

# Leonardo Gualtieri

## Curriculum Vitæ

### Part I - General Information

Full Name: Leonardo Gualtieri  
Birth:  
Citizenship:  
Address:  
  
E-Mail:  
Personal Webpage:  
Academic Sector: FIS/02 - 02/A2  
Spoken Languages: English (fluent), French (good knowledge), Italian (mother language)

### Part II - Education and Habilitations

Mar 2021 Italian National Scientific Habilitation (ASN):

- Astrophysics (02/C1) - Full Professor

Jul 2018 Italian National Scientific Habilitation (ASN):

- Theoretical Physics (02/A2) - Full Professor

Jan 2014 Italian National Scientific Habilitation (ASN):

- Theoretical Physics (02/A2) - Full Professor
- Theoretical Physics (02/A2) - Associate Professor
- Astrophysics (02/C1) - Associate Professor

Feb 2000 Ph.D. in Physics at Università di Torino  
Title of the Thesis: *“Harmonic analysis and superconformal gauge theories in three dimensions from the AdS/CFT correspondence”*

Dec 1995 “Laurea” Degree in Physics at “Sapienza” Università di Roma (110/110 cum laude)

### Part III - Appointments

From Jul 2022 Full Professor at Università di Pisa

Nov 2015 - Jun 2022 Associate Professor at “Sapienza” Università di Roma

Mar 2006 - Oct 2015 Research Scientist at “Sapienza” Università di Roma

Oct 2005 - Feb 2006 Enrico Fermi Fellow at “Sapienza” Università di Roma

May 2001 - Sep 2005 Postdoctoral Researcher at “Sapienza” Università di Roma

Nov 1999 - Apr 2001 Postdoctoral Researcher at Université Libre de Bruxelles

## Part IV - Teaching experience

I have taught the following courses at “Sapienza” Università di Roma:

2020/2021	“Relatività Generale”, Undergraduate, Physics
From 2019/2020	“Onde Gravitazionali, Stelle e Buchi Neri”, Master (“Laurea Magistrale”)
From 2016/2017	“Meccanica Analitica e Relativistica”, Undergraduate, Physics
2015/2016	“Meccanica”, Undergraduate, Physics
2011/2012 - 2018/2019	“Fisica”, Undergraduate, Natural Science
2009/2010	“Relatività Generale”, Undergraduate, Physics
2007/2008 - 2016/2017	“Buchi Neri in Relatività Generale”, Ph.D., Physics

Moreover, from 2003 to 2009 I have been teaching assistant at various undergraduate and Ph.D. courses.

I have supervised the graduate students: Giovanni Camelio, Tiziano Abdelsalhin, Lorenzo Annulli, Gonçalo Castro, Lorenzo Pierini, Susanna Barsanti.

Moreover, I have been involved in the training of several graduate students, most of which have become successful and respected scientists, as: Emanuele Berti (Professor, JHU, Baltimore, U.S.), Giovanni Miniutti (CAB-CSIC Researcher, Madrid, Spain), Paolo Pani (Associate Professor, Sapienza, Rome), Riccardo Ciolfi (INAF Researcher, Padova), Francesco Pannarale (Associate Professor, Sapienza, Rome).

I have published - in collaboration with Valeria Ferrari and Paolo Pani - a textbook, “[General Relativity and its Applications: Black Holes, Compact Stars and Gravitational Waves](#)” (CRC Press - Taylor & Francis), addressed to third-year undergraduate and especially to graduate students in Physics or Astrophysics, who want to learn the basics of General Relativity and its diverse phenomenological consequences.

## Part V - Awards & Honors

2019	<a href="#">Class.Quant.Grav. 36, 143001</a> selected for the Highlights of CQG
2018	<a href="#">Phys. Rev. Lett. 120, 081101</a> selected as Editor’s Suggestion
2015	<a href="#">Class.Quant.Grav. 32, 243001</a> selected for the Highlights of CQG.
2015	<a href="#">Class.Quant.Grav. 32, 204001</a> selected for an Insight on CQG+ - <i>high-quality papers published in Class.Quant.Grav.</i>
2012	<a href="#">Phys.Rev.Lett. 109, 131102</a> selected for a <a href="#">Highlight</a> in <i>Physics - spotlighting exceptional research</i> of APS, and reported on the <a href="#">New Scientist</a>
2007	“ <i>Honorable mention</i> ” in the “GRF Essay Contest” from Gravity Research Foundation
1996	“ <i>Luca Branca</i> ” Fellowship for Graduates in Astrophysics from “Sapienza” Università di Roma
1992	“ <i>Persico</i> ” Fellowship for Undergraduate Students in Physics from Accademia Nazionale dei Lincei

## Part VI - Research Grants

- Principal Investigator (**PI**) or Principal Investigator of a local node (**Local PI**):

2021-2025	H2020-MSCA-RISE Grant “ <i>Gravitational Universe: Challenges and Opportunities</i> ” - GRU <b>PI</b>	European Union	280.6 k€
2020	“Iniziativa Specifica” Grant TEONGRAV <b>PI</b>	INFN	35.5 k€
2019	“Iniziativa Specifica” Grant TEONGRAV <b>PI</b>	INFN	28.0 k€
2018-2019	Research Grant “ <i>Gravitational Wave sources</i> ” <b>PI</b>	“Sapienza” Università di Roma	15.0 k€
2018	“Iniziativa Specifica” Grant TEONGRAV <b>PI</b>	INFN	29.0 k€
2017	“Iniziativa Specifica” Grant TEONGRAV <b>PI</b>	INFN	26.5 k€
2016	“Iniziativa Specifica” Grant TEONGRAV <b>PI</b>	INFN	30.5 k€
2016-2019	H2020-MSCA-RISE Grant “ <i>Strong Gravity and High Energy Physics</i> ” - StronGrHEP <b>Local PI</b>	European Union	36.0 k€
2015	“Iniziativa Specifica” Grant TEONGRAV <b>PI</b>	INFN	32.0 k€
2014-2015	Research Grant “ <i>Gravitational Wave sources</i> ” <b>PI</b>	“Sapienza” Università di Roma	7.0 k€
2014	“Iniziativa Specifica” Grant TEONGRAV <b>PI</b>	INFN	20.5 k€
2013-2014	Research Grant “ <i>Gravitational Wave sources</i> ” <b>PI</b>	“Sapienza” Università di Roma	7.0 k€

2013-2014	Funding for a 2-year postdoctoral position <b>PI</b>	“Sapienza” Università di Roma & INFN Roma1	45.6 k€
2012-2013	Research Grant “ <i>Gravitational Wave sources</i> ” <b>PI</b>	“Sapienza” Università di Roma	8.0 k€
2012-2015	FP7-PEOPLE-IRSES Grant “ <i>Numerical Relativity and High Energy Physics</i> ” - NRHEP <b>Local PI</b>	European Union	23.1 k€
2011-2012	Research Grant “ <i>Gravitational Wave sources</i> ” <b>PI</b>	“Sapienza” Università di Roma	8.0 k€
2002-2003	Research Grant “Progetto Giovani Ricercatori” <b>PI</b>	Italian University Ministry	4.0 k€

- **Scientist in Charge:**

2015-2016	FP7-PEOPLE-IEF Grant (Marie Curie fellowship) “ <i>Gravity, fundamental physics and astrophysics: the missing link</i> ” - ASTROGRAPHY <b>Scientist in charge</b>	European Union	179.7 k€
2016	Research Grant for Outstanding Visiting Researchers <b>Scientist in charge</b>	“Sapienza” Università di Roma	5.0 k€

## **Part VII - Research Activity**

My research field is gravitational theory, which is an extremely diversified subject. During the years, I have been studying **gravity** under many different points of view.

### ◆ **1998 - 2001**

During my Ph.D. studies in Turin (under the supervision of Pietro Frè), my main interest has been **Supergravity**, which I have seen as a way to approach String Theory/M theory starting from General Relativity (GR). Indeed Supergravity (a low energy limit of String Theory/M theory) is the supersymmetric extension of GR, and incorporates all of its deeper successes, problems and issues. After an extensive study of four-dimensional maximal gauged supergravities, in which we pioneered the use of an “embedding tensor” to describe these theories, I focused on the **AdS/CFT correspondence**, a conjecture according to which it is

possible to describe the non-perturbative regime of conformal quantum theories in terms of a classical supergravity theory in a higher dimensional space-time. The main result of my Ph.D. studies has been the systematic analysis of a specific case of this correspondence, from the derivation of the supergravity theory to the construction of the dual conformal theory.

After the Ph.D., I was postdoc fellow at ULB (Bruxelles), working in the group of Marc Hennaux. In these years I have been studying **gravitational theory as a spin-two field theory**. Using gauge theory techniques like the Batalin-Vilkovisky formalism we found that GR is the only consistent and non-trivial interaction of massless spin-two fields. [This work](#) had a significant impact on the field, receiving more than 200 citations (ISI-WoS).

#### ◆ 2001 - 2005

In 2001 I moved to “Sapienza” Università di Roma as a postdoc fellow, joining the group of Valeria Ferrari on the study of **gravitational wave (GW) sources**. Ferrari (who had been working with S. Chandrasekhar, e.g. on the quasi-normal modes of compact stars) had an expertise in general relativity and in the phenomenology of gravitational waves. In these years I learned that gravitational waves can be a fundamental tool to study gravity, and - despite the fact that at that time GWs had not been observed yet - the importance of connecting theoretical studies with phenomenology.

In particular:

- We studied the **coalescence of neutron star binary systems** - one of the most promising sources for ground-based gravitational wave detectors - using an approximate model within spacetime perturbation theory.
- We gave a major contribution to the development of **gravitational wave asteroseismology**, a powerful tool to study the behaviour of matter at supranuclear density, through the detection (by GW experiments) of the quasi-normal modes of a neutron star. We considered different kinds of compact stars: neutron stars, quark matter stars, newly born proto-neutron stars.

#### ◆ 2006 - today

In 2006 I got a permanent position in “Sapienza”, first as a as a Research Scientist, then as an Associate Professor. I kept working in the [Rome group](#) of gravity theory and phenomenology, and developed other collaborations worldwide (in particular, I am an external collaborator of the [GRIT-CENTRA](#) group in Lisbon). Then, in 2022, I moved to University of Pisa, where I am now working as a Full Professor.

My research interests developed, based on my diverse experience in the PhD and postdoc years, into a general interest in the strong-field regime of gravity.

GWs are a powerful probe of strong-field gravity; their direct observation, started in 2015, provides new opportunities to study fundamental interactions: from gravity itself (testing GR against possible modifications), to nuclear physics (e.g. the elusive equation of state of neutron stars), to new fundamental fields and dark matter candidates which necessarily couple with the gravitational interaction. **In my research activity I try to address fundamental physics issues and problems using strong gravity and gravitational wave physics.** This necessarily involves several, different fields - from general relativity to GW phenomenology and data analysis, from astrophysics to cosmology, from nuclear physics to high-energy physics - employing different approaches (perturbation theory, post-Newtonian expansions, Numerical Relativity). Most importantly, this research activity requires both **theoretical and phenomenological** work.

Most of my work in these years belongs to two general lines of research:

(i) the study of neutron stars in GR, mainly to probe the equation of state of the matter in their inner core; (ii) the study of extensions and deviations of GR, using GWs from single and binary black holes to test gravity in the strong-field regime.

### (i) Neutron stars in GR

- We studied the **coalescence of neutron star binary systems**, focussing on the tidal deformation of the stars in the last stages of the inspiral, which affects the GW emission and can be used to probe the neutron star equation of state.
- We kept studying **gravitational wave asteroseismology**, studying the oscillations of neutron stars (also taking into account superfluidity), quark stars, newly born proto-neutron stars, but also black holes. We also developed data analysis approaches to study the ringdown signal at the end of a compact binary coalescence.
- We studied how a single, **deformed neutron star** can emit GWs detectable by ground-based interferometers. We have modelled the deformations due to the strong magnetic field expected to be present in young neutron stars, and the corresponding GW emission; our results have been used in the data analysis from LIGO-Virgo.

### (ii) Extensions and deviations of GR

- We studied the phenomenological consequences of **scalar-tensor theories**, in which gravity is coupled to scalar fields, possibly through bilinear terms in the curvature tensor; these theories belong to the class of Horndesky gravity theories (which are equivalent to Galileon theories). To this aim, we used different approaches, from post-Newtonian expansions, to perturbation theory, to fully non-linear numerical relativity simulations.
- We studied the possible astrophysical and GW signature of **ultra-light scalar/vector/pseudoscalar fields** (such as e.g. the axion-like particles), which are potential **dark matter candidates**. These fields may originate in the so-called "string axiverse" scenario, and are coupled with the other fields only (or mainly) through the gravitational interaction; thus, their existence may be revealed (or excluded) by studying strong gravity phenomena.
- We studied the possibility of modifications of the black hole structure due to **quantum gravity corrections**, which may be observable by next-generation GW detectors.
- We studied **gravity in higher dimensions**, and in particular the so-called "brane-world" scenario, in which our four-dimensional space-time is embedded in a higher-dimensional space; this model predicted the formation of mini-black holes in LHC, and has been tested (and mostly disproved) by LHC in recent years; our works, in which we pioneered the application of the techniques of numerical relativity to model the black hole generation, have been used in the event generators for the LHC data analysis. More recently, we studied perturbations of the Kerr brane in higher dimensions and the tidal deformations of higher-dimensional black holes.

In these years I have written some reviews on topics where I had given a significant contribution with my research work:

- [\*Testing general relativity with present and future astrophysical observations\*](#), Berti *et al.*, CQG 2015. It is an extensive review of GR tests from astrophysical observations, which is now one of the main resources on this topic (it is among the "Highly-Cited Papers", receiving over 600 citations in few years, on ISI-WoS). There are several authors but, since I was one of the main contributors, I am in the first block of the author list.
- [\*Gravitational waves from single neutron stars: an advanced detector era survey\*](#), Glampedakis & Gualtieri 2018. A review on single (non necessary isolated) as GW sources, including the different emission mechanism (deformations, oscillations, glitches).
- [\*Testing the black hole no-hair hypothesis\*](#), Cardoso & Gualtieri, CQG 2016. A general review on the no-hair hypothesis and its theoretical and phenomenological aspects.

- [\*Exploring new physics frontiers through numerical relativity\*](#), Cardoso, Herdeiro, Sperhake, Gualtieri, Liv. Rev. Rel. 2015. A review of the applications of numerical relativity techniques to study high-energy physics.
- [\*Quasi-normal modes and gravitational wave astronomy\*](#), Ferrari & Gualtieri, GRG 2008. An extensive review on the theory and phenomenology of quasi-normal modes of neutron stars and black holes.

The complete list of my publications can be found e.g. in my Google Scholar profile webpage, <http://scholar.google.it/citations?hl=en&user=-wWP-tUAAAAJ>

I presently have active collaborations with - but not limited to - world-leading experts as: Vitor Cardoso (Lisbon, Portugal), leader of the GRIT-CENTRA group of IST-Lisbon, Portugal; Luciano Rezzolla (Frankfurt, Germany), leader of the Numerical Relativity group of Frankfurt, Germany; Emanuele Berti (Johns Hopkins Univ., U.S.), Nicolas Yunes (Illinois Univ. at Urbana-Champaign, U.S.), experts in black hole perturbation theory; Frans Pretorius (Princeton, U.S.), Ulrich Sperhake (Cambridge, U.K.) and Helvi Witek (Illinois Univ. at Urbana-Champaign, U.S.), experts in numerical relativity; José A. Pons and Juan A. Miralles (Alicante, Spain), experts in neutron star physics; Carlos Herdeiro (Lisbon, Portugal) and Akihiro Ishibashi (Osaka, Japan), experts in black holes and high-energy physics; Omar Benhar (Rome), Fiorella Burgio and Hans-Josef Schultze (Catania), Mikhail Gusakov and Elena Kantor (S. Petersburg, Russia), experts in physics of nuclear matter.

I am the Principal Investigator of a project funded by the European Union (280.6 k€) involving a network of Universities and Research Institutions (the Universities of Roma “Sapienza”, Lisbon, Rikkyo (Japan), John Hopkins (US), together with Caltech in U.S., the Perimeter Institute in Canada, SISSA in Italy and the CNRS in France), with the aim of developing theoretical models of gravitational wave sources and data-analysis algorithms.

I have also been invited to ~30 national and international conferences, to present the results of my research activity and to give review talks.

## Part VIII - Summary of Scientific Achievements

Articles on ISI Journals	111
Total Hirsch number (WoS/SPIRES/Google Scholar)	43/48/51
Total number of citations (WoS/SPIRES/Google Scholar)	6246/8056/9058

Only 8 of my publications are co-authored with my Ph.D. supervisor (Pietro Frè), and 44 of them are co-authored with my Master Thesis supervisor (Valeria Ferrari). Most of my publications appeared in Phys. Rev. D (IF 4.380); eight of them appeared in Phys. Rev. Lett. (IF 8.385), one in Liv. Rev. Rel. (IF 23.333) and one in Nature Astronomy (IF 14.437).

## Part IX - Other activities

- Coordination and organization activities at Teaching & Research Institutions

2014- National coordinator of the INFN Specific Initiative “TEONGRAV”, which includes the  
2020 Italian community studying the theory and phenomenology of gravitational waves

From Member of the organizing committee of the yearly Ph.D. School “Astroparticle Physics,  
2017 Cosmology and Gravitation” for the Galileo Galilei Institute (GGI) of Florence

2016- Convener of the working group “*Gravitational Waves*” for the “What Next”  
2017 initiative of INFN

2014- Topic Leader for “*Gravitational Wave Emission from Individual Stars*”  
2016 in the NewCompStar COST Research Newtorking Programme

- Coordination/participation to research groups

2021- Coordinator of the H2020-MSCA-RISE Network “*Gravitational Universe: Challenges*  
2025 *and Opportunities*” (GRU)

From Coordinator of the “[Gravity theory and phenomenology](#)” group at Dipartimento di Fisica,  
2019 “Sapienza” Università di Roma

2016- Coordinator of the “Roma Sapienza” node of the H2020-MSCA-RISE Network  
2019 “[StronGrHEP](#)”

2014- Topic Leader for “*Gravitational Wave Emission from Individual Stars*”  
2016 in the NewCompStar COST Research Newtorking Programme

2012- Coordinator of the “Roma Sapienza” node of the FP7-PEOPLE-IRSES Network  
2015 “NRHEP”

From Member of the “[GRIT - Gravitation in Técnico](#)” group at CENTRA - Instituto Superior  
2008 Técnico - University of Lisbon

2001- Member of the “[Gravity theory and phenomenology](#)” group at Dipartimento di Fisica,  
2019 “Sapienza” Università di Roma

- Scientific Adviser

Referee for the following International Journals: Physical Review Letters, Physical Review D, Journal of High Energy Physics, The Astrophysical Journal, Monthly Notices of the Royal Astronomical Society, Classical and Quantum Gravity, General Relativity and Gravitation, Physica Scripta.

Referee for fellowships and grants for INFN (Italy), Conseil Regional Ile de France (France), FNRS (Belgium), NKFI (Poland).

External referee for the Ph.D. theses of Helvi Witek at IST, Lisbon (Portugal), 2012; Antonio Pili, Università di Firenze, 2017; Elena De Paoli, Università di Roma 3/Aix-Marseille Université, 2020; Antonio Figura, Wei Jibao at Università di Catania, 2021; Alexandru Dima, SISSA, 2021.



- Committees and boards

2021	Member of the Committee to select an Associate Professor in Theoretical Physics at “Sapienza” Università di Roma
From 2018	Member of the Board of the Italian General Relativity Society (SIGRAV)
2018	Member of the “Research and 3 <sup>rd</sup> Mission” committee of the Physics Department at “Sapienza” Università di Roma
From 2017	Member of the organizing committee of the “ <i>Ph.D. School of Astroparticle Physics, Cosmology and Gravitation</i> ” at the Galileo Galilei Institute, INFN, Firenze
2015	Convener of the working group “ <i>Gravitational Waves</i> ” for the “What Next” initiative of INFN
2015	Member of the defence committee for the Astrophysics Ph.D. at “Sapienza” Università di Roma
2012	Member of the committee to select the candidates for the Physics Ph.D. at “Sapienza” Università di Roma
From 2009	Member of the Physics Ph.D. Board at “Sapienza” Università di Roma
From 2006	Member of several committees to assign research and teaching fellowships at the Physics Department of “Sapienza” Università di Roma
2000-2001	Member of the Board of the Italian Ph.D. Students and Postdocs Association

- Member of the Organising Committees of the following International Conferences in the last ten years

2022	<i>Theoretical Aspects of Astroparticle Physics, Cosmology and Gravitation</i>	Firenze	14/3-25/3
2021	<i>23<sup>th</sup> SIGRAV Conference</i>	Urbino	7/9-9/9
2021	<i>Theoretical Aspects of Astroparticle Physics, Cosmology and Gravitation</i>	Firenze	15/3-26/3
2020	<i>SIGRAV International School 2020</i>	Vietri sul Mare	3/2-7/2
2019	<i>22<sup>th</sup> International Conference of General Relativity and Gravitation (GR22)</i>	Valencia, Spain	7/7-12/7
2019	<i>Theoretical Aspects of Astroparticle Physics, Cosmology and Gravitation</i>	Firenze	11/3-22/3
2019	<i>1<sup>st</sup> European Physical Society Conference on Gravitation</i>	Roma	19/2-21/2
2017	“ <i>Strong Gravity Universe</i> ”	São Miguel, Portugal	3/7-7/7
2017	“ <i>New Frontiers of Gravitational-Wave Astrophysics</i> ”	Roma	19/6-22/6

2015	“4 <sup>th</sup> NRHEP Network Meeting”	Roma	7/7 - 10/7
2013	VESF School “Gravitational waves, neutrinos and multi-wavelength observations”	Monte Porzio, Roma	15/4 - 18/4
2013	“Strong Gravity Beyond General Relativity”	Lisbon, Portugal	5/3 - 8/3

- Invited speaker at the following International Conferences and PhD Schools in the last ten years:

2022	<i>Theoretical Aspects of Astroparticle Physics, Cosmology and Gravitation</i>	Firenze	14/3-25/3
2021	<i>SIGRAV School 2021: Gravity of compact astrophysical objects and gravitational waves</i>	Vietri sul Mare, Salerno	1/2-5/2
2019	<i>PHAROS 2019: The multimessenger physics and astrophysics of neutron stars</i>	Platja D’Aro (Spain)	22/4-26/4
2019	<i>GWEOS 2019: Constraining the EOS of matter at extreme densities with GW observations</i>	Pisa	25/2-26/2
2019	<i>Athens 2019: Gravitational Waves and Fundamental Physics</i>	Athens (Greece)	21/1-24/1
2018	<i>23<sup>th</sup> SIGRAV Conference on General Relativity and Gravitational Waves</i>	S. Margherita di Pula (Cagliari)	9/9-15/9
2018	<i>Gravity @ Malta 2018</i>	La Valletta (Malta)	22/1-25/1
2016	<i>22<sup>th</sup> SIGRAV Conference on General Relativity and Gravitational Waves</i>	Cefalù, Palermo	12/9-18/9
2016	<i>What Next 2016</i>	Roma	16/2-17/2
2015	<i>Annual NewCompStar Conference 2015</i>	Budapest (Hungary)	15/6-19/6
2013	VESF School “Gravitational waves, neutrinos and multi-wavelength observations”	Monte Porzio, Roma	15/4 - 18/4
2015	<i>One Hundred Years of Strong Gravity</i>	Lisbon (Portugal)	12/6-15/6
2014	<i>NewCompstar WG3 Meeting</i>	Lyon (France)	17/11-19/11
2014	<i>21<sup>th</sup> SIGRAV Conference on General Relativity and Gravitational Waves</i>	Alessandria	15/9-19/9
2014	<i>Gravitational Physics in the Next 20 Years</i>	Napoli	2/4

Roma, 2/12/2022

Leonardo Gualtieri

