

LEONARDO (LEO) ROSA WERNECK

Postdoctoral researcher

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BIOGRAPHICAL DATA

Birth date September 24, 1991
Birth place São Paulo, Brazil
Citizenship Brazil
Languages English (fluent), Portuguese (native), Spanish (basic)

WORK EXPERIENCE

Postdoctoral researcher, University of Idaho, USA 2021 – Present

Postdoctoral researcher, West Virginia University, USA 2020 – 2021

EDUCATION

Ph.D. in Physics, University of São Paulo, Brazil 2016 – 2020
Thesis: *Aspects of Numerical Relativity*. **Advisor:** Elcio Abdalla

M.Sc. in Physics, University of São Paulo, Brazil. 2013 – 2016
Dissertation: *A Gauge Theory for Continuous Spin Particles*. **Advisor:** Victor O. Rivelles.

Physics Teaching Degree, University of São Paulo, Brazil. 2009 – 2013
Research Project: *Plasma Physics in Tokamaks*. **Advisor:** Artour Elfimov

GRANTS

Institutional Principal Investigator: *Gravitational-Wave Signatures of Massive Black Hole Formation*, NASA LISA Preparatory Science Program. 2023 – Present
Total funding: \$644,836; \$78,298 to L. Werneck

FELLOWSHIPS

Ph.D. Fellowship, CAPES, Brazil 2016 – 2020

M.Sc. Fellowship, CAPES, Brazil 2013 – 2016

Undergraduate Research Fellowship, CNPq, Brazil 2011 – 2013

MENTORING

2024

Mentoring two graduate students: one is working on writing a new TOV solver for the Einstein Toolkit; the other is working on a new version of NRPyElliptic.

2023

Mentored two graduate students: one is working on writing a new TOV solver for the Einstein Toolkit; the other is working on a new version of NRPyElliptic.

2022

Mentored one graduate student on general relativity and numerical relativity.

2021

Mentored two undergraduate students on how to use SFcollapse1D for their senior thesis & one graduate student in the development of NRPyElliptic.

2020

Mentored two undergraduate students on how to use SFcollapse1D for their senior thesis.

COMMUNITY INVOLVEMENT

2023

- College of Science Tailgate Event, *physics booth interactive demonstrator*, Moscow, ID, USA.
- Reviewer for physics journals *Physical Review D* and *Classical and Quantum Gravity*.
- Manager for the Einstein Toolkit May 2023 release (codename “Karl Schwarzschild”).
- M.Sc. committee member for Joaquín E. L. Salazar, UNIFEI, Brazil (online participation).
- Idaho Science & Engineering Fair, *Natural Sciences & Best in Fair Judge*, Moscow, ID, USA.

2022

- College of Science Tailgate Event, *physics booth interactive demonstrator*, Moscow, ID, USA.
- North American Einstein Toolkit Summer School, *Member of Scientific & Local Organizing Committees*, University of Idaho, ID, USA.
- First Einstein Toolkit Hackaton, *NRPy+ mentor; documented several thorns*, online event.

TEACHING EXPERIENCE

• Courses Taught

- PHYS 213 (Engineering Physics III), University of Idaho *Spring 2024*
- Experimental Physics I,* University of São Paulo *1st Semester 2017, 2018, 2019, 2020*
- Experimental Physics II,* University of São Paulo *2nd Semester 2017, 2018*
- Introduction to Experimental Physics,* University of São Paulo *2nd Semester 2016*

• Teaching Assistant

- Statistical Data Analysis in Experimental Physics, University of São Paulo *2016*
- Electricity and Magnetism, University of São Paulo *2011, 2012*

• Substitute Lecturer

- PHYS 404/504 (Relativistic Astrophysics), University of Idaho *2024*
- PHYS 428/528 (Numerical Methods), University of Idaho *2023*
- PHYS 111 (General Physics I), University of Idaho *2022*
- PHYS 212 (Oscillations and Thermal Physics), West Virginia University *2020*

*Course taught as a graduate student, under supervision of a professor.

RESEARCH EXPERIENCE

Compact object binaries in fully dynamical spacetimes

- Neutron star-neutron star (Pubs. [2], [3], [4]).
- Black hole-black hole (Pubs. [5]).

Black hole accretion (Pubs. [2], [3], [4], [7]).

Critical phenomena in gravitational collapse (Pubs. [6], [8]).

Development of numerical relativity software (Pubs. [3], [4], [5], [6], [8]).

Image analysis & particle tracking (Pubs. [1]).

PUBLICATIONS

Prefix denotes number of citations on INSPIRE-HEP (*: 1–5; **: 6–10; *: 11–15; ****: 16–20)**

- [1] **L. R. Werneck**, C. Jessup, A. Brandenberger, T. Knowles, C. W. Lewandowski, M. Nolan, K. Sible, Z. B. Etienne, and B D’Urso, “*Cross-correlation image analysis for real-time particle tracking*,” arXiv: 2310.08770 [physics.optics] (**2023**). [submitted to Rev. Sci. Instrum.]
- [2] * Y. Zenati, J. H. Krolik, **L. R. Werneck**, A. Murguia-Berthier, Z. B. Etienne, S. C. Noble and T. Piran, “*Bound Debris Expulsion from Neutron Star Merger Remnants*,” *Astrophys. J.* **958**, no.2, 161, arXiv: 2306.09464 [astro-ph.HE] (**2023**).
- [3] *** **L. R. Werneck**, Z. B. Etienne, A. Murguia-Berthier, R. Haas, F. Cipolletta, S. C. Noble, L. Ennoggi, F. G. L. Armengol, B. Giacomazzo and T. Assumpção, *et al.* “*Addition of tabulated equation of state and neutrino leakage support to illinoisgrmhd*,” *Phys. Rev. D* **107**, no.4, 044037, arXiv: 2208.14487 [gr-qc] (**2023**).
- [4] ** F. G. L. Armengol, Z. B. Etienne, S. C. Noble, B. J. Kelly, **L. R. Werneck**, B. Drachler, M. Campanelli, F. Cipolletta, Y. Zlochower and A. Murguia-Berthier, *et al.* “*Handing off the outcome of binary neutron star mergers for accurate and long-term postmerger simulations*,” *Phys. Rev. D* **106**, no.8, 083015, arXiv: 2112.09817 [astro-ph.HE] (**2022**).
- [5] ** T. Assumpcao, **L. R. Werneck**, T. P. Jacques and Z. B. Etienne, “*Fast hyperbolic relaxation elliptic solver for numerical relativity: Conformally flat, binary puncture initial data*,” *Phys. Rev. D* **105**, no.10, 104037, arXiv: 2111.02424 [gr-qc] (**2022**).
- [6] * **L. R. Werneck**, Z. B. Etienne, E. Abdalla, B. Cuadros-Melgar and C. E. Pellicer, “*NRPycritCol & Sfcollapse1D: an open-source, user-friendly toolkit to study critical phenomena*,” *Class. Quant. Grav.* **38**, no.24, 245005, arXiv: 2106.06553 [gr-qc] (**2021**).
- [7] **** A. Murguia-Berthier, S. C. Noble, L. F. Roberts, E. Ramirez-Ruiz, **L. R. Werneck**, M. Koclacki, Z. B. Etienne, M. Avara, M. Campanelli and R. Ciolfi, *et al.* “*HARM3D+NUC: A New Method for Simulating the Post-merger Phase of Binary Neutron Star Mergers with GRMHD, Tabulated EOS, and Neutrino Leakage*,” *Astrophys. J.* **919**, no.2, 95, arXiv: 2106.05356 [astro-ph.HE] (**2021**).
- [8] L. R. Werneck “*Aspects of numerical relativity: scalar fields and neutron stars*,” Ph.D. thesis, University of São Paulo (Brazil), doi:10.11606/T.43.2020.tde-01092020-014914, (**2020**). Downloaded 673 times as of November 2, 2023.
- [9] L. R. Werneck “*A gauge theory for continuous spin particles*,” M.Sc. disseration, University of São Paulo (Brazil), doi:10.11606/d.43.2016.tde-07062016-114220, (**2016**). Downloaded 372 times as of November 2, 2023.

SOFTWARE DEVELOPMENT

IllinoisGRMHD , ¹ <i>Core developer & maintainer</i>	<i>2019 – Present</i>
Einstein Toolkit thorn providing GRMHD for dynamical spacetimes.	
– Documented entire code in pedagogical Jupyter notebooks.	
– Added support for finite-temperature, microphysical equation of state tables.	
Einstein Toolkit , ² <i>Contributor</i>	<i>2019 – Present</i>
A community-driven software platform of core computational tools to support research in relativistic astrophysics and gravitational physics.	
GRHayL , ³ <i>Core developer & maintainer</i>	<i>2023 – Present</i>
An open-source, modular, infrastructure agnostic GRMHD library.	
NRPy+ , ⁴ <i>Core developer & maintainer</i>	<i>2019 – Present</i>
Python-based C code generator for Numerical Relativity and beyond.	
NRPyLeakage , ⁵ <i>Lead developer & maintainer</i>	<i>2022 – Present</i>
NRPy+-based neutrino leakage code.	
– Lead developer of Einstein Toolkit thorn version of the code, NRPyLeakageET. i	
NRPyElliptic , ⁶ <i>Core developer & maintainer</i>	<i>2021 – Present</i>
Easily extensible, NRPy+-based elliptic solver for Numerical Relativity initial data.	
– Lead developer of Einstein Toolkit thorn version of the code, NRPyEllipticET.	
NRPyCritCol , ⁷ <i>Lead developer & maintainer</i>	<i>2019 – Present</i>
User-friendly, well-documented NRPy+-based code to study critical phenomena.	
SFCollapse1D , ⁸ <i>Lead developer & maintainer</i>	<i>2018 – Present</i>
User-friendly, well-documented C++ code to study critical phenomena of a massless scalar field in 1D.	
RETINAS , ⁹ <i>Lead developer & maintainer</i>	<i>2021 – Present</i>
An open-source, GPU-capable image analysis code for real-time particle tracking.	

¹: <https://github.com/IllinoisGRMHD>

²: <http://einstein toolkit.org>

³: <https://github.com/GRHayL>

⁴: <https://nrpyplus.net>

⁵: <https://github.com/IllinoisGRMHD>

⁶: <http://github.com/assumpcao thiago/NRPyElliptic>

⁷: <https://github.com/zachetienne/nrpytutorial>

⁸: <https://github.com/leowerneck/SFcollapse1D>

⁹: <https://github.com/leowerneck/RETINAS>

SOFTWARE SKILLS

Operating systems: Linux, Mac OS, and Windows.

Programming languages: C^{****}, C++^{****}, Fortran^{****}, Python^{***}, Bash^{***}, CUDA^{*},

UNIX CLI tools: git^{***}, awk^{**}, sed^{**}, grep^{***}, make^{***}, autoconf^{*}, automake^{*}

Parallel programming paradigms: OpenMP^{***}, MPI^{***}

Document editing tools: L^AT_EX^{****}, Overleaf^{***}, Microsoft {Word, Excel, Powerpoint}^{****}, Apple {Keynote, Pages, Numbers}^{***}, Libre Office^{***}

Package Managers: pip^{***}, Homebrew^{***}, Conda^{**}, Spack^{*},

HPC Workload Managers: Slurm^{***}, PBS^{***}

* : 1–2; ** : 2–4; *** : 5–6; **** : >6 years of experience

DISTINGUISHED TALKS

2024

- Selected talk, APS April Meeting, *Binary Neutron Star Mergers on a Moving Mesh*, SAFE Credit Union Convention Center, Sacramento, CA.

2023

- Invited talk, INT 23-2: Astrophysical Neutrinos and the Origin of the Elements, *GRHayL: An Open-source, Modular, Extensible GRMHD Library*, Institute for Nuclear Theory, Seattle, WA.
- Invited talk, North American Einstein Toolkit Summer School, *Tutorial: Einstein Toolkit Simulation Analysis*, Rochester Institute of Technology, NY, USA.
- Selected talk, APS April Meeting, *IllinoisGRMHD: Recent Developments and Future Plans*, Hilton Minneapolis, Minneapolis, MN.

2022

- Invited talk, North American Einstein Toolkit “Working Workshop”, *An introduction to NRPy+*, University of Illinois at Urbana-Champaign, IL, USA.
- Invited talk, North American Einstein Toolkit Summer School, *Accurate, long-term binary neutron stars simulations with IllinoisGRMHD and HARM+NUC*, University of Idaho, ID, USA.
- Selected talk, APS April Meeting, *Accurate, long-term binary neutron stars simulations with IllinoisGRMHD and HARM+NUC*, New York Marriott Marquis, NY, USA.

2021

- Poster presentation, Midwest Relativity Meeting, *IllinoisGRMHD+HARM3D: Next-generation binary neutron stars simulations*, University of Illinois at Urbana-Champaign, IL, USA..
- Invited talk, North American Einstein Toolkit Summer School, *NRPy+ tutorial: Maxwell’s equations in flat space & ET thorn generation*, University of Illinois at Urbana-Champaign, IL, USA (online event).
- Invited talk, TCAN on BNS Workshop, *IllinoisGRMHD progress update—advanced, tabulated equation of state support*, Rochester Institute of Technology, NY, USA (online event).
- Selected talk, APS April Meeting, *New, user-friendly codes to study critical collapse*, online event.

2020

- Invited talk, TCAN on BNS Workshop, *IllinoisGRMHD progress update—piecewise polytropic equation of state support*, Rochester Institute of Technology, NY, USA (online event).