Etevaldo dos Santos Costa Filho

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I graduated in Physics at the Federal University of Espírito Santo with the work of undergraduate research and final project being on the Heisenberg anisotropic spin model and on the Aharonov-Bohm effect, respectively. Soon after graduation, I entered the master's degree at the University of São Paulo with the problem of construction of n-solitonic space-times with aid of the Sibgatullin integral method. My current research is primarily focused on investigating non-topological and topological solitons from a mathematical and physical perspective, with a particular emphasis on their application in gravitating systems. To effectively analyze these complex phenomena, I utilize the CADSOL/FIDISOL PDE solver, which was developed in Fortran.

Languages

Portuguese ●●●●●
English ●●●●○

Skills

- Creative thinking
- Dedicated
- Open minded

Education

2021-Present	Ph.D. student at Aveiro University, Portugal, within the MAP-Fis Ph.D. programme.
2018-2020	Master in Science Physics, University of São Paulo (Master's degree funded by CAPES, 01/2018-12/2018)
2014-2018	Bachaleor in Science Physics, Federal University of Espírito Santo

Grants

05/2022-Present	4 year BD grant under the research project PRT/BD/153349/2021, Aveiro University, Portugal.
10/2021-04/2022	1 year BI grant under the research project PTDC/FIS-AST/3041/2020, Aveiro University, Portugal.
01/2018-12/2018	Master's degree granted by CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior).

Professional experience

Present – January 2019 | **Petrobras | Geophysicist Junior, Rio de Janeiro, Brazil**
- Inverse scattering methods and signal analysis.
- Implementation of multiphysics methods on the whole oil exploration.
- Technological solutions.

Python · Matlab · Julia · Fortran

December 2017 – March 2017 | **Federal University of Espírito Santo | Tutoring, Espírito Santo, Brazil**
- Teaching assistant in mechanics course.

Communication

Projects

PhD Project : Searching for new particles with astrophysical compact objects — 2022-Present

University of Aveiro

Supervisors : Carlos Herdeiro, Eugen Radu

Dark matter remains a central mystery of modern-day science. The elusiveness of dark matter candidates in colliders suggests we further search for its true nature where it was first unveiled - in astrophysics via its gravitational effects. In particular, the new golden age in strong gravity - with the gravitational wave era and remarkable new electromagnetic observations of compact objects - is providing intriguing hints on fuzzy dark matter. Such phenomenological studies start from constructing appropriate compact objects where such fuzzy dark matter plays a key role, both new types of black holes and horizonless compact objects. This thesis aims to go beyond the simplest fuzzy dark matter models based on Abelian fields. A dark sector, like the visible one, may contain non-Abelian fields. The central goal of this thesis is the impact of such fields on the phenomenology of compact objects, connecting them to gravitational wave and electromagnetic observations.

Research Project : Testing the Kerr hypothesis with gravitational waves and lensing

2021-2022

University of Aveiro

Supervisors : Carlos Herdeiro, Eugen Radu

This project is divided into five interconnected parts, studying : 1) the theory of deviations from the Kerr paradigm, and, in particular, the construction of alternative models, both in modified gravity and in General Relativity in the presence of dark matter candidates, as ultralight bosons. 2) effects of light bending by BNs and their shadow, in these alternative models, making contact with the Event Horizon Telescope (EHT) observations. 3) gravitational waves emitted in different dynamic scenarios involving these alternative models, making contact with data from the LIGO-Virgo Scientific Collaboration. 4) other astrophysical phenomenological aspects of alternative models, namely orbits of stars. 5) on the theoretical front, concrete scenarios beyond the standard model of particle physics, where ultra-light dark matter models have theoretical support, considering the constraints of particle accelerators, namely the Large Hadron Collider (LHC).

Employment Position : Geophysicist of Exploration

2019-Present

Petrobras

In my position at Petrobras, Brazil's premier oil company, I engaged in several projects focused on advancing subsurface data recovery and analysis and what is known as geophysics of explorations. My responsibilities encompassed applying signal analysis and inverse scattering methods rooted in geophysics to accurately extract subsurface data. Besides the roles of processing and interpreting the data, I played a role in integrating artificial intelligence algorithms to enhance data analysis and improve operational efficiency. My work involved handling Controlled Source Electromagnetic (CSEM) and magnetotelluric data, necessitating precision and a deep understanding of geophysical data interpretation. Collaborating with a team of experts, I contributed to a knowledge-sharing environment, fostering innovation and continuous learning. This experience not only refined my technical skills in subsurface data analysis but also highlighted the value of interdisciplinary collaboration and applying theoretical knowledge to solve complex geophysical challenges.

Master's Thesis : Construction of new solutions of the electro-vacuum Einstein equation

2018-2020

University of São Paulo

Advisor : Betti Hartmann

The construction of exact axisymmetric solutions of the Einstein-Maxwell equations possessing the prescribed physical properties means the obtaining of solutions in which different parameters would correspond to different relativistic multipole moments determining the structure of space-time. Associated with this, there are various solution-generating techniques based on integrable models that can be employed to obtain particular families of solutions from any suitable "seed" solution, one of them, known as Sbigatullin's method, is applied. Sibgatullin's method is fully revised and its parameters in the N-soliton solution are conected with Einstein-Maxwell multipoles moments.

Volunteer Project : COVID-19 BRASIL

2020-2020

University of São Paulo

Supervisor : Domingos Alves

We are a team of independent scientists from several Brazilian research institutions, highly motivated to contribute to the control of the coronavirus outbreak that took place in Brazil, based on the real-time monitoring of data provided by official sources on the spread of the virus in the country. Besides, we will use scientifically based analysis tools to help managers, authorities, and the population in general, to face this actual war against COVID-19. On the portal https://ciis.fmrp.usp.br/covid19/ , I am responsible for monitoring Brazil, updating the monitoring of daily cases and daily deaths with moving average, data projection for the next ten days based on exponential modeling of all capitals and states (and Brazil). I also wrote some opinion articles based on scientific evidence.

Undergraduate Final Project : The Aharanov-Bohm Effect

2017-2018

Federal University of Espírito Santo

Advisor : Gabriel Luchini

The Aharanov-Bohm effect is discussed in detail : from the introduction of fundamental concepts about electromagnetism as a gauge theory, the repercussions of this symmetry in quantum mechanics and its construction based on the Stokes theorem for

the introduction of the geometric phase. In addition to the usual, more conceptual discussions about the effect, the problem of quantum electron scattering in a region with a confined magnetic field is made.

Undergraduate Research : Spin dynamics in the anisotropic Heisenberg model 2016-2018

Federal University of Espírito Santo

Advisor : Gabriel Luchini

The so-called Heisenberg model describes magnetic systems very well in different situations of interest. In the continuous limit, with the imposition of a bond on the norm of this field, the dynamics of the spin field of the Heisenberg continuous model is equivalent to the static solutions of the two-dimensional non-linear sigma model. A study was carried out on the existence, stability and behaviour of solitons in different geometries, that is, in spaces with cylindrical symmetry, so that there is the "coupling" of the spin with the geometry making the anisotropic model in a certain sense. By rewriting the equations of motion as Bogomol'nyi equations and including an axial symmetry ansatz for the spin field, it was possible to understand how to simplify the equations of motion and obtain analytical solutions for surfaces with axial symmetry.

Publications

Papers in Scientific Journals

Universal relations for rotating scalar and vector boson stars
Physical Review D 110 (2024) 8, 084017 | *Published : Oct 4, 2024* | *DOI : 10.1103/PhysRevD.110.084017*
C. Adam, J. Castelo Mourelle, E. dos Santos Costa Filho, C.A.R. Herdeiro, A. Wereszczynski

Spinning Proca-Higgs balls, stars and hairy black holes
Journal of Cosmology and Astroparticle Physics 07 (2024) 081 | *Published : Jul 30, 2024* | *DOI : 10.1088/1475-7516/2024/07/081*
C. Herdeiro, E. Radu, E. dos Santos Costa Filho

Self-interactions can (also) destabilize bosonic stars
Classical and Quantum Gravity 41 (2024) 19, 195005 | *Published : Aug 30, 2024* | *DOI : 10.1088/1361-6382/ad7188*
M. Brito, C. Herdeiro, N. Sanchis-Gual, E. dos Santos Costa Filho, M. Zilhão

The non-spherical ground state of Proca stars
Physics Letters B | *2024* | *DOI : 10.1016/j.physletb.2024.138595*
C.A.R. Herdeiro, E. Radu, N. Sanchis-Gual, N.M. Santos, E. dos Santos Costa Filho

Proca-Higgs balls and stars in a UV completion for Proca self-interactions
Journal of Cosmology and Astroparticle Physics | *2023* | *DOI : 10.1088/1475-7516/2023/05/022*
C. Herdeiro, E. Radu, E. dos Santos Costa Filho

Collective coordinates for the hybrid model
International Journal of Modern Physics A | *2023* | *DOI : 10.1142/S0217751X23500069*
C.F.S. Pereira, E. dos Santos Costa Filho, T. Tassis

The relations between the multipole moments in axistationary electrovacuum spacetimes and the N-soliton solution
General Relativity and Gravitation | *2022* | *DOI : 10.1007/s10714-022-02903-w*
E. dos Santos Costa Filho, A. Guimarães, I. Cabrera-Munguia

Calculation of multipole moments of axistationary electrovacuum spacetimes
Physical Review D | *2021* | *DOI : 10.1103/PhysRevD.104.064012*
G. Fodor, E. dos Santos Costa Filho, B. Hartmann

Corotating binary systems of identical Kerr-Newman black holes
Physics Letters B | *2020* | *DOI : 10.1016/j.physletb.2020.135917*
I. Cabrera-Munguia, E. dos Santos Costa Filho, H.H. Hernández, D. Vázquez-Valdez

Brazil : the emerging epicenter of COVID-19 pandemic
Journal of the Brazilian Society of Tropical Medicine | *2020* | *DOI : 10.1590/0037-8682-0550-2020*
M.B. Neiva, I. Carvalho, E. dos Santos Costa Filho, *et al.*

Contributed Speaker in Conferences

Proca-Higgs model in a UV completion for Proca self-interactions
New horizons for (no-)horizon physics : from gauge to gravity and back II | *2023* | *GGI*

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Proca-Higgs balls and stars in a UV completion for Proca self-interactions
XV Black Holes Workshop | 2022 | *XVBHW*
Etevaldo dos Santos Costa Filho

Calculation of multipole moments of axistationary electrovacuum spacetimes
Spanish-Portuguese Relativity Meeting | 2021 | *EREP2021*
Etevaldo dos Santos Costa Filho

Summary Published in Proceedings of Conferences

Construction of Binary black hole and soliton space-times
XLI Paulo Leal Ferreira Congress of Physics | 2018
Etevaldo dos Santos Costa Filho, Betti Hartmann

Spin dynamics in the anisotropic Heisenberg model
II Patrício Letelier School of Mathematical Physics | 2018 | *ISSN : 2594-9268*
Etevaldo dos Santos Costa Filho, Gabriel Luchini

Events Organization

European Einstein Toolkit Meeting 2023 in Aveiro
University of Aveiro, Portugal | 19–23 June 2023 | *euet2023*
Local Organizing Committee

State of the art techniques in Strong gravity
São Pedro do Sul, Portugal | 26–28 April 2023 | *GR@V*
Organization