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. I also work with observations of radio pulsars and radio-transients.

Personal information

Adress	Instituto Argentino de Radioastronomía, Buenos Aires, Argentina
Citizenship	Argentina
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Education

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

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.

2021 **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 *(Postponed: work started online due to COVID19)*.

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

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.

Computational expertise

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 experience

Radio observations of *pulsars* with single dish Antennas at the Argentine Institute of Radioastronomy. Reduction and analysis of data. Software usage: `PRESTO`,`PSRCHIVE`,`Enterprise`,`TEMPO2`

Telegrams

1 **Follow up of the radio flare from the magnetar XTE J1810-197 at 1.4 GHz**.

Del Palacio, S.; Garcia, F.; Combi, L.; Lopez Armengol, F.; Gancio, G.; Muller, A. L.; Kornecki, P., on behalf of the PuMA Collaboration

The Astronomer's Telegram, **12323**, 2018

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, L. Combi, J. A. Combi , G. Gancio , A. L. Mueller, P. Kornecki, on behalf of the PuMA Collaboration

The Astronomer's Telegram, **12482**, 2019

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 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. Octubre 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

2019 *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

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 2015

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 2017

2018 *Orbits in inhomogeneous expanding space-times*

Luciano Combi, Eduardo Gutiérrez

LAPIS: Cosmology in the era of large surveys, April, 2018

2018 *The IAR observatory and the PuMA project*

Luciano Combi, Guillermo Gancio, Carlos Lousto

IPTA international meeting, Albuquerque, USA

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 (IAR) (*Pulsar Monitoring in Argentina* collaboration. **Status:** Full member. **Place:** Argentine Institute of Radioastronomy (IAR), La Plata, Argentina

Compact binaries (RIT). Research collaboration for multi-messenger astrophysics.

GARRA (IAR-FCGALP) (*Grupo de Astrofísica relativista y radioastronomía)*

RelAstro (PI-U.Guelph) (*Relativistic Astrophysics Group at Perimeter Institute and U. of Guelph*)

Other activities

Reviewer in scientific journals and institutions:

Astrophysics and Space Science (Springer)

Gravitation and Cosmology (Springer)

Estonian Research Council (ETIS)

Publications

Papers in major peer-reviewed journals

2021 **GRMHD simulations of binary neutron star mergers with weak interactions I**. Luciano Combi, Daniel Siegel

Astrophysical Journal, (In prep.)

2021 **Accretion onto spinning black hole binaries: mini-disks structure and outflows**.

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

Astrophysical Journal, (In prep.)

2021 **An 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, (Submitted)

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

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

Astrophysical Journal, **913** 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

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, (2018)

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

2021 **Is space-time material?**.

Luciano Combi

Ontological and Epistemological Issues in Contemporary Materialism, Syntheses-Springer, 2020 (Forthcoming)