

LEONARDO (LEO) ROSA WERNECK

Postdoctoral researcher

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BIOGRAPHICAL DATA

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

WORK EXPERIENCE

University of Idaho, USA 2021 – Present
Postdoctoral researcher

West Virginia University, USA 2020 – 2021
Postdoctoral researcher

EDUCATION

University of São Paulo, Brazil 2016 – 2020
Ph.D. in Physics

University of São Paulo, Brazil 2013 – 2016
M.Sc. in Physics

University of São Paulo, Brazil 2009 – 2013
Physics Teaching Degree

RESEARCH INTERESTS

Compact object binaries in fully dynamical spacetimes

- Black hole-black hole (Pubs. [3]).
- Neutron star-neutron star (Pubs. [1], [2]).

Black hole accretion (Pubs. [1], [5], [2]).

Critical phenomena in gravitational collapse (Pubs. [4], [6]).

Development of numerical relativity software (Pubs. [1], [3], [4], [2], [6]).

SOFTWARE DEVELOPMENT

IllinoisGRMHD¹ 2019 – Present
Developer & maintainer
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 Toolkit² 2019 – Present
Contributor
A community-driven software platform of core computational tools to support research in relativistic astrophysics and gravitational physics.

NRPy+³ 2019 – Present
Developer & maintainer
Python-based C code generator for Numerical Relativity and beyond.

NRPyElliptic⁴

2021 – Present

Developer & maintainer

Easily extensible, NRPy+-based elliptic solver for Numerical Relativity initial data.

– Lead developer of Einstein Toolkit thorn version of the code, NRPyEllipticET.

NRPyLeakage⁵

2022 – Present

Lead developer & maintainer

NRPy+-based neutrino leakage code.

– Lead developer of Einstein Toolkit thorn version of the code, NRPyLeakageET.

NRPyCritCol⁶

2019 – Present

Lead developer & maintainer

User-friendly, well-documented NRPy+-based code to study critical phenomena.

SFcollapse1D⁷

2018 – Present

Lead developer & maintainer

User-friendly, well-documented C++ code to study critical phenomena of a massless scalar field in 1D.

¹: <https://github.com/IllinoisGRMHD>

⁵: <https://github.com/IllinoisGRMHD>

²: <http://einstein toolkit.org>

⁶: <https://github.com/zachetienne/nrpytutorial>

³: <https://nrpyplus.net>

⁷: <https://github.com/leowerneck/SFcollapse1D>

⁴: <http://github.com/assumpcao/assumpcao/NRPyElliptic>

MENTORING

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.

FELLOWSHIPS

CAPES (Brazil) Ph.D. fellowship

2016 – 2020

CAPES (Brazil) M.Sc. fellowship

2013 – 2016

CNPq (Brazil) undergraduate research fellowship

2011 – 2013

PUBLICATIONS

2023 peer-reviewed publications

- [1] **L. R. Werneck**, Z. B. Etienne, A. Murguia-Berthier, R. Haas, F. Cippolletta, 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: [arXiv:2208.14487](https://arxiv.org/abs/2208.14487) [gr-qc] (2023).

2022 peer-reviewed publications

- [2] F. G. L. Armengol, Z. B. Etienne, S. C. Noble, B. J. Kelly, **L. R. Werneck**, B. Drachler, M. Campanelli, F. Cippolletta, 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: [arXiv:2112.09817](https://arxiv.org/abs/2112.09817) [astro-ph.HE] (2022).
- [3] 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: [arXiv:2111.02424](https://arxiv.org/abs/2111.02424) [gr-qc] (2022).

2021 peer-reviewed publications

- [4] **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: [arXiv:2106.06553](https://arxiv.org/abs/2106.06553) [gr-qc] (2021).
- [5] A. Murguia-Berthier, S. C. Noble, L. F. Roberts, E. Ramirez-Ruiz, **L. R. Werneck**, M. Kolacki, 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: [arXiv:2106.05356](https://arxiv.org/abs/2106.05356) [astro-ph.HE] (2021).

Dissertations & Theses

- [6] **L. R. Werneck**, “*Aspects of numerical relativity: scalar fields and neutron stars*,” Ph.D. Thesis, University of São Paulo (Brazil). doi:[doi:10.11606/T.43.2020.tde-01092020-014914](https://doi.org/10.11606/T.43.2020.tde-01092020-014914). (2020).
- [7] **L. R. Werneck**, “*A gauge theory for continuous spin particles*,” M.Sc. Dissertation, University of São Paulo (Brazil). doi:[doi:10.11606/d.43.2016.tde-07062016-114220](https://doi.org/10.11606/d.43.2016.tde-07062016-114220). (2016).

TALKS

2022

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

2021

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

2020

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

OUTREACH

2023

- Idaho Science & Engineering Fair: *Natural Sciences & Best in Fair Judge*. University of Idaho, Moscow, ID, USA.

2022

- North American Einstein Toolkit Summer School: *Member of Scientific & Local Organizing Committees*. University of Idaho, ID, USA.
- First Einstein Toolkit Hackaton: *NRPy+ mentor; contributor* to the documentation of several thorns (online event).