

# Mário Raia Neto

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## Education

### Degrees:

#### 2025 - ongoing 📖 Bachelor in Physics

Department of Physics, **Federal University of São Carlos** (UFSCar), São Carlos, São Paulo, Brazil

Advisor: Prof. Raphael Santarelli   

Monography: *Classical and Quantum Aspects of Black Holes*

### Distinguished courses:

These are full-semester subjects beyond the mandatory UFSCar BSc curriculum. In some of them, I was required to produce reports, deliver one-time lectures, or give presentations in order to be graded.

### During BSc time:

#### 2025 🏛 Numerical Simulations of Accretion Discs

Polish Academy of Sciences, Nicolaus Copernicus Astronomical Center, Warszawa, Poland

Professors: Miljenko Čemeljić  and Debora Lančová 

*Report: Different magnetic field topologies in black hole MAD accretion disk simulations*

#### 2024-ongoing 🏛 Introduction to Magnetohydrodynamics

Universidad Nacional de La Plata, Facultad de Ciencias Astronómicas y Geofísicas, Argentina

Professors: Patricia Sallago  and María Fernanda Montero 

*Lecture: Magnetohydrodynamic waves*

#### 2022 🏛 Foundations of General Relativity




Federal University of ABC (UFABC)

Professor: André Landulfo   

- 2022  **Classical Field Theory**  
Federal University of ABC (UFABC)  
Professor: Ricardo Pasko  
- 2021  **Mathematical Methods of Relativity**  
State University of Campinas (UNICAMP)  
Professor: João Paulo Pitelli   
- 2023  **Relativity**  
Federal University of São Carlos (UFSCar)  
Professor: Paulo Daniel Emmel 
- 2023  **Fluid Dynamics**  
Federal University of São Carlos (UFSCar)  
Professor: Vivaldo Leiria    
*Presentation: Black Hole Analogues*
- 2021  **Differential Geometry**  
Federal University of Santa Catarina (UFSC)  
Professor: Marianna Ravara Vago 
- 2023  **Algorithms and Programming**  
Federal University of São Carlos (UFSCar)  
Professor: Fabiano Cutigi Ferrari   
- 2023  **Temporal Series Analysis with R language**  
Federal University of São Carlos (UFSCar)  
Professor: Andreza Palma   

## Advanced courses:






### During BSc time:






- 2022  **Introduction to Group Theory**  
State University of Rio de Janeiro (UERJ)  
4th UERJ Graduate School on Physics
- 2022  **Introduction to Differential Forms**  
University of São Paulo (USP)  
Summer School on Mathematics
- 2022  **Geometry of Information**  
University of São Paulo (USP)  
Summer Program on Mathematics

- 2021  **Introduction to Mathematical Gauge Theory**  
University of São Paulo (USP)  
III Jayme Tiomno School
- 2021  **Algebraic Methods in Theoretical Physics**  
University of São Paulo (USP)  
III Jayme Tiomno School
- 2019  **Operator Algebra**  
University of São Paulo (USP)  
II Jayme Tiomno School
- 2019  **Variational Calculus**  
University of São Paulo (USP)  
II Jayme Tiomno School
- 2019  **Tensor Algebra**  
University of São Paulo (USP)  
II Jayme Tiomno School
- 2019  **Relativistic Quantum Mechanics**  
University of São Paulo (USP)  
II Jayme Tiomno School

## Schools and Internships:






### During BSc time:

- 2024  **5th Summer International School on Gravity, Cosmology and Astrophysics**  
Russian Gravitational Society  
Russia
- 2024  **II School of Cosmology and Gravitation**  
CBPF  
Brazil
- 2022  **IAstro Summer Internships Program**  
Institute of Astrophysics and Space Sciences  
Portugal
- 2022  **4th UERJ Graduate School on Physics**  
State University of Rio de Janeiro (UERJ)  
Brazil
- 2021  **Summer School on High Energy Physics**  
IFT - UNESP - SPRACE  
Brazil

- 2022  **Summer School on Mathematics**  
ICMC - USP  
Brazil
- 2023  **Summer Program on Mathematics**  
ICMC - USP  
Brazil
- 2021  **III Jayme Tiomno School**  
IF - USP  
Brazil
- 2019  **II Jayme Tiomno School**  
IF - USP  
Brazil
- 2013  **5th INPE Advanced Course**  
Instituto Nacional de Pesquisas Espaciais - INPE  
Brazil

## Miscellanea:

### During BSc time:

- 2022  **III UERN Minicourses on Cosmology**  
State University of Rio Grande do Norte  
In this week I did the minicourse "Inflation on the Primordial Universe"
- 2021  **5th Journey of Physics**  
Federal Institute of Ceará (IF-Ceará)  
In this one week journey, I did courses on general relativity, classical field theory and lagrangian and hamiltonian dynamics
- 2020  **How to prepare and publish an scientific research paper**  
Annual Reunion of SBPC  
In this 10 day reunion, I did a mini-course about scientific writting and paper publishing.
- 2016  **Introduction to  $\text{\LaTeX}$**   
Federal University of São Carlos
- 2014  **General Astrophysics**  
National Observatory

# Academic Publications

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## Papers (During BSc time):

### Refereed International:

**1** **M. Raia Neto**, D. Pérez, and J. Pelle. “The Shadow of Charged Traversable Wormholes”. *International Journal of Modern Physics D*, **v.32**, 2250137 (2023). arXiv:2210.14106 [gr-qc].

**2** D. Pérez and **M. Raia Neto**. “A new solution for a generalized cosmological wormhole”. *The European Physics Journal C*, **v.83**, 1127 (2023). arXiv:2312.07736 [gr-qc].

### Refereed National:

**3** **M. Raia Neto** and L. C. L. Botti. “Rotating Spacetimes”. *Boletim da Sociedade Astronômica Brasileira* **v.33** (2022).

# Research Projects

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## During BSc time:

### National advisor:

#### **1** Relativistic Magnetohydrodynamics, Blandford-Znajek Mechanism and an Introduction to Numerical Relativity

The objective of this project is the study the formalism of general relativistic magnetohydrodynamics (GRMHD), the physics of Shakura-Sunayev and Thorne-Novikov accretion disks, the Blandford-Znajek mechanism, Blandford-Payne mechanism and a introduction to numerical relativity with GRMHD torus setup from the iharm3d code.

Advisor: Javier Fernando Caro  

Voluntary research

2024-Ongoing

#### **2** Introduction to Black Hole Physics and to some Exotic Solutions of General Relativity

The objective of this project is threefold: 1. the study of standard black hole solutions from general relativity, the geodesic motion of particles around them and black hole shadows. 2. the study of Morris-thorne wormholes and warpdrive spacetimes and its energy conditions. 3. introductory black hole astrophysics and introductory data analysis of light curves of 3C273, M87\*, OJ287 and SgA\*.

Advisor: Luiz Claudio Lima Botti  

Funded

2019-Ongoing

### 3 Geometry of Black Holes

The objective of this project is the study of the differential geometry, topology and physics of Kerr space-time.

Advisor: José Nazareno   

Voluntary research

2023-2024

### 4 Introduction to Fiber Bundles: Geometry and Physics

A study on the differential geometry of the standard model of particle physics.

Advisor: José Nazareno   

Voluntary research

2022-2023

### 5 Observation and Data Collection of Gravitational Lenses using the Itapetinga Radio Telescope

Study of the phenomenon of gravitational lensing using observational data from the Itapetinga Radio Observatory (Pierre Kauffman Radio Observatory, ROPK) and an analysis of the source PKS-1830.

Advisor: Luiz Claudio Lima Botti  

Funded

2014-2016

#### International advised:

### 5 Cosmological Tests: How to know the evolution of the Universe

A short-term project in the 2022 IAstro Summer Internships Program. The project focused on studying the standard cosmological model (Lambda-CDM), and supernova data fit using the EMCEE package.

Advisor: António C. da Silva 

2022-2022

## Funding

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#### During BSc period:

2019 - Ongoing



**Scientific Initiation Grant**

**National Council for Scientific and Technological Development (CNPq)**

*Project: Introduction to Black Hole Physics and to some Exotic Solutions of General Relativity*

2014 - 2016



**Scientific Initiation Grant**

**National Council for Scientific and Technological Development (CNPq)**

*Project: Observation and Data Collection of Gravitational Lenses using the Itapetinga Radio Telescope*

## Teaching Experience

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### During BSc time:

#### Teaching Assistant:

2022



**Relativity**

**Federal University of São Carlos (UFSCar)**, São Paulo, São Carlos, Brazil

Professor: Paulo Daniel Emmel 🧠

#### Workshops:

2022



**Theoretical Aspects of Kerr Black Holes**

At VII UNIFESP Workshop of Cosmology and Astrophysics

2022



**Black Hole Shadows**

I Workshop of Astronomy and Astrophysics of Paraná

#### Other:

2025



**Facultad de Ciencias Astronómicas y Geofísicas, La Plata, Argentina**

I did a full lecture on Magnetohydrodynamic Waves.

2020-ongoing



**UFSCar Journal Club on Physics**

**Federal University of São Carlos (UFSCar)**, São Paulo, São Carlos, Brazil

In this journal club, I ministered the following lectures: 1.The geometry of rotating black holes I, 2.The geometry of rotating black holes II, 3.The first and the second law of black hole thermodynamics, 4. Black hole mechanics and Komar integrals, 5.Schwarzschild Interior Solution, TOV Equation, and Buchdahl's Theorem, 6.Causal Structure of Spacetime and Penrose Diagrams, 7.Basic GRMHD Equations and Accretion Disks, 8.Blandford-Znajek Process.

# Research Presentations and Participation on scientific events

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## During BSc time:

For every scientific event, except for the part "other", I both presented some work and participated.

## Poster presentations:


- 2025  **Black Hole Magnetospheres and Blandford-Znajek Mechanism**
  - 3rd Brazilian Meeting of Girls and Women in Astrophysics, Cosmology, and Gravitation
  
- 2024  **A new solution for a generalized cosmological wormhole**
  - 2nd School of Cosmology and Gravitation of CBPF
  
- 2024  **Introduction to Fiber Bundles: Physics and Geometry**
  - 30th Scientific Initiation Congress - UFSCar
  
- 2023  **Stability of the Photon Ring of a Charged Traversable Wormhole**
  - 1st Astrophysics in the New Era of MM Astronomy International Conference
  
- 2022  **Shadow of a Charged Wormhole**
  - XXVIII Scientific Initiation Congress - UFSCar
  
- 2021  **A study on the physics of some solutions of Einstein field equation: black holes, wormholes and warp drives**
  - 2021 - VIII Brazilian Symposium on Physics and Astronomy
  
- 2019-ongoing  **Introduction to Black Hole Physics and to Some Exotic Solutions of General Relativity**
  - 2019,2020,2021,2022,2023,2024 - ongoing SICINPE
  - 2020 - Tenth Integrated Week of Undergraduate and Graduate Studies of the São Carlos Institute of Physics
  - 2019 - 27<sup>o</sup> International Symposium on Scientific and Technological Initiation of USP



- 2014-2016  **Observation and Data Collection of Gravitational Lenses using the Itapetinga Radio Telescope**
- 2014,2015 and 2016 SICINPE

- 2024  **The Development of Manufacturing Processes and Testing of Metallic Membranes in Hypersonic Launches**
- National Congress of Mechanical Engineering




#### Contributed Talks:

- 2020  **Introduction to Black Hole Physics**
- XVI Physics Week of UFSCar

#### Flash Talks:

- 2024  **An Introduction to Kerr Black Holes and to Blandford-Znajek Mechanism**
- PLUTO Symposium 2024 - University of Torino

#### Other:

- 2019  **One-day Relativity Workshop**
- IFT-UNESP
- 2015  **XXXVIII Paulo Leal Ferreira Congress of Physics**
- IFT-UNESP
- 2022  **Python for Finances**
- "Pequi Mecânico" Robotic Nucleus

## Scientific Societies

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 **Brazilian Astronomical Society**