

# NÍCKOLAS DE AGUIAR ALVES

## Theoretical Physicist

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## EDUCATION

### Doctor in Physics

#### Federal University of ABC (UFABC)

📅 September 2023 – Ongoing    📍 Santo André, SP, Brazil

Advisor: Prof. André Gustavo Scagliusi Landulfo

### Master in Physics

#### Federal University of ABC (UFABC)

📅 February 2021 – April 2023    📍 Santo André, SP, Brazil

MPhys Thesis: Nonperturbative Aspects of Quantum Field Theory in Curved Spacetime

Advisor: Prof. André Gustavo Scagliusi Landulfo

### Bachelor in Physics

#### Institute of Physics, University of São Paulo (IFUSP)

📅 February 2017 – January 2021    📍 São Paulo, SP, Brazil

## STUDENTSHIPS

### CAPES Social-Demand Program

#### Coordenação de Aperfeiçoamento do Pessoal de Ensino Superior (CAPES)

📅 September 2023 – Ongoing

Granted to pursue my PhD degree after placing first in UFABC's admission ranking.

### The Functional Renormalization Group in Quantum Field Theory in Curved Spacetimes

#### São Paulo Research Foundation (FAPESP)

📅 December 2021 – February 2023

🔗 Grant No. 2021/07372-7

Granted to pursue my MSc degree. This is the most prestigious studentship in Brazil at this educational level.

Advisor: Prof. André Gustavo Scagliusi Landulfo (UFABC)

### CAPES Social-Demand Program

#### Coordenação de Aperfeiçoamento do Pessoal de Ensino Superior (CAPES)

📅 March 2021 – November 2021

Granted to pursue my MSc degree after placing first in UFABC's admission ranking. Interrupted due to the start of my FAPESP studentship.

## RESEARCH INTERESTS

### Broadly

- Why do things fall?
- What are things made of?
- What is time?

### More specifically

- Quantum Fields in Curved Spacetime
- General Relativity and Gravitation
- General Theory of Particles and Fields
- Algebraic Quantum Field Theory
- Nonperturbative Physics
- Semiclassical Gravity
- Quantum Gravity

## DIGITAL SKILLS

C   HTML    $\LaTeX$    Lua  
Mathematica   Python

## LANGUAGES

Portuguese    native  
English    fluent

## Hyperbolic Equations

**São Paulo Research Foundation (FAPESP)**

📅 August 2019 – December 2020

🔗 Grant No. 2019/12158-4

Granted to pursue my undergraduate research project. This is the most prestigious studentship in Brazil at this educational level.

**Advisor:** Prof. João Carlos Alves Barata (IFUSP)

## ATTENDED EVENTS

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### Golden Wedding of Black Holes and Thermodynamics

**Independently Organized**

📅 04–08 December 2023

📍 Online

Main organizer, taught a minicourse in quantum field theory in curved spacetimes, and presented the contributed talk “Nonperturbative Renormalization Group Flow for a Particle Detector”.

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### XLVI Paulo Leal Ferreira Congress

**Institute of Theoretical Physics, São Paulo State University (IFT-UNESP)**

📅 October 2023

📍 IFT-UNESP, São Paulo

Presented the poster “Nonperturbative Aspects of Quantum Field Theory in Curved Spacetime”.

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### V Jayme Tiomno Physics School

**Dead Physicists Society**

📅 September 2023

📍 IFUSP, São Paulo

Presented the poster “Nonperturbative Aspects of Quantum Field Theory in Curved Spacetime”.

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### Interfaces Between Quantum and Classical Statistical Mechanics

**Institute of Mathematics and Statistics, University of São Paulo**

📅 July 2023

📍 IME-USP, São Paulo

Presented the poster “Nonperturbative Aspects of Quantum Field Theory in Curved Spacetime”.

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### XLIV Paulo Leal Ferreira Congress

**Institute of Theoretical Physics, São Paulo State University (IFT-UNESP)**

📅 October 2021

📍 IFT-UNESP, São Paulo — Online

### One-Day Relativity Workshop

**ICTP South American Institute for Fundamental Research (ICTP-SAIFR)**

📅 November 2019

📍 IFT-UNESP, São Paulo, Brazil

## EXTRACURRICULAR COURSES

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### IV Jayme Tiomno Physics School

**Dead Physicists Society**

📅 August 2022

📍 IFUSP, São Paulo — Online

Attended the minicourses “Quantum Gravity and Asymptotic Safety: An Introduction” and “Applications of Topos Theory to the Mathematical Foundations of Quantum Theory”.

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### Third Patricio Lettelier School on Mathematical Physics

**Instituto de Ciências Matemáticas e de Computação, University of São Paulo (ICMC-USP)**

📅 December 2021

📍 ICMC-USP, São Carlos — Online

## I Meeting of Women Mathematicians at UFABC

**Federal University of ABC (UFABC)**

📅 September 2021

📍 UFABC, Santo André — Online

Attended the minicourse “Introduction to Algebraic Topology”.

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## XIII CBPF School

**Brazilian Center for Physical Research (CBPF)**

📅 August 2021

📍 CBPF, Rio de Janeiro — Online

Attended the courses “Topics in Open Quantum Systems” and “Magnetic Monopoles 5.0”.

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## III Jayme Tiomno School in Theoretical Physics

**Dead Physicists Society**

📅 August 2021

📍 IFUSP, São Paulo — Online

Taught the minicourse “Algebraic Methods of Theoretical Physics” and attended the course “Introduction to Superstring Theory”.

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## XXI Jorge André Swieca Summer School in Particles and Fields

**Brazilian Physical Society (SBF)**

📅 February 2021

📍 Online

## IV Journeys Into Theoretical Physics

**IFT-Perimeter-SAIFR**

📅 July 2019

📍 IFT-UNESP, São Paulo, Brazil

## II Jayme Tiomno School in Theoretical Physics

**Dead Physicists Society**

📅 July 2019

📍 IFUSP, São Paulo, Brazil

Co-organized the school and attended the courses “Magnetohydrodynamics” and “Relativistic Quantum Mechanics”.

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## IME-USP’s Summer Program

**Institute of Mathematics and Statistics, University of São Paulo (IME-USP)**

📅 January 2018 – February 2018

📍 IME-USP, São Paulo, Brazil

Attended the course “Linear Algebra”.

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# ORGANIZATION OF EVENTS

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## Golden Wedding of Black Holes and Thermodynamics

**Alves, N. A.; Arderucio Costa, B.; Correa da Silva, R. et al.**

📅 October–December 2023

📍 Online

🔗 [bht50.github.io/](https://bht50.github.io/)

A fully online international event celebrating fifty years of the seminal paper “The Four Laws of Black Hole Mechanics” by Bardeen, Carter, and Hawking.

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## Dead Physicists Society’s Mini Winter School in Theoretical Physics

**Alves, N. A.; Almeida, F. B. S.**

📅 2020

📍 Online

An online winter school organized by students at IFUSP covering topics in Theoretical Physics and Computer Science aimed mainly at undergraduate students.

## Tensorial Reception

**Maruyama, W.; Alves, N. A.; Correa da Silva, R.**

📅 2018 – 2019

📍 IFUSP, São Paulo, Brazil

This event consisted of a series of 20-minute long presentations by (mostly) graduate students about their research projects as a motivation for the Institute's freshmen. I helped organize it in 2018 and 2019, but it was created by other IFUSP students roughly ten years before and other younger students have recently organized the 2022 edition.

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## Giants of Physics

**Correa da Silva, R.; Alves, N. A.; Zukanovich Funchal, R. et al.**

📅 April 2018 – May 2019

📍 IFUSP, São Paulo, Brazil

A series of events in honor of great physicists. Each event consisted of three presentations related, but not restrained, to the scientist's work given by graduate students, which were followed by a round table formed by experienced researchers and, finally, a miscellaneous event related to the scientist (a lecture about his life, a movie exhibition, etc).

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## Jayme Tiomno School in Theoretical Physics

**Alves, N. A.; Tredezini, P. H. T. L.; Maruyama, W.**

📅 2018 – 2019

📍 IFUSP, São Paulo, Brazil

🔗 [lambdadps.github.io/jayme/](https://lambdadps.github.io/jayme/)

A winter school organized by students at IFUSP covering topics in Theoretical Physics, Computer Science, and Mathematics aimed at undergraduate students. While I only organized the first two editions of the school, it still exists and is currently heading to its fifth edition.

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## Dead Physicists Society

**Alves, N. A. et al.**

📅 October 2018 – 2021

📍 IFUSP, São Paulo, Brazil

🔗 [lambdadps.github.io](https://lambdadps.github.io)

A student-driven organization at IFUSP. Some of the events that were sponsored and/or organized by the DPS were weekly undergraduate seminars, winter schools aimed at IFUSP students, and a number of welcoming academic events aimed at freshmen. I created the organization on October 2018 and was one of its directors and main contributors until 2021. Nevertheless, it is still active nowadays.

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# TEACHING EXPERIENCE

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## Quantum Field Theory in Curved Spacetime

**Golden Wedding of Black Holes and Thermodynamics**

📅 October 2023

📍 Online

🔗 [bht50.github.io/minicourses/QFTCS/](https://bht50.github.io/minicourses/QFTCS/)

Minicourse taught as part of the Golden Wedding of Black Holes and Thermodynamics, celebrating fifty years of the seminal paper “The Four Laws of Black Hole Mechanics” by Bardeen, Carter, and Hawking. The minicourse comprised a short introduction to the main results and methods of QFTCS.

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## Journal Club

**Self organized**

📅 July 2021 – November 2022

📍 Online

Since July 2021 I have been organizing an online undergraduate seminar group focused mainly on General Relativity. The students (and sometimes I) present seminars for each of the topics we previously accorded and we discuss the material together. The people participating in the group have changed with time, but it is usually comprised of about seven undergraduates. Most of them are carrying out their undergraduate research projects with my MSc advisor, Prof. Landulfo.

## TA: Classical Mechanics II

### Federal University of ABC (UFABC)

📅 September 2021 – December 2021

📍 Santo André, Brazil

I was a teaching assistant in the Classical Mechanics II course taught by Prof. André G. S. Landulfo at UFABC.

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## Algebraic Methods of Theoretical Physics

### III Jayme Tiomno School in Theoretical Physics

📅 August 2021

📍 IFUSP, São Paulo — Online

🔗 [alves-nickolas.github.io/teaching/algebricos/](https://alves-nickolas.github.io/teaching/algebricos/)

Minicourse taught at the III Jayme Tiomno School in Theoretical Physics, in which I taught freshmen students the fundamentals of group and representation theory, and illustrated how they find applications in Particle Physics, General Relativity, and Quantum Field Theory in Curved Spacetimes. The link leads to the course webpage (in Portuguese).

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## An Introduction to $\text{\LaTeX}$

### XV Oceanography Thematic Week

📅 November 2020

📍 IOUSP, São Paulo — Online

🔗 [alves-nickolas.github.io/pdf/LaTeX\\_XV\\_STO.pdf](https://alves-nickolas.github.io/pdf/LaTeX_XV_STO.pdf)

Workshop presented at the XV Oceanography Thematic Week, in which I taught students the fundamentals of  $\text{\LaTeX}$ . The link leads to the course's lecture notes (in Portuguese).

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## Classical Mechanics

### Dead Physicists Society's Mini-Winter School in Theoretical Physics

📅 August 2020

📍 Online

🔗 [alves-nickolas.github.io/teaching/mecanica/](https://alves-nickolas.github.io/teaching/mecanica/)

Workshop presented at the Dead Physicists Society's Mini-Winter School in Theoretical Physics, in which I taught students the basics of Lagrangian and Hamiltonian Mechanics. The link leads to the course webpage (in Portuguese).

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## An Introduction to $\text{\LaTeX}$

### I Jayme Tiomno School in Theoretical Physics

📅 July 2019

📍 IFUSP, São Paulo, Brazil

Workshop presented at the I Jayme Tiomno School in Theoretical Physics, in which I taught students the fundamentals of  $\text{\LaTeX}$ .

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## TA: Mathematical Physics I

### University of São Paulo (USP)

📅 February 2019 – July 2019

📍 IFUSP, São Paulo, Brazil

I was a teaching assistant in the Mathematical Physics I course taught by Prof. Domingos H. U. Marchetti at IFUSP.

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# MISCELLANEOUS

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## gravitonick (YouTube Channel)

📅 June 2023 – Ongoing

📍 Online

🔗 [www.youtube.com/@gravitonick](https://www.youtube.com/@gravitonick)

I own an YouTube channel in which I discuss advanced physics themes—usually related to gravitational and quantum physics—at a level suitable for undergraduate students and physicists acting in other areas.

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## Unified Examination of Graduate Courses in Physics

📅 2020 and 2022

📍 Brazil

🔗 [www1.fisica.org.br/euf/](https://www1.fisica.org.br/euf/)

The Unified Examination of Graduate Courses in Physics (Exame Unificado das Pós-Graduações em Física, EUF, in Portuguese) is a national exam covering all topics from the undergraduate Physics curriculum. Namely, Classical Mechanics,

Statistical Mechanics, Quantum Mechanics, Electrodynamics, Thermodynamics, and Modern Physics. It is often required in applications for Physics graduate school in Brazil. I was ranked in the top 3% of candidates in the 2020-1 edition, and in the top 0.5% in the 2022-2 edition. The link leads to the EUF webpage—while my scores are not publicly available, I hope the website might provide more information on the exam.

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## Journal Club Organization

📅 July 2021 – Ongoing

📍 Online

Since July 2021 I have been organizing our group's Journal Club alongside Prof. Landulfo. The Journal Club includes not only the students working with Prof. Landulfo, but also Profs. George E. A. Matsas (IFT-UNESP), Daniel A. T. Vanzella (IFCS-USP), and their students.

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## Physics Stack Exchange

📅 2018 – Ongoing

📍 Online

🔗 [physics.stackexchange.com/users/168783/](https://physics.stackexchange.com/users/168783/)

I have been an active contributor to the Physics Stack Exchange community for a while now. In particular, I am (December 5, 2023) the most prolific contributor to the `qft-in-curved-spacetime` tag.

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## Online Notes and Notebooks

📅 Circa 2018 – Ongoing

📍 Online

🔗 [alves-nickolas.github.io](https://alves-nickolas.github.io)

Since around 2018 I have been making many of my lecture notes and study notes publicly available on my website hoping they can be useful to other students. While my notebooks from my undergraduate research project and master's project are not currently available, I often share them upon reasonable request.

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# ACADEMIC PRODUCTION

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## 📄 Papers

- **N. de Aguiar Alves**, “Measurements are Never Relative,” 2023, in preparation.
- **N. de Aguiar Alves**, A. G. S. Landulfo, and A. D. Pereira, “Nonperturbative Renormalization Group Flow for a Particle Detector,” 2023, in preparation.

## 🎓 Thesis

- **N. de Aguiar Alves**, “Nonperturbative Aspects of Quantum Field Theory in Curved Spacetime,” MSc thesis, Federal University of ABC, Santo André, Brazil, 2023, xxiv, 152 pp. arXiv: 2305.17453 [gr-qc].

## 👤 Poster Presentations

- **N. de Aguiar Alves**, “Nonperturbative aspects of quantum field theory in curved spacetime,” presented at the Interfaces Between Quantum and Classical Statistical Mechanics (University of São Paulo's Institute of Mathematics and Statistics, Jul. 24–28, 2023), poster presentation, 2023.
- **N. de Aguiar Alves**, “Nonperturbative aspects of quantum field theory in curved spacetime,” presented at the V Jayme Tiomno Physics School (University of São Paulo's Institute of Physics, Sep. 4–8, 2023), poster presentation, 2023.
- **N. de Aguiar Alves**, “Nonperturbative aspects of quantum field theory in curved spacetime,” presented at the XLVI Paulo Leal Ferreira Congress (São Paulo State University's Institute of Theoretical Physics, Oct. 24–27, 2023), poster presentation, 2023.
- **N. de Aguiar Alves**, “Nonperturbative renormalization group flow for a particle detector,” presented at the Quantum Spacetime and the Renormalization Group 2023 (Sant'Elmo Beach Hotel, Oct. 2–6, 2023), online flash talk, 2023.

## 👤 Contributed Talks

- **N. de Aguiar Alves**, “Nonperturbative renormalization group flow for a particle detector,” presented at the Golden Wedding of Black Holes and Thermodynamics (Dec. 4, 2023), online contributed talk, 2023.
- **N. de Aguiar Alves**, “Why do things fall? an introduction to quantum field theory in curved spacetime,” presented at the Theory Lectures by Young Researchers (Galileo Galilei Institute, Sep. 22, 2023), online contributed talk, 2023.

## Courses Taught

- **N. de Aguiar Alves**, “Quantum field theory in curved spacetime,” short course, Golden Wedding of Black Holes and Thermodynamics: An Online Celebration, 2023.
- **N. de Aguiar Alves**, “Métodos algébricos da física teórica,” short course taught in Portuguese, III Jayme Tiomno School of Theoretical Physics, 2021. [Online]. Available: [alves-nickolas.github.io/teaching/algebricos/](https://alves-nickolas.github.io/teaching/algebricos/).
- **N. de Aguiar Alves**, “Introdução ao  $\text{\LaTeX}$ ,” short course taught in Portuguese, XV Oceanography Thematic Week, 2020.
- **N. de Aguiar Alves**, “Mecânica clássica,” short course taught in Portuguese, DPS's Mini-Winter School, 2020. [Online]. Available: [alves-nickolas.github.io/teaching/mecanica/](https://alves-nickolas.github.io/teaching/mecanica/).
- **N. de Aguiar Alves**, “Introdução ao  $\text{\LaTeX}$ ,” short course taught in Portuguese, I Jayme Tiomno School of Theoretical Physics, 2018.