

Volunteered as Explainer at Barcelona's Science Museum explaining demonstrations to visitors on weekends. Participated in events such as Explainers during Winter, Explainers at Barcelona's City Science Fair and CosmoXarxa.

Music Band

2021-2024

Playing piano in different groups, school events, competitions, and solidarily at local children's hospital. Continue playing as hobby.