Luciano Combi

I am a relativistic astrophysicist interested in the violent phenomena that occur around strong gravitational fields. I use simulations and semi-analytical models to study the electromagnetic radiation from compact objects such as black holes, supermassive black holes binaries, neutron star mergers, and other systems.

Personal information

Adress Instituto Argentino de Radioastronomía, Buenos Aires, Argentina

Citizenship Argentina

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Education

2011 - 2016 ***Licenciatura* in physics**, *Department of physics*, Faculty of Exact Sciences, *Universidad Nacional de La Plata* (UNLP).

(*Equivalent to a Master's degree)*

Average mark: 9.60/10

Degree thesis: Equivalence between General Relativity and Teleparallel Gravity. Mark: 10/10. Supervisor: Gustavo E. Romero.

2017 - 2022 **Ph.D. in Physics**, *Department of physics*, Faculty of Exact Sciences, UNLP.

Supervisor: Gustavo E. Romero.

Degree thesis: Local effects of the cosmic expansion

Current position

2017 - **CONICET Ph.D Fellow**.

Supervisor: Gustavo E. Romero.

Place: Instituto Argentino de Radioastronomía

Awards

2017 **Joaquín V. Gonzales award** for distinguished graduate of the National University of La Plata. Given by the City Government of La Plata, Capital of Buenos Aires.

2017 **CONICET Fellowship**, 5 year fellowship awarded by the National Research Council of Argentina.

2020 **Visiting Fellowship from Perimeter Institute**, Awarded one semester visiting fellowship at Perimeter Institute (full funding) to work with Dr. Daniel Siegel on binary neutron star mergers.

2021 **AARMS award**, Third place for Best Graduate student talk in the Canadian Student and Postdoc Conference on Gravity.

2022 **Perimeter Postdoctoral Fellowship**, 3 year fellowship awarded by Perimeter Institute. Joint with CITA National Fellowship.

2022 **CITA National Fellowship**, National fellowship awarded by the Canadian Institute of Theoretical Astrophysics with U. of Guelph and Perimeter Institute.

Research stays abroad

2018 *West Virginia University*, **Place:** Morgantown, West Virginia, USA. **Duration** 1 month, **Funding:** NANOGrav Collaboration, **Project:** Timing of milisecond pulsar J0437-4715, with Michael Lam and Maura McLauhglin

2019 *Rochester Institute of Technology*, **Place:** Rochester, NY, USA, **Duration** 6 months, **Funding:** Center for Computational Relativity and Gravitation, RIT, **Project:** MHD simulations of spinning binary black hole systems, with Manuela Campanelli.

Professional Skills

Programming Languages	Mathematica, Python, C/C++, BASH, Jupyter
HPC	MPI/OMP, Einstein Toolkits (Cactus), GRMHD codes such as HARM3D and GRHydro
Use of clusters	Frontera (TX, USA), BlueWaters (IL, USA), Niagara (ON, CAN)
Observational Expertise	Radio observations of *pulsars* with single dish Antennas. Reduction and analysis of timing data. Software usage: `PRESTO`,`PSRCHIVE`,`Enterprise`,`TEMPO2`

Teaching and mentoring experience

Course assistant

2015 **Undergraduate teaching assistant** of Calculus II, Department of Mathematics, Faculty of Exact Sciences, UNLP. **Period**: 1th semester

2015 - 2017 **Undergraduate teaching assistant**, Department of Physics, Faculty of Exact Sciences, UNLP. Courses given: Linear Algebra, General Physics I, General Physics II

2015 - 2017 **Undergraduate teaching assistant** Faculty of Engineering, UNLP. **Course**: Physics I (Laboratory duties)

2017 - 2019 **Graduate teaching assistant** Department of Physics, Faculty of Exact Sciences, UNLP. Courses given: Gravitation, General Physics III, Methods in Mathematical Physics. Mechanics I

Mentorship

2019 - 2020 **Thesis co-advisor** for the master's degree (*Licenciatura*) in Astronomy, Valentina Sosa Fiscella. **Topic**: High-precision timing of pulsar J0437-4715 from IAR

Grants and travel funding

2016 Full funding given by the ICTP-Perimeter Institute for one-week school 'Journeys in theoretical physics' at ICTP, Sao Pablo, Brasil

2018 Partial funding given by NANOgrav for one month research visit at the West Virginia University, Morgantown, USA

2018 Partial funding given by the Templeton foundation for one-week school 'First Biennial Midwest Summer School in Philosophy of Physics' at University of Chicago, Chicago, USA

2018 Full funding given by the ICTP for three-week school 'The Sound of Spacetime' at ICTP, Sao Pablo, Brasil

2019 Full funding given by the CCRG for six month research visit at the Rochester Institute of Technology (Rochester, USA) (PI: Manuela Campanelli)

2020 Full funding given by the Perimeter Institute for four month research visit at the Perimeter Institute (Waterloo, Canada) (PI: Daniel Siegel)

2020 Collaborator in NSF grant: "MRI: Acquisition of a Computing System for Large Simulation Data Sets in Multimessenger Astrophysics" (PI: Manuela Campanelli)

2021 Collaborator in NSF grant: "Collaborative Research: Supermassive Binary Black Hole Mergers: Accretion Dynamics and Electromagnetic Output" (at NSF Windows on the Universe: The Era of Multi-messenger Astrophysics) (PI: Manuela Campanelli and Julian Krolik)

Workshops and Schools

2016 *Journeys in theoretical physics*, (ICTP-Perimeter Institute). **Place:** Sao Paulo, Brasil. **Duration:** 1 week (40 hs). **Funding:** ICTP-SAIFR

2016 *$f(R)$ theories of gravity*, (FCGALP, UNLP). **Place:** La Plata, Argentina. **Duration:** 1 week (40 hs).

2018 *LAPIS: Cosmology in the era of large surveys*, (FCGALP, UNLP). **Place:** La Plata, Argentina. **Duration:** 1 week (40 hs).**Funding:** UNLP

2018 *International Pulsar Timing Array, student week*, (NRAO). **Place:** New Mexico, USA. **Duration:** 1 week (40 hs).

2018 *First Biennial Midwest Summer School in Philosophy of Physics*, (University of Chicago). **Place:** Chicago, USA. **Duration:** 1 week (40 hs).

2018 *The Sound of Space-Time: The dawn of Gravitational Wave Science*, (ICTP-SAIFR). **Place:** Sao Paulo, Brasil.**Duration:** 3 weeks (120 hs). **Funding:** ICTP-SAIFR

2019 *North American Einstein Toolkit Workshop*, (RIT). **Place:** Rochester, USA. **Duration:** 3 days. **Funding:** CCRG-RIT

2020 *TCAN on Binary Neutron Stars*, (RIT). **Place:** Rochester, USA. **Duration:** 5 days.

Scientific meetings

Invited presentation

2017 *The PuMA project: Pulsar Monitoring in Argentina* (in Spanish)
Encuentro de Estudiantes de Astronomía, Buenos Aires, Argentina. September 2017

2018 *First Pulsar Observations in South America*
Binational meeting SOCHIAS-AAA, La Serena, Chile. October 16

2021 *GRMHD simulations of accretion disks onto spinning supermassive binary black holes*
Gravitational Wave lunch seminar, NASA Goddard, Baltimore, USA. September 16

2021 *Accretion onto spinning supermassive binary black holes*
Plasma-astro seminar, Princeton University, Princeton, USA. October 22

2021 *Electromagnetic signatures from neutron star mergers and supermassive binary black holes*
Strong gravity seminar, Perimeter Institute, Waterloo, Canada. November 16

Contribution presentation

2015 *Inconsistency within the Everett interpretation of Quantum Mechanics*
First Latin-American congress of Scientific Philosophy (In honor to Mario Bunge), Buenos Aires, Argentina. October 2015

2019 *Gravitational wave science and pulsars in Argentina*
Grav19, Cordoba, Argentina. April 12

2020 *Dual jets in supermassive black hole binaries*
Argentine Astronomical Association, Rosario, Argentina. October 13

2021 *GRMHD simulations of binary neutron stars with weak interactions*
Canadian Student and Postdoc Conference on Gravity, Memorial University of Newfoundland, Canada. May 4

2021 *Accretion onto spinning supermassive black hole binaries*
LISA Astrophysics Working Group Meeting, Institute of Computational Science (ICS), University of Zurich. September

2022 *Electromagnetic signatures from fast ejecta in neutron star mergers*
Seminaire haute énergie, LUTH, Paris, France. May 29

Posters and proceedings

2015 *Force between cylindric magnets: Theory and experiment* (in Spanish)
Luciano Combi, Lucas Pili, Pablo Pisani, Fernando Monticelli
100ª Anual Meeting of the Asociación Argentina de Física (AFA), September 15

2017 *Intensive monitoring of pulsars in the south hemisphere* (in Spanish)

Luciano Combi, Jorge Combi, Federico García, Guillermo Gancio, Carlos Lousto
Anual Meeting of the Asocación Argentina de Astronomía (AAA), September 12

2018 *Orbits in inhomogeneous expanding space-times*
Luciano Combi, Eduardo Gutiérrez
LAPIS: Cosmology in the era of large surveys, April 1

2018 *The IAR observatory and the PuMA project*
Luciano Combi, Guillermo Gancio, Carlos Lousto
IPTA international meeting, Albuquerque, USA, June

2020 *Developing a digital receiver for pulsar observations*
Gancio, G., Lousto, C., Combi, L., García, F., and Colaboración PuMA
Boletín de la Asociación Argentina de Astronomía, La Plata, Argentina, vol. 61, pp. 222–224, 2020

Outreach & media

2018 *Friday talks in the Planetarium*: Gravitational waves and pulsars. Outreach talk at Planetarium, La Plata, Argentina

2018 Member of the **outreach** department at Argentine Institute of Radioastronomy. In charge of social media management and guide for primary school and high-school visits to the Institute

2019 On the existence of black holes, outreach article in the bi-monthly Radioastronomy Bulletin (spanish)

2019 'A vision of the Argentine Institute of Radioastronomy', producer of the mini-documentary directed by Luciana Demichelis

2020 Wormholes and other speculations, opinion column in the bi-monthly Radioastronomy Bulletin (spanish)

2020 Pulsar hunters, media cover in CONICET and the Argentine National News Agency (spanish)

Languages

Native **Spanish**
Proficient **English**
Intermediate **French**

Memberships

PuMA: *Pulsar Monitoring in Argentina* collaboration at the Argentine Institute of Radioastronomy (IAR), La Plata, Argentina

Compact binaries: Research collaboration for multi-messenger astrophysics at the Rochester Institute of Technology, NY, USA

GARRA: *Grupo de Astrofísica relativista y radioastronomía)* at IAR-FCGALP, La Plata, Argentina

RelAstro (*Relativistic Astrophysics Group* at Perimeter Institute and U. of Guelph, Ontario, Canada

Other activities

Reviewer in scientific journals and institutions:

Astrophysics and Space Science (Springer), Gravitation and Cosmology (Springer), Foundations of Science (Springer), Estonian Research Council (ETIS)

Publications

14 papers in international peer-review journals.

9 first author papers.
5 second/third author papers.
1 chapter in book. **3** Astronomy Telegrams.

Papers published/submitted in major peer-reviewed journals

2022 **GRMHD simulations of binary neutron star mergers with weak interactions: electromagnetic signatures of dynamical ejecta**.

Luciano Combi , Daniel Siegel

Submitted to ApJ

https://arxiv.org/2206.03618

2022 **Electromagnetic emission from supermassive black hole binaries approaching merger**.

Eduardo Gutierrez, Luciano Combi , Scott Noble, Manuela Campanelli, Julian Krolik, Federico Lopez Armengol, Federico García

The Astrophysical Journal 928, 137

2022 **Mini-disk Accretion onto Spinning Black Hole Binaries: Quasi-periodicities and outflows**.

Luciano Combi , F.G. Lopez Armengol, Manuela Campanelli, Scott Noble, Mark Avara, Julian Krolik, Dennis Bowen

The Astrophysical Journal 928, 187

2021 **Vela Pulsar: Single Pulses Analysis with Machine Learning Techniques.** .

Lousto, C.O., Missel, R., Prajapati, H., Fiscella, V.S., Armengol, F.G.L., Gyawali, P.K., Wang, L., Cahill, N., Luciano Combi , del Palacio, S. and Combi, J.A.

Monthly Notices of the Royal Astronomical Society 509 (4), 5790-5808

2021 **Superposed metric for spinning black hole binaries**.

Luciano Combi , F.G. Lopez Armengol, Manuela Campanelli, Brennan Ireland, Scott Noble, Hiroyuki Nakano, Dennis Bowen

Physical Review D 104 (4), 044041 [*Chosen as PRD Editors' Suggestion*]

2021 **Circumbinary Disk Accretion into Spinning Black Hole Binaries**.

F.G. Lopez Armengol, Luciano Combi , Manuela Campanelli, Scott Noble, Dennis Bowen, Mark Avara

The Astrophysical Journal 913 (1), 16

2021 **PSR J0437-4715: The Argentine Institute of Radioastronomy 2019-2020 Observational Campaign**.

V. Sosa Fiscella, S. del Palacio, Luciano Combi , C.O. Lousto, F. G. Lopez Armengol, J. A. Combi, F. García, P.Kornecki, A. L. Müller, E. Gutierrez, and F. Hauscarriaga

The Astrophysical Journal , 913, 158

2020 **Relativistic rigid systems and the cosmic expansion**.

Luciano Combi , Gustavo E. Romero

General Relativity and Gravitation , 52:93

2020 **Upgraded antennas for pulsar observations in the Argentine Institute of Radio astronomy**.

G. Gancio, C.O. Lousto, Luciano Combi , S. del Palacio, F. G. Lopez Armengol, J. A. Combi, F. García, P.Kornecki, A. L. Müller, E. Gutierrez, and F. Hauscarriaga

Astronomy and Astrophysics , 633, A84

2019 **Electromagnetic fields and charges in expanding universes**.

Luciano Combi , Gustavo E. Romero

Physical Review D , 99, 064017

2019 **A note on geodesics in inhomogeneous expanding spacetimes**.
D. Perez, G.E. Romero, Luciano Combi , E.M. Gutiérrez.
Classical and Quantum Gravity , 36, 055002

2018 **Is Teleparallel Gravity really equivalent to General Relativity?**.
Luciano Combi , Gustavo E. Romero.
Annalen der Physik, 1700175

2017 **Gravitational energy and radiation of a charged black hole**.
Luciano Combi , Gustavo E. Romero.
Classical and Quantum Gravity , 34, 195008

2017 **Inconsistency within the Everett interpretation of Quantum Mechanics**.
Luciano Combi , Gustavo E. Romero.
Methateoria (ISSN 1853-2322) 7, 47-53

Chapter in books

1 **Space-time is material**.
Luciano Combi
In *Contemporary Materialism. Its Ontology and Epistemology*, Synthese Library, 447, Springer, (2021)

Telegrams

3 **A new Glitch in the Vela Pulsar (PSR B0833-45/PSR J0835-4510)**.
V Sosa-Fiscella, E Zubieta, S del Palacio, F Garcia, FA Lopez-Armengol, JA Combi, CO Lousto, G Gancio, Luciano Combi , E Gutierrez, A Simaz Bunzel, F Hauscarriaga, on behalf of the PuMA Collaboration
The Astronomer's Telegram, **14806**, 2021

2 **Radio observations following the recent glitch of Vela Pulsar (PSR B0833-45)**.
F. G. Lopez Armengol, C. O. Lousto, S. del Palacio , F. Garcia, Luciano Combi , J. A. Combi , G. Gancio , A. L. Mueller, P. Kornecki, on behalf of the PuMA Collaboration
The Astronomer's Telegram, **12482**, 2019

1 **Follow up of the radio flare from the magnetar XTE J1810-197 at 1.4 GHz**.
Del Palacio, S.; Garcia, F.; Luciano Combi ; Lopez Armengol, F.; Gancio, G.; Muller, A. L.; Kornecki, P., on behalf of the PuMA Collaboration
The Astronomer's Telegram, **12323**, 2018