MATTEO SADUN BORDONI

Doctoral Researcher in Astrophysics

CONTACT

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INFORMATION

- Nationality: italian
- Birth date: 02/03/1998
- Gender: Male

LANGUAGES

- Italian: Mother tongue
- English: Level C1
- German: Level B1
- Spanish: Level A2

PROGRAMMING SKILLS

- **Python for** data analysis and visualization of large datasets
- **C++** & **Fortran** for numerical simulations, including solving differential equations relevant to astrophysical systems
- Experience with sophisticated **N-body codes** such as AR-Chain
- **Bash** scripting for automated data reduction workflows and pipeline handling
- **Wolfram Mathematica for** theoretical modeling, including regression models to fit stellar orbits to data.
- **LaTeX** for scientific writing
- **QFitsView** for handling of FITS files
- Fundamentals of **parallel computing** and **deep learning**

PROFILE

Highly motivated PhD student at the Max Planck Institute for Extraterrestrial Physics (MPE), supervised by Prof. Reinhard Genzel, Prof. Frank Eisenhauer and Dr. Stefan Gillessen. My research sits at the interface between observational and theoretical astrophysics, focusing on the dynamics of the S-star cluster orbiting the supermassive black hole Sagittarius A* at the Galactic Center.

EDUCATION

- **PhD in Astrophysics** [09/2022 – PRESENT]

  Max Planck Institute for Extraterrestrial Physics (MPE), Garching, Germany / Ludwig Maximilian University (LMU), Munich

  Part of the International Max Planck Research School (IMPRS) on Astrophysics

  Extensive hands-on experience from over 40 nights as a visitor at the Paranal Observatory in Chile, observing with the GRAVITY near-infrared interferometer and the ERIS instrument at the Very Large Telescope (VLT). Co-Investigator of the GRAVITY and ERIS GTO Galactic Center programs. Proficient in reducing, analyzing and interpreting both imaging, spectroscopic and interferometric data. My main interest lies in the theoretical interpretation of these observations, comparing results with high-precision numerical simulations. My PhD project focuses on studying relativistic effects induced by the central massive black hole on the orbits of S-stars, as well as the influence of a surrounding unseen mass distribution—including faint stars, stellar remnants, and potentially dark matter. These studies have important implications for future gravitational wave observations with the LISA mission.

- **Master's degree in Astronomy and Astrophysics** [09/2020 – 07/2022]

  "La Sapienza University", Rome, Italy

  Final grade: 110 with honours/110
  Thesis: "On the precession and redshift of S-stars in the Galactic Center".
  Thesis supervisor: Prof. Roberto Capuzzo Dolcetta

  The work of my Master's thesis resulted in a publication in the Monthly Notices of the Royal Astronomical Society (MNRAS) titled "Orbital Precession of Stars in the Galactic Centre".
  On May 16, 2024, I received an award for being among the Excellent Graduates of the University for the academic year 2021/2022.

- **Bachelor degree in Physics** [10/2016 – 01/2020]

  "La Sapienza University", Rome, Italy

  Final grade: 110 with honours/110
  Thesis: "Stellar dynamics around the Galactic Center"
  Thesis supervisor: Prof. Roberto Capuzzo Dolcetta

TEACHING AND TUTORING EXPERIENCE

- Private tutor in physics and mathematics for middle school, high school, and undergraduate students (2017–PRESENT)
- Assistant in examinations of Bachelor and Master level physics courses at LMU and TUM (2023-PRESENT)

OUTREACH

Passionate about science communication.

- Presented the research of the Infrared Group at MPE during the MPE Open Day, interacting with a broad audience ranging from children to adults
- Talks to visiting high school students at MPE on multiple occasions, introducing them to astrophysical research and the work of our group

AWARDS

Excellent Graduate Award, Sapienza University (2021/2022): awarded by Rector Antonella Polimeni in the presence of the President of the Italian Republic, Sergio Mattarella

Merit Scholarships, Sapienza University & Liceo Ennio Quirino Visconti: awarded for graduating with the highest grade from high school

HOBBIES

Piano and singing

Photography

Travelling

Outdoor sports: tennis, horse riding and skiing

PUBLICATIONS

Here is a list of selected publications:

- **Orbital precession of stars in the Galactic Centre, M. Sadun Bordoni & R. Capuzzo Dolcetta, MNRAS, 522(4), 5828–5839 (2023)**

  Theoretical study aimed at determining the precision achievable in measuring the relativistic orbital precession of S-stars when using a post-Newtonian approximation. The study identifies the orbital characteristics of hypothetical S-stars that would enable a reliable measurement of the spin of the central massive black hole.

- **Improving constraints on the extended mass distribution in the Galactic center with stellar orbits, M. Sadun Bordoni & GRAVITY Collaboration, A&A, 692, A242 (2024)**

  Analysis of astrometric and spectroscopic data of S-stars, yielding the most stringent constraints to date on the extended mass distribution surrounding the central massive black hole, Sagittarius A*, within the inner 10 milliparsecs of the Galactic Center.

- **Impact of a granular mass distribution on the orbit of S2 in the Galactic center, M. Sadun Bordoni et al., submitted to A&A**

  Numerical study investigating the impact of scattering by stellar-mass black holes on the orbit of the S2 star. Includes mock data analysis to evaluate the detectability of these perturbations with current and future observations.

Full publication list available on NASA ADS at this link

CONFERENCES AND SEMINARS

10+ presentations across major international conferences and seminars, including an invited talk at NASA/JPL.

Selected presentations at conferences:

- **Invited talk, "10 years to LISA," JPL/NASA, Pasadena** (April 2025).
  Talk title: *"The Galactic center with GRAVITY(+) and the ELT: what can we learn before LISA flies?"*.
- **LISA Astrophysics Working Group Meeting, MPA, Garching** (November 2024).
  Talk title: *"Probing the Mass Distribution in the Galactic Center through GRAVITY Observations"*.
- **MODEST24, Copernicus Center, Warsaw** (August 2024).
  Talk title: *"The Extended Mass Distribution in the Galactic Center"*.
- **XVI Black Holes Workshop, Porto** (December 2023).
  Talk title: *"Probing the Gravitational Potential Around Sagittarius A* with Stellar Orbits"*.
- **Fundamental Physics at the Galactic Centre, Porto** (December 2023).
  Talk title: *"Probing the Gravitational Potential Around Sagittarius A* with Stellar Orbits"*

Invited to give numerous seminars, among which:

- Gran Sasso Science Institute (GSSI), L'Aquila, Italy.
  Talk title: *"Probing the Mass Distribution in the Galactic Center with GRAVITY"*.
- "Black Hole day" at MPE, Garching, Germany.
  Talk title: *"Probing the Mass Distribution in the Galactic Center through GRAVITY Observations"*.
- European Southern Observatory (ESO), Santiago, Chile.
  Talk title: *"Probing the Gravitational Potential Around Sagittarius A* with Stellar Orbits"*.
- Deutsches Elektronen-Synchrotron (DESY), Zeuthen, Germany.
  Talk title: *"In the Quest of Sagittarius A*'s Nature and Its Spin"*