Cristian Joana

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PRINCIPAL INTERESTS

early Universe cosmology, cosmic inflation, (p)reheating, primordial black holes, exotic compact objects, gravitational waves sources, numerical relativity.

RESEARCH AND ACADEMIC BACKGROUND

Postdoctoral researcher 2025 - Present
International Center for Theoretical Physics Asia-Pacific (ICTP-AP), China.
Advisor: Prof. Jun Zhang

Visitor researcher 2025
Institute of Science Tokyo, Japan.
Advisor: Prof. Teuraki Suayama

Postdoctoral researcher 2022 - 2025
Institute of Theoretical Physics (ITP-CAS), China.
Advisor: Prof. Shi Pi

Visitor researcher 2021-2022
Free University of Brussels (ULB), Belgium.
Advisor: Prof. Sebastien Clesse

Ph.D. in Physics 2019 - 2022
University of Louvain, (UCLouvain-CURL), Belgium.
Thesis supervisors: Prof. Christophe Ringeval and Prof. Sebastien Clesse.

M.Sc. in Physics, major in QFT and Gauge Theories 2014 - 2016
RWTH Aachen University, Germany.
Thesis supervisor: Prof. Julien Lesgourgues.

B.Sc. in Physics, mention in theoretical physics 2009 - 2013
Autonomous University of Barcelona (UAB), Catalonia/Spain.
Thesis supervisor: Prof. Rafel Escribano

OTHER RESEARCH EXPERIENCE

Research Assistant 2016 - 2018
Institute of Neuroscience and Medicine (INM-6),
Juelich Research Centre, Germany.
Group Leader: Prof. Sonja Gruen

Research Internship 2013 - 2014
National Institute of Informatics (NII), Japan.
Group Leader: Prof. Tim Byrnes

SCIENTIFIC GRANTS AND AWARDS

NSFC Research Fund for International Scientist (No. W2433007) 2025
National Natural Science Foundation of China, NSFC, RFIS I, China.

NSFC Special Fund for Theoretical Physics. (No. 12347132) 2024
National Natural Science Foundation of China, NSFC, China.

ICERM visiting grant (3 months) CANCELLED due to COVID-19 2020
National Science Foundation and ICERM's Federal funds, NSF, USA.

Co-I, PRACE Tier-0. (No. 2018194669) 2020
30M CPU/hrs, Computational Grant.

FNRS-FRIA grant (bourse de doctorat, 4 years) 2019
Fonds de la Reserche Scientifique, FRS-FNRS, Belgium.

NII International Internship Program (6 months) 2013
National Institute of Informatics, Sokendai, Japan.

TEACHING EXPERIENCE

Tutor in Quantum Mechanics II (UCLouvain) 2019-2021
Tutor in Computational Neuroscience (RWTH Aachen) 2017-2018

PERSONAL DETAILS

Nationality: Spanish
Date of birth: 01-05-1990
Languages: Native in Catalan and Spanish, Proficiency in English,
Intermediate level in French,
Basics in Mandarin Chinese, Japanese and German.
ICT Skills: Debian GNU/Linux based Operative Systems,
Programming in C/C++ and Python, Mathematica™, LaTeX
Hobbies: Reading, playing chess, astronomy, traveling and hiking.

RESEARCH ACTIVITIES

- Member of the LISA Cosmology Gravitational Wave working group.
- Member of the LISA Primordial Black Hole working group.
- Member of the GRTL Collaboration (previously known as the GRChombo Collaboration), and developer/user of the GRChombo numerical relativity code.
- Member and contributor of the yt-project code (astrophysical python toolkit).
- Associate member for the TAIJI gravitational wave experiment.
- Journal referee for PRL, PRD, JCAP, JOSS, elsevier

LIST OF PUBLICATIONS

GR-QC, ASTRO-CO, HEP-Th, COND-MAT:

1. Joana, C., van Loock, P., Deng, H., Byrnes, T. (2016). "Steady-state generation of negative-Wigner-function light using feedback". Phys. Rev. A, 94, 063802 (2016). arXiv:1612.00629
2. Joana, C., Clesse, S. "Inhomogeneous pre-inflation across Hubble scales in full general relativity", Phys. Rev. D 103, 083501 (2021). arXiv:2011.12190
3. Joana, C. "Gravitational dynamics of Higgs inflation: Preinflation and preheating with an auxiliary field", Phys. Rev. D, vol. 106, pp. 023504 (2022). arXiv:2202.07604
4. Andrade, T., Joana C. et, al. "GRChombo: An adaptable numerical relativity code for fundamental physics", Journal of Open Source Software (JOSS), 6(68), 3703, arXiv:2201.03458
5. Auclair, P., Bacon, D., Joana, C, et. al. [LISA Collaboration],"Cosmology with the Laser Interferometer Space Antenna", Living Rev Relativ 26, 5 (2023). arXiv:2204.05434
6. Bagui, E., Clesse, S., Joana, C., et. al. [LISA Collaboration], "Primordial black holes and their gravitational wave signatures", Living Rev.Rel. 28 (2025) 1, 1, arXiv:2310.19857
7. Dumpui, E., Joana, C., Clesse, S., Escriva A., "Baryogenesis from sub-threshold curvature perturbations", arXiv:2401.09408 (Submitted to PRL)
8. Joana, C. "Beginning inflation in non-conformally flat spacetimes", Phys.Rev.D 110 (2024) 6, 063534, arXiv:2406.00811

9. Yuwen, Z-Y., Joana, C, Wang S-H, Cai R-G., "Bubbles kick off primordial black holes to form more binaries", arXiv: 2406.05838 (Submitted to PRL)
10. Inui, R., Joana, C. Motohashi, H., Pi, S., Tada, Y., Yokoyama, S., "Primordial black holes and induced gravitational waves from logarithmic non-Gaussianity", J. Cosmol. Astropart. Phys. 2025 021, arXiv:2411.07647

INTERDISCIPLINARY:

11. Yamane, Y., Ito, J., Joana, C., Fujita, I., Tamura, H, Maldonado, P., Gruen, S., "Neuronal population activity in macaque visual cortices dynamically changes through repeated fixations in active free viewing", eNeuro 5 October 2023, ENEURO.0086-23.2023; doi:10.1523/ENEURO.0086-23.2023.
12. Ito, J., Joana, C., Yamane, Y., Fujita, I., Tamura, H, Maldonado, P., Gruen, S. (2022), "Latency shortening with enhanced sparseness and responsiveness in V1 during active visual sensing", Sci Rep 12, 6021 (2022

ARTICLES IN PREPARATION:

13. Bagui, E., Clesse, S., Joana, C., et. al. [LISA Collaboration], "`PrimBHoles`: A code for the computation of the gravitational wave signatures of primordial black holes ", (in progress)
14. Joana, C., Clesse, S., Pi, S., "Primordial black hole formation after collapse of asymmetric curvature perturbations", (in progress)
15. Bagui, E., Clesse, S., Joana, C., et. al. [LISA Collaboration], "PrimBHoles: an analysis toolkit for primordial black hole research", (in progress)
16. Turk, M., Joana, C., et. al [yt-project Collaboration] "Introducing yt 4.0: Analysis and Visualization of Volumetric Data", (in progress)

GIVEN TALKS

- Numerical Relativity and Primordial Black Holes with local non-Gaussianities
  Cosmology seminars, Science Tokyo, January 2025
- Primordial black holes and scalar induced gravitational waves from logarithmic non-Gaussianity
  2nd Bangkok workshop on Gravity & Cosmology, January 2025
- Beginning inflation from inhomogeneous initial conditions
  Majorana-Raychaudhuri Seminars, INFN, Italy & PAMU, India, Aug 2024
- Starting inflation from conformally curved initial conditions
  GRTL meetings, Cambridge U., UK, June 2024
- Generating Chombo checkpoint files using pyhton.
  GRTL meetings, Cambridge U., UK, June 2024
- PrimBHoles: a pythonic toolkit to compute PBH signatures
  11th LISA CosGW workshop, Porto U., Portugal, June 2024
- On Primordial Black Hole Formation
  PCFT/ICTS seminars, USTC, Hefei, P.R. China, October 2023
- Introduction to Numerical Relativity in Cosmology
  College of Physics seminars, Chongqing U., P.R. China, April 2023
- GR-Simulations of the Early Universe
  Chinese GW annual meeting, Chongqing, P.R. China, April 2023
- Numerical relativity in Cosmology
  Gravity-matters seminars, University of Oslo, Norway, Nov. 2022

- Visualitzation tools for GRChombo: Yt and Visit
  GRChombo meetings '22 (I), Cambridge U., UK, March 2022
- Dynamics of pre- and post- Higgs inflation
  GRChombo meetings '22 (I), Cambridge U., UK, March 2022
- Gravitational dynamics of Higgs pre-inflation and preheating
  Oxford gr-qc JC, Oxford U., UK, March 2022
- Simulations of the early Universe with numerical General Relativity
  Tonale winter school of cosmology, Tonale, Italy, December 2021
- Exploring the early Universe with numerical General Relativity
  Belgian Gravitational Wave Seminars, ULB, Brussels, Belgium, Nov. 2021
- The inhomogeneous pre-inflationary era: A numerical relativity approach
  GRChombo meetings '20 II, Oxford U., Oxford, UK, December 2020
- Graviational waves from the inhomogeneous pre-inflationary era
  Belgian Gravitational Wave Seminars, KU-Leuven, Belgium, Nov. 2020