# LUCAS DE SÁ

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## RESEARCH INTERESTS

Physics of compact objects. Massive stellar and binary evolution. Population synthesis. Gravitational waves.

## EDUCATION

**Ph.D. Astronomy** Institute of Astronomy, Geophysics and Atmospheric Sciences — Mar 2021 - Jun 2025 (expected)
University of São Paulo (IAG-USP)
*Advisor:* Prof. Dr. Jorge E. Horvath
*Project title:* Compact object binaries over cosmic time

**B.Sc. Physics** São Carlos Institute of Physics
University of São Paulo (IFSC-USP) — Mar 2017 - Feb 2021
*Advisor*: Dr. Gustavo D. Telles
*Project title*: Machine learning optimization of a magneto-optical trap

## RESEARCH POSITIONS

**Pre-Doctoral Fellow** Center for Computational Astrophysics, Flatiron Institute — Sep 2024 - Jan 2025
*Advisors:* Dr. Lieke van Son & Dr. Matteo Cantiello, CCA/Princeton

## FUNDING

**Jul 2021 - now** **National Council of Scientific and Technological Development (CNPq)**
Ph.D. scholarship,

**Sep 2024 - Jan 2025** **Flatiron Institute Pre-Doctoral Fellowship**
4.5 months fellowship, including paid housing in New York $\sim$ \$9k.
*New York, USA*

**Nov 2023** **São Paulo Research Foundation (FAPESP)/Bavarian Academic Center for Latin America (BAYLAT)**
Visit to the Erlangen Centre for Astroparticle Physics (ECAP) to collaborate with Alison Mitchell and Giovanni Cozzolongo on pulsar wind nebula populations and gamma-ray observations.
*Erlangen, Germany*

## INVITED TALKS

**Jan 2025** **Columbia University**, THEA Seminar, New York, USA

**Jan 2025** **Center for Computational Astrophysics**, Stars & Plasma Meeting, New York, USA

**Nov 2024** **UC San Diego**, STRAND Seminar, San Diego, USA

**Mar 2024** **City University of São Paulo**, NAT Colloquium, São Paulo, Brazil

**Oct 2023** **University of São Paulo**, Midday Astronomy seminar, São Paulo, Brazil

**Jun 2023** **São Paulo State University**, Astrophysics & Cosmology Journal Club, São Paulo, Brazil

## CONFERENCE CONTRIBUTIONS AND PARTICIPATION

**Mar 2025** **Contributed talk**, Stellar black hole formation and detection workshop
*Kyoto, Japan*

**Jun 2024** **Contributed talk**, Physics Of Extreme Massive Stars International Conference
*Rio de Janeiro, Brazil*

**Apr 2024** **Contributed talk**, 2nd FAPESP/BAYLAT Workshop "High-energy astrophysics in the multi-messenger era"
*São Carlos, Brazil*

**Mar 2024** **Participation**, Workshop on stable mass transfer in binaries: from onset to remnants
*New York, USA*

**Nov 2023** **Contributed parallel talk**, XVII Latin American Regional IAU Meeting
*Montevideo, Uruguay*

**Oct 2023** **Contributed plenary talk**, XLVI Annual Brazilian Astronomical Society Meeting
*Rio de Janeiro, Brazil*

**May 2023** **Contributed talk**, 1st FAPESP/BAYLAT Workshop "High-energy astrophysics in the multi-messenger era"
*Erlangen, Germany*

**Sep 2022** **Poster**, 10th International Workshop on Astronomy and Relativistic Astrophysics
*Antigua, Guatemala (virtual)*

**Nov 2020** **Poster**, 10th São Carlos Institute of Physics Integrated Week
*São Carlos, Brazil (virtual).*

## PUBLICATIONS

First authored papers

4. **L. M. de Sá**, L. S. Rocha, A. Bernardo, R. R. A. Bachega, J.E. Horvath. *Compact object populations over cosmic time II. Compact object merger rates and masses over redshift from varying initial conditions* (2024). MNRAS, 535, 2041

3. **L. M. de Sá**, A. Bernardo, L. S. Rocha, R. R. A. Bachega, J. E. Horvath. *Compact object populations over cosmic time I. BOSSA: a Binary Object environment-Sensitive Sampling Algorithm* (2024). MNRAS, 535, 2019

2. **L. M. de Sá**, A. Bernardo, R. R. A. Bachega, L. S. Rocha, P. H. R. S Moraes, J. E. Horvath (2023). *An Overview of Compact Star Populations and Some of Its Open Problems*. Galaxies, 11(1), 19.

1. **L. M. de Sá**, A. Bernardo, R. R. A. Bachega, J. E. Horvath, L. S. Rocha, P. H. R. S Moraes (2022). *Quantifying the Evidence Against a Mass Gap between Black Holes and Neutron Stars*. ApJ, 941, 130.

Second or third authored papers

2. L. S. Rocha, J. E. Horvath, **L. M. de Sá**, G. Y. Chinen, L. G. Barão, M. G. B. de Avellar (2023). *Mass Distribution and Maximum Mass of Neutron Stars: Effects of Orbital Inclination Angle*. Universe, 10(1), 3.

1. J. E. Horvath, L. S. Rocha, **L. M. de Sá**, P. H. R. S. Moraes, L. G. Barão, M. G. B. de Avellar, A. Bernardo, R. R. A. Bachega (2023). *A light strange star in the remnant HESS J1731-347: Minimal consistency checks.* A&A, 672, L11

Book chapters

1. J. E. Horvath, **L. M. de Sá**, L. S. Rocha, G. Y. Chinen, L. G. Barão, M. G. B. de Avellar. *Evolution of long-period compact radio sources driven by winds.* In: Pulsar Astronomy, Unveiling Compact Stars with China's New Facilities. World Scientific, 2025

Conference proceedings

5. **L. M. de Sá**, A. Bernardo, R. R. A. Bachega, L. S. Rocha, J. E. Horvath (2023). *Compact object populations over cosmic time.* Boletim da SAB, 35, 167

4. L. G. Barão, **L. M. de Sá**, A. Bernardo, J. E. Horvath (2023). *Describing the evolution and perturbations to biodiversity using a simple dynamical model.* Astron. Nachr, e20230025

3. **L. M. de Sá**, A. Bernardo, R. R. A. Bachega, L. S. Rocha, J. E. Horvath (2022). *Effects of a non-universal IMF and binary parameter correlations on compact binary mergers.* Astron. Nachr., 344, e20220089

2. A. Bernardo, L. Paulucci, **L. M. de Sá**, J. E. Horvath (2022). *Counting states: a combinatorial analysis of SQM fragmentation.* Astron. Nachr., 344, e220100

1. J. E. Horvath; A. L. C. Bernardo; R. R. A. Bachega; **L. M. de Sá**; L. S. Rocha; P. H. R. S. Moraes (2022). *Quantifying the Evidence Against a Mass Gap between Black Holes and Neutron Stars.* Astron. Nachr., 344, e220106

## BOOKS

2. J. E. Horvath, **L. M. de Sá**, R. R. Fernandes, L. S. Rocha, R. R. A. Bachega, L. G. Barão (2023). *A natureza do mundo físico: do que é feito o Universo? Do Iluminismo à Ciência Contemporânea [The nature of the physical world: what is the Universe made of? From the Enlightenment to Contemporary Science].* Vol. 2 (Livaria da Física, São Paulo).
Second book in a two-volume series on the History of Physics and its Philosophy for a non-academic audience.

1. J. E. Horvath, **L. M. de Sá**, R. R. Fernandes, L. S. Rocha, R. R. A. Bachega, L. G. Barão (2023). *A natureza do mundo físico: do que é feito o Universo? Dos pré-Socráticos à Revolução Científica [The nature of the physical world: what is the Universe made of? From the pre-Socratics to the Scientific Revolution].* Vol. 1 (Livaria da Física, São Paulo).
First book in a two-volume series on the History of Physics and its Philosophy for a non-academic audience.

## SCHOOL PARTICIPATION

**Aug 2024** **Participation**, Cosmological History: from Gravitational Waves to Exoplanets
*São Paulo, Brazil*

**Jun 2023** **Poster**, Thematic School GWsNS-2023: Gravitational Waves from Neutron Stars
*Aussois, France*

**Mar 2023** **Participation**, 4th G2Net Training School
*Thessaloniki, Greece (virtual)*

**Feb 2020** **Participation**, 2020 Summer School of the Institute of Physics of the University of São Paulo
*São Paulo, Brazil*

## SERVICE

**2024** Substitute graduate representative, Congregation
*IAG-USP*

**2023** Titular graduate representative, Graduate Committee of the Astronomy Program
*Department of Astronomy, IAG-USP*
Helped lead graduate student-faculty discussions on new regulations for the possibility of accumulating other paid work with scholarships.

**2023** Substitute graduate representative, Technical-Administrative Council
*IAG-USP*

**2021 - 2022** Member of the "Graduate Student Permanence and Formation Support Program" Work Group
*USP Graduate Student Associations (APGs)*
Participated in research and writing of, and advocacy for, a proposal for extending a pre-existing program of financial aid for socioeconomically vulnerable undergraduate students to graduate students, including organization of an online discussion and writing of an article. Resulted in the extension of the aforementioned program to graduate students starting in 2023 (links in Portuguese).

## DATA & SOFTWARE

3. BOSSA and COMPAS datasets for BBH, BHNS and BNS mergers from "Compact object populations over cosmic time II". On Zenodo.

2. **BOSSA** Initial sampling algorithm for binary population synthesis, self-consistently implementing correlated and environment-dependent initial conditions. **L. M. de Sá, 2024.** Available at `https://github.com/lmdesa/BOSSA`.

1. **L. M. de Sá**, A. Bernardo, R. R. A. Bachega, L. S. Rocha, P. H. R. S Moraes, J. E. Horvath (2023), data from *An Overview of Compact Star Populations and Some of Its Open Problems*, on Zenodo.

## OUTREACH

**Jan 2022 - now** Writing about High-Energy Astrophysics and History & Philosophy of Physics for the Instagram profile of the GARDEL group (in Portuguese).

## OTHER SKILLS

CODING Python (expert): main working language; BOSSA and data analysis. Fotran (basic): Modifying MESA.

LANGUAGES Portuguese (native), English (fluent), French (intermediate), Spanish (intermediate)