

Curriculum Vitae et Studiorum

Gianluca Calcagni

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Name: GIANLUCA CALCAGNI

Born: Venice (Italy), September 10th, 1977

Institution:

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Present Position

Ramón y Cajal tenure-track, from end of 2017 changing to Senior Scientist (*Científico Titular*; equivalent to the tenured rank of Associate Professor).

Education

- Laurea (Degree + Master) in Physics, Padua University, Italy, June 7th, 2001. Title: *Inflation and non-Gaussian fluctuations in the Cosmic Microwave Background*. Advisor: Prof. Sabino Matarrese.
- PhD Degree in Physics, Parma University, Italy, March 2nd, 2005. Title: *Braneworld cosmology and noncommutative inflation*. Advisor: Prof. Luca Griguolo. Homologation at the Complutense University of Madrid, Spain, 2013.
- Attended graduate and post-graduate schools: ► 10th Summer School in Theoretical Physics, Parma, Italy, 3-14/09/2001, “Standard Model, Conformal Theories, String Theory and Extra Dimensions”. ► Introductory School on String Theory, ICTP, Trieste, Italy, 3-14/06/2002. ► 8th Summer Institute at Gran Sasso National Laboratory, Assergi, Italy, 7-19/07/2002, “New Dimensions in Astroparticle Physics”. ► 11th Summer School in Theoretical Physics, Parma, Italy, 2-13/09/2002, “Computer Physics”. ► RTN Winter School on Strings, Supergravity and Gauge Theory, Turin, Italy, 7-11/01/2003. ► Spring School on Superstring Theory and Related Topics, ICTP, Trieste, Italy, 31/03-8/04/2003. ► School on Mathematics in String and Field Theory, ICTP, Trieste, Italy, 2-12/06/2003. ► 12th Summer School in Theoretical Physics, Parma, Italy, 2-12/09/2003, “Standard Model, Supersymmetry and Matrix Models”. ► Cargèse Summer School 2004, NATO Advanced Study Institute, Cargèse, France, 7-19/06/2004, “String Theory: From Gauge Interactions to Cosmology” (*invited participant*). ► 13th Summer

School in Theoretical Physics, Parma, Italy, 30/08-10/09/2004, “Cosmology and Gravitational Waves”. ► RTN Winter School on Strings, Supergravity and Gauge Theories, CERN, Geneva, Switzerland, 16-20/01/2006. ► Universenet Annual School on The Origin of the Universe, Mytilene, Greece, 24-29/09/2007. ► First TRR33 Winter school, Passo del Tonale, Italy, 2-8/12/2007. ► Sixth Aegean Summer School on “Quantum Gravity and Quantum Cosmology”, Chora, Greece, 12-17/09/2011 (*organizer*). ► Sixth International School on “Field Theory and Gravitation”, Petrópolis, Brazil, 23-27/04/2012 (*plenary speaker*).

- Undergraduate student in Psychology, UNED, Madrid, Spain.

Academic Qualifications

- “Maître de conférences” [Assistant Professor] (n. 08229191227) in section 29 “Constituants élémentaires” [Fundamental constituents] of the National Council of Universities (Conseil National des Universités, CNU), France, February 8th, 2008.
- “Professeur des universités” [**Full Professor**] (n. PR-2011-29-11129217870) in section 29 “Constituants élémentaires” [Fundamental constituents] of the National Council of Universities (Conseil National des Universités, CNU), France, February 4th, 2011.
- National Scientific Qualification as “Professore di seconda fascia” [Associate Professor] (n. 16584) in sector 02/A2 “Fisica teorica delle interazioni fondamentali” [Theoretical physics of fundamental interactions] of the Ministry of Education and Research, Italy, November 28th, 2013.
- National Scientific Qualification as “Professore di prima fascia” [**Full Professor**] (n. 16578) in sector 02/A2 “Fisica teorica delle interazioni fondamentali” [Theoretical physics of fundamental interactions] of the Ministry of Education and Research, Italy, November 28th, 2013.
- I3 Certificate (Programa de Incentivación de la Incorporación e Intensificación de la Actividad Investigadora), National Agency for Research (Agencia Estatal de Investigación), Spain, December 15th, 2016.

Postdoctoral Fellowships and Professorships

- March 2005 – July 2005: *JSPS Fellowship*, Gunma National College of Technology, Gunma, Japan.
- August 2005 – February 2006: *Angelo della Riccia Fellowship*, Department of Physics and Astronomy, University of Sussex, Brighton, UK.
- March 2006 – February 2008: *Marie Curie Intra-European Fellowship*, Department of Physics and Astronomy, University of Sussex, Brighton, UK.
- March 2008 – August 2009: Postdoctoral fellow, Institute for Gravitation and the Cosmos, Penn State University, PA.
- September 2009 – August 2011: Advanced Postdoc Fellowship (*Senior Researcher*), Max Planck Institute for Gravitational Physics (Albert Einstein Institute), Golm (Potsdam), Germany.
- September 2011 – August 2012: **Assistant Professor**, Max Planck Institute for Gravitational Physics (Albert Einstein Institute), Golm (Potsdam), Germany.

Funding ID

Awarded grants as principal investigator

- January 2013 – December 2014: *i-Link+ 2012 Program*, network collaboration between IEM-CSIC (Madrid, Spain), Tokyo University of Science (Japan) and Fudan University (Shanghai,

China). Project title (ID): *Cosmology of Quantum Gravity Models* (iLink0484). Funding institution: CSIC (Consejo Superior de Investigaciones Científicas), Spain. Budget (without overhead): €30,000. Number of participants: 8 researchers, 3 institutions.

- January 2015 – December 2017: *I+D Project* (co-PI) at IEM-CSIC (Madrid, Spain). Project title (ID): *Gravity and the Quantum Universe: Loop Cosmology, Black Holes and Fractals* (FIS2014-54800-C2-2-P). Funding institution: Ministry of Economy and Competitiveness, Spain. Budget (excluding overhead): €32,000. Number of participants: 7 researchers, 5 institutions.

Awarded grants as single investigator

- January 2002 – December 2003: *Young Researchers and Single Researchers Grant*, Parma University, Italy. Project title: *Braneworld Cosmology*. Funding institution: INFN (Istituto Nazionale di Fisica Nucleare), Italy. Budget: €2,000.
- March 2005 – July 2005: *JSPS Fellowship*, Gunma National College of Technology, Gunma, Japan. Project title (ID): *String and Braneworld Cosmology* (PE04076). Funding institution: JSPS (Japan Society for the Promotion of Science), Japan. Budget: ¥2M (€15,000).
- August 2005 – February 2006: *Angelo della Riccia Fellowship* (AY 2004-2005), Department of Physics and Astronomy, University of Sussex, Brighton, UK. Project title: *Particle Physics Models of the Early Universe and Observational Constraints from the Cosmic Background Radiation*. Funding institution: Fondazione Angelo della Riccia, Italy. Budget: €9,000.
- March 2006 – February 2008: *Marie Curie Intra-European Fellowship*, Department of Physics and Astronomy, University of Sussex, Brighton, UK. Project title (contract n.): *EU-CosMO: Early-Universe Cosmological Models with Observations* (MEIF-CT-2006-024523). Funding institution: European Commission (FP6). Budget: €160,000.
- September 2012 – August 2017: *Ramón y Cajal* contract (RYC-2011-09009), IEM-CSIC, Madrid, Spain. Project title: *Foundations, Cosmology and Experimental Signatures of Quantum Gravity Models*. Funding institution: Ministry of Economy and Competitiveness, Spain. Budget: €183,600.
- September 2012 – August 2014: start-up research grant Ramón y Cajal. Funding institution: Ministry of Economy and Competitiveness, Spain. Budget: €15,000.

Grants as collaborating investigator

- ▶ “Models and Applications of Loop Quantum Gravity” (NSF grant PHY-0653127); PI: Martin Bojowald; grant duration: 1/06/2007-31/05/2008.
- ▶ “Theoretical Investigations in Classical and Quantum Gravity” (NSF grant PHY-0854743); PI: Abhay Ashtekar; grant duration: 1/01/2008-31/12/2009.
- ▶ “Effective Descriptions of Quantum Systems in Cosmology” (NSF grant PHY-0748336); PI: Martin Bojowald; grant duration: 1/01/2008-31/05/2012; number of participants: 15.
- ▶ “Foundational Questions in Cosmology and Quantum Gravity” (FQXi grant RFP2-08-01); PI: Martin Bojowald; grant duration: 1/09/2008-31/08/2009.
- ▶ “Quantising Gravity: New Insights into the Fundamental Nature of Space and Time and the Early Universe” (Sofja Kovalevskaja Award); PI: Daniele Oriti; grant duration: 1/01/2009-31/12/2013; number of participants: 20.
- ▶ “Cosmology and Astrophysics Network for Theoretical Advances and Training Actions (CAN-TATA)” (COST Action CA15117); PI: Ruth Lazkoz; grant duration: 8/04/2016-7/04/2020; number of participants: ~ 120.

Ongoing Grant Applications

November 2016: *ERC Consolidator Grant*. Funding institution: European Research Council (FP7). Budget: €2M. Role: Principal Investigator.

Research Topics in Physics

- *Present*: Development of consistent multi-scale theories of fields and gravity, their cosmology and phenomenology; multi-fractal geometry and quantum gravity; non-local dynamics in M-theory and quantum gravity, and its cosmology; big bang problem; cosmology of the early universe and inflation; cosmological constant problem; group field theory and its cosmology.
- *Past*: Braneworld and non-commutative cosmology; modified gravity models; dark energy in string gravity; loop quantum gravity and cosmology; string field theory and tachyon condensation; computation of the spectral dimension in various frameworks, including string theory, asymptotic safety, black holes, spin foams, loop quantum gravity.

Research Topics in Psychology

Associative mathematical models in Pavlovian conditioning and their description in terms of fractal geometry; associative models of post-conditioning.

Scientific Publications

I published **2 books** with Springer and **84 papers** (32 as a single author) in international journals of highly-ranked impact factor in physics (such as Phys. Rev. Lett., Phys. Rev. D, JHEP, JCAP, Nucl. Phys. B, Class. Quantum Grav.) and mathematical physics (Adv. Theor. Math. Phys., J. Math. Phys., Phys. Rev. E, SIGMA, J. Phys. A), for a total of 68 publications in the first quartile, about **3,050 citations** and an **h-index 33** (inspirehep.net database). 22 of these papers have more than 50 citations each. I worked on:

- Braneworld and noncommutative cosmology and effective string cosmologies [1–11, 13, 62, 80, 81] (15 published articles, 19% of the total published production).
- String field theory [12, 17, 20, 26, 30, 61, 67] and nonlocal theories of matter and gravity [16, 19, 27, 33, 57] (12 articles, 15%).
- Loop quantum cosmology and loop quantum gravity [15, 21–24, 34, 35, 37, 40, 43, 49, 50, 63, 66, 69, 82] (16 articles, 20%).
- Other theories of quantum gravity and related cosmology [14, 18, 25, 28, 29, 44, 46, 51, 54, 59, 63–65, 68, 69, 74, 77, 84] (18 articles, 22%), including major contributions to models such as Horava–Lifshitz gravity and to the understanding of the change of spacetime dimensionality in quantum gravity.
- Fractal, multiscale and multifractional spacetimes [31, 32, 36, 38, 39, 41, 42, 45, 47, 48, 51–53, 55, 56, 58, 60, 70–73, 75–79, 83] (27 articles, 32%), a research trend I initiated in 2010.

A book on multi-scale theories will be published by Imperial College Press / World Scientific in 2017.

Peer-reviewed articles

Q indicates the quartile of the journal (best between Journal Citation Report and Scopus; unavailable rankings Q* are extrapolated from contiguous year). Single-authored papers are underlined; authors order is always alphabetical.

- [1] G. Calcagni, *Consistency equations in Randall-Sundrum cosmology: a test for braneworld inflation*, JCAP **0311**, 009 (2003) [[arXiv:hep-ph/0310304](#)] [[INSPIRE-HEP](#)] (**Q1**).
- [2] G. Calcagni, *Degeneracy of consistency equations in braneworld inflation*, JCAP **0406**, 002 (2004) [[arXiv:hep-ph/0312246](#)] [[INSPIRE-HEP](#)] (**Q1**).
- [3] G. Calcagni, *Slow-roll parameters in braneworld cosmologies*, Phys. Rev. D **69**, 103508 (2004) [[arXiv:hep-ph/0402126](#)] [[INSPIRE-HEP](#)] (**Q1**).

- [4] G. Calcagni, *Noncommutative models in patch cosmology*, *Phys. Rev. D* **70**, 103525 (2004) [[arXiv:hep-th/0406006](#)] [[INSPIRE-HEP](#)] (Q1).
- [5] G. Calcagni, *Consistency relations and degeneracies in (non)commutative patch inflation*, *Phys. Lett. B* **606**, 177 (2005) [[arXiv:hep-ph/0406057](#)] [[INSPIRE-HEP](#)] (Q1).
- [6] G. Calcagni, S. Tsujikawa, *Observational constraints on patch inflation in noncommutative spacetime*, *Phys. Rev. D* **70**, 103514 (2004) [[arXiv:astro-ph/0407543](#)] [[INSPIRE-HEP](#)] (Q1).
- [7] G. Calcagni, *Patch dualities and remarks on nonstandard cosmologies*, *Phys. Rev. D* **71**, 023511 (2005) [[arXiv:gr-qc/0410027](#)] [[INSPIRE-HEP](#)] (Q1).
- [8] G. Calcagni, *Non-Gaussianity in braneworld and tachyon inflation*, *JCAP* **0510**, 009 (2005) [[arXiv:astro-ph/0411773](#)] [[INSPIRE-HEP](#)] (Q1).
- [9] G. Calcagni, S. Tsujikawa, M. Sami, *Dark energy and cosmological solutions in second-order string gravity*, *Class. Quantum Grav.* **22**, 3977 (2005) [[arXiv:hep-th/0505193](#)] [[INSPIRE-HEP](#)] (Q1).
- [10] G. Calcagni, A.R. Liddle, E. Ramírez, *Flow equations in generalized braneworld scenarios*, *Phys. Rev. D* **72**, 043513 (2005) [[arXiv:astro-ph/0506558](#)] [[INSPIRE-HEP](#)] (Q1).
- [11] G. Calcagni, *de Sitter thermodynamics and the braneworld*, *JHEP* **0509**, 060 (2005) [[arXiv:hep-th/0507125](#)] [[INSPIRE-HEP](#)] (Q1).
- [12] G. Calcagni, *Cosmological tachyon from cubic string field theory*, *JHEP* **0605**, 012 (2006) [[arXiv:hep-th/0512259](#)] [[INSPIRE-HEP](#)] (Q1).
- [13] G. Calcagni, B. de Carlos, A. De Felice, *Ghost conditions for Gauss–Bonnet cosmologies*, *Nucl. Phys. B* **752**, 404 (2006) [[arXiv:hep-th/0604201](#)] [[INSPIRE-HEP](#)] (Q1).
- [14] G. Calcagni, A.R. Liddle, *Tachyon dark energy models: dynamics and constraints*, *Phys. Rev. D* **74**, 043528 (2006) [[arXiv:astro-ph/0606003](#)] [[INSPIRE-HEP](#)] (Q1).
- [15] G. Calcagni, M. Cortês, *Inflationary scalar spectrum in loop quantum cosmology*, *Class. Quantum Grav.* **24**, 829 (2007) [[arXiv:gr-qc/0607059](#)] [[INSPIRE-HEP](#)] (Q1).
- [16] G. Calcagni, M. Montobbio, G. Nardelli, *Route to nonlocal cosmology*, *Phys. Rev. D* **76**, 126001 (2007) [[arXiv:0705.3043](#)] [[INSPIRE-HEP](#)] (Q1).
- [17] G. Calcagni, G. Nardelli, *Tachyon solutions in boundary and cubic string field theory*, *Phys. Rev. D* **78**, 126010 (2008) [[arXiv:0708.0366](#)] [[INSPIRE-HEP](#)] (Q1).
- [18] G. Calcagni, A.R. Liddle, *Stability of multi-field cosmological solutions*, *Phys. Rev. D* **77**, 023522 (2008) [[arXiv:0711.3360](#)] [[INSPIRE-HEP](#)] (Q1).
- [19] G. Calcagni, M. Montobbio, G. Nardelli, *Localization of nonlocal theories*, *Phys. Lett. B* **662**, 285 (2008) [[arXiv:0712.2237](#)] [[INSPIRE-HEP](#)] (Q1).
- [20] G. Calcagni, G. Nardelli, *Nonlocal instantons and solitons in string models*, *Phys. Lett. B* **669**, 102 (2008) [[arXiv:0802.4395](#)] [[INSPIRE-HEP](#)] (Q1).
- [21] S.H.S. Alexander, G. Calcagni, *Quantum gravity as a Fermi liquid*, *Found. Phys.* **38**, 1148 (2008) [[arXiv:0807.0225](#)] [[INSPIRE-HEP](#)] (invited submission) (Q3).
- [22] S.H.S. Alexander, G. Calcagni, *Superconducting loop quantum gravity and the cosmological constant*, *Phys. Lett. B* **672**, 386 (2009) [[arXiv:0806.4382](#)] [[INSPIRE-HEP](#)] (Q1).
- [23] G. Calcagni, G.M. Hossain, *Loop quantum cosmology and tensor perturbations in the early universe*, *Adv. Sci. Lett.* **2**, 184 (2009) [[arXiv:0810.4330](#)] [[INSPIRE-HEP](#)] (invited research paper) (Q2*).

- [24] G. Calcagni, S. Mercuri, *Barbero–Immirzi field in canonical formalism of pure gravity*, *Phys. Rev. D* **79**, 084004 (2009) [[arXiv:0902.0957](#)] [[INSPIRE-HEP](#)] (Q1).
- [25] G. Calcagni, *Cosmology of the Lifshitz universe*, *JHEP* **0909**, 112 (2009) [[arXiv:0904.0829](#)] [[INSPIRE-HEP](#)] (**Top Cite 2009**) (Q1).
- [26] G. Calcagni, G. Nardelli, *Kinks of open superstring field theory*, *Nucl. Phys. B* **823**, 234 (2009) [[arXiv:0904.3744](#)] [[INSPIRE-HEP](#)] (Q1).
- [27] G. Calcagni, G. Nardelli, *Cosmological rolling solutions of nonlocal theories*, *Int. J. Mod. Phys. D* **19**, 329 (2010) [[arXiv:0904.4245](#)] [[INSPIRE-HEP](#)] (Q3).
- [28] G. Calcagni, *Detailed balance in Hořava–Lifshitz gravity*, *Phys. Rev. D* **81**, 044006 (2010) [[arXiv:0905.3740](#)] [[INSPIRE-HEP](#)] (Q1).
- [29] S. Alexander, T. Biswas, G. Calcagni, *Cosmological Bardeen–Cooper–Schrieffer condensate as dark energy*, *Phys. Rev. D* **81**, 043511 (2010); Erratum-ibid. *D* **81**, 069902(E) (2010) [[arXiv:0906.5161](#)] [[INSPIRE-HEP](#)] (Q1).
- [30] G. Calcagni, G. Nardelli, *String theory as a diffusing system*, *JHEP* **1002**, 093 (2010) [[arXiv:0910.2160](#)] [[INSPIRE-HEP](#)] (Q1).
- [31] G. Calcagni, *Fractal universe and quantum gravity*, *Phys. Rev. Lett.* **104**, 251301 (2010) [[arXiv:0912.3142](#)] [[INSPIRE-HEP](#)] (**Editor’s Suggestion**) (Q1).
- [32] G. Calcagni, *Quantum field theory, gravity and cosmology in a fractal universe*, *JHEP* **1003**, 120 (2010) [[arXiv:1001.0571](#)] [[INSPIRE-HEP](#)] (Q1).
- [33] G. Calcagni, G. Nardelli, *Nonlocal gravity and the diffusion equation*, *Phys. Rev. D* **82**, 123518 (2010) [[arXiv:1004.5144](#)] [[INSPIRE-HEP](#)] (Q1).
- [34] M. Bojowald, G. Calcagni, *Inflationary observables in loop quantum cosmology*, *JCAP* **1103**, 032 (2011) [[arXiv:1011.2779](#)] [[INSPIRE-HEP](#)] (Q1).
- [35] G. Calcagni, S. Gielen, D. Oriti, *Two-point functions in (loop) quantum cosmology*, *Class. Quantum Grav.* **28**, 125014 (2011) [[arXiv:1011.4290](#)] [[INSPIRE-HEP](#)] (Q1).
- [36] G. Calcagni, *Gravity on a multifractal*, *Phys. Lett. B* **697**, 251 (2011) [[arXiv:1012.1244](#)] [[INSPIRE-HEP](#)] (Q1).
- [37] M. Bojowald, G. Calcagni, S. Tsujikawa, *Observational constraints on loop quantum cosmology*, *Phys. Rev. Lett.* **107**, 211302 (2011) [[arXiv:1101.5391](#)] [[INSPIRE-HEP](#)] (Q1).
- [38] G. Calcagni, *Discrete to continuum transition in multifractal spacetimes*, *Phys. Rev. D* **84**, 061501(R) (2011) [[arXiv:1106.0295](#)] [[INSPIRE-HEP](#)] (**Rapid Communication**) (Q1).
- [39] G. Calcagni, *Geometry of fractional spaces*, *Adv. Theor. Math. Phys.* **16**, 549 (2012) [[arXiv:1106.5787](#)] [[INSPIRE-HEP](#)] (Q1).
- [40] M. Bojowald, G. Calcagni, S. Tsujikawa, *Observational test of inflation in loop quantum cosmology*, *JCAP* **1111**, 046 (2011) [[arXiv:1107.1540](#)] [[INSPIRE-HEP](#)] (Q1).
- [41] G. Calcagni, *Geometry and field theory in multi-fractional spacetime*, *JHEP* **1201**, 065 (2012) [[arXiv:1107.5041](#)] [[INSPIRE-HEP](#)] (Q1).
- [42] M. Arzano, G. Calcagni, D. Oriti, M. Scalisi, *Fractional and noncommutative spacetimes*, *Phys. Rev. D* **84**, 125002 (2011) [[arXiv:1107.5308](#)] [[INSPIRE-HEP](#)] (Q1).
- [43] K. Banerjee, G. Calcagni, M. Martín-Benito, *Introduction to loop quantum cosmology*, *SIGMA* **8**, 016 (2012) [[arXiv:1109.6801](#)] [[INSPIRE-HEP](#)] (**invited review**) (Q2).

- [44] G. Calcagni, S. Gielen, D. Oriti, *Group field cosmology: a cosmological field theory of quantum geometry*, *Class. Quantum Grav.* **29**, 105005 (2012) [[arXiv:1201.4151](#)] [[INSPIRE-HEP](#)] (invited submission) (Q1).
- [45] G. Calcagni, G. Nardelli, *Momentum transforms and Laplacians in fractional spaces*, *Adv. Theor. Math. Phys.* **16**, 1315 (2012) [[arXiv:1202.5383](#)] [[INSPIRE-HEP](#)] (Q1).
- [46] G. Calcagni, *Diffusion in quantum geometry*, *Phys. Rev. D* **86**, 044021 (2012) [[arXiv:1204.2550](#)] [[INSPIRE-HEP](#)] (Q1).
- [47] G. Calcagni, *Diffusion in multiscale spacetimes*, *Phys. Rev. E* **87**, 012123 (2013) [[arXiv:1205.5046](#)] [[INSPIRE-HEP](#)] (Q1).
- [48] G. Calcagni, G. Nardelli, M. Scalisi, *Quantum mechanics in fractional and other anomalous spacetimes*, *J. Math. Phys.* **53**, 102110 (2012) [[arXiv:1207.4473](#)] [[INSPIRE-HEP](#)] (Q2).
- [49] G. Calcagni, D. Oriti, J. Thürigen, *Laplacians on discrete and quantum geometries*, *Class. Quantum Grav.* **30**, 125006 (2013) [[arXiv:1208.0354](#)] [[INSPIRE-HEP](#)] (Q1).
- [50] G. Calcagni, *Observational effects from quantum cosmology*, *Ann. Phys. (Berlin)* **525**, 323 (2013); *Erratum 2013* [[arXiv:1209.0473](#)] [[INSPIRE-HEP](#)] (invited research and review paper) (Q2).
- [51] G. Calcagni, *Multi-fractional spacetimes, asymptotic safety and Hořava–Lifshitz gravity*, *Int. J. Mod. Phys. A* **28**, 1350092 (2013) [[arXiv:1209.4376](#)] [[INSPIRE-HEP](#)] (Q3).
- [52] G. Calcagni, G. Nardelli, *Symmetries and propagator in multifractional scalar field theory*, *Phys. Rev. D* **87**, 085008 (2013) [[arXiv:1210.2754](#)] [[INSPIRE-HEP](#)] (Q1).
- [53] G. Calcagni, G. Nardelli, *Spectral dimension and diffusion in multiscale spacetimes*, *Phys. Rev. D* **88**, 124025 (2013) [[arXiv:1304.2709](#)] [[INSPIRE-HEP](#)] (Q1).
- [54] G. Calcagni, A. Eichhorn, F. Saueressig, *Probing the quantum nature of spacetime by diffusion*, *Phys. Rev. D* **87**, 124028 (2013) [[arXiv:1304.7247](#)] [[INSPIRE-HEP](#)] (Q1).
- [55] G. Calcagni, J. Magueijo, D. Rodríguez-Fernández, *Varying electric charge in multiscale spacetimes*, *Phys. Rev. D* **89**, 024021 (2014) [[arXiv:1305.3497](#)] [[INSPIRE-HEP](#)] (Q1).
- [56] G. Calcagni, G. Nardelli, *Quantum field theory with varying couplings*, *Int. J. Mod. Phys. A* **29**, 1450012 (2014) [[arXiv:1306.0629](#)] [[INSPIRE-HEP](#)] (Q2).
- [57] G. Calcagni, L. Modesto, P. Nicolini, *Super-accelerating bouncing cosmology in asymptotically-free non-local gravity*, *Eur. Phys. J. C* **74**, 2999 (2014) [[arXiv:1306.5332](#)] [[INSPIRE-HEP](#)] (Q1).
- [58] G. Calcagni, *Relativistic particle in multiscale spacetimes*, *Phys. Rev. D* **88**, 065005 (2013) [[arXiv:1306.5965](#)] [[INSPIRE-HEP](#)] (Q1).
- [59] M. Arzano, G. Calcagni, *Black-hole entropy and minimal diffusion*, *Phys. Rev. D* **88**, 084017 (2013) [[arXiv:1307.6122](#)] [[INSPIRE-HEP](#)] (Q1).
- [60] G. Calcagni, *Multi-scale gravity and cosmology*, *JCAP* **1312**, 041 (2013) [[arXiv:1307.6382](#)] [[INSPIRE-HEP](#)] (Q1).
- [61] G. Calcagni, L. Modesto, *Nonlocality in string theory*, *J. Phys. A* **47**, 355402 (2014) [[arXiv:1310.4957](#)] [[INSPIRE-HEP](#)] (Q2).
- [62] G. Calcagni, S. Kuroyanagi, J. Ohashi, S. Tsujikawa, *Strong Planck constraints on braneworld and non-commutative inflation*, *JCAP* **1403**, 052 (2014) [[arXiv:1310.5186](#)] [[INSPIRE-HEP](#)] (Q1).
- [63] G. Calcagni, D. Oriti, J. Thürigen, *Spectral dimension of quantum geometries*, *Class. Quantum Grav.* **31**, 135014 (2014) [[arXiv:1311.3340](#)] [[INSPIRE-HEP](#)] (Q1).

- [64] G. Calcagni, C. Kiefer, C.F. Steinwachs, *Quantum cosmological consistency condition for inflation*, *JCAP* **1410**, 026 (2014) [[arXiv:1405.6541](#)] [[INSPIRE-HEP](#)] (Q1).
- [65] G. Calcagni, *Loop quantum cosmology from group field theory*, *Phys. Rev. D* **90**, 064047 (2014) [[arXiv:1407.8166](#)] [[INSPIRE-HEP](#)] (Q1).
- [66] A. Barrau, M. Bojowald, G. Calcagni, J. Grain, M. Kagan, *Anomaly-free cosmological perturbations in effective canonical quantum gravity*, *JCAP* **1505**, 051 (2015) [[arXiv:1404.1018](#)] [[INSPIRE-HEP](#)] (Q1).
- [67] G. Calcagni, L. Modesto, *Nonlocal quantum gravity and M-theory*, *Phys. Rev. D* **91**, 124059 (2015) [[arXiv:1404.2137](#)] [[INSPIRE-HEP](#)] (Q1).
- [68] G. Calcagni, L. Modesto, G. Nardelli, *Quantum spectral dimension in quantum field theory*, *Int. J. Mod. Phys. D* **25**, 1650058 (2016) [[arXiv:1408.0199](#)] [[INSPIRE-HEP](#)] (Q2*).
- [69] G. Calcagni, D. Oriti, J. Thürigen, *Dimensional flow in discrete quantum geometries*, *Phys. Rev. D* **91**, 084047 (2015) [[arXiv:1412.8390](#)] [[INSPIRE-HEP](#)] (Q1).
- [70] G. Calcagni, G. Nardelli, D. Rodríguez-Fernández, *Particle-physics constraints on multifractal spacetimes*, *Phys. Rev. D* **93**, 025005 (2016) [[arXiv:1512.02621](#)] [[INSPIRE-HEP](#)] (Q1*).
- [71] G. Calcagni, G. Nardelli, D. Rodríguez-Fernández, *Standard Model in multiscale theories and observational constraints*, *Phys. Rev. D* **94**, 045018 (2016) [[arXiv:1512.06858](#)] [[INSPIRE-HEP](#)] (Q1*).
- [72] G. Calcagni, *ABC of multi-fractal spacetimes and fractional sea turtles*, *Eur. Phys. J. C* **76**, 181 (2016) [[arXiv:1602.01470](#)] [[INSPIRE-HEP](#)] (Q1*).
- [73] G. Calcagni, *Lorentz violations in multifractal spacetimes*, *Eur. Phys. J. C* **77**, 291 (2017) [[arXiv:1603.03046](#)] [[INSPIRE-HEP](#)] (Q1*).
- [74] M. Arzano, G. Calcagni, *What gravity waves are telling about quantum spacetime*, *Phys. Rev. D* **93**, 124065 (2016) [[arXiv:1604.00541](#)] [[INSPIRE-HEP](#)] (Q1*).
- [75] G. Calcagni, S. Kuroyanagi, S. Tsujikawa, *Cosmic microwave background and inflation in multifractional spacetimes*, *JCAP* **1608**, 039 (2016) [[arXiv:1606.08449](#)] [[INSPIRE-HEP](#)] (Q1*).
- [76] G. Calcagni, M. Ronco, *Deformed symmetries in noncommutative and multifractional spacetimes*, *Phys. Rev. D* **95**, 045001 (2017) [[arXiv:1608.01667](#)] [[INSPIRE-HEP](#)] (Q1*).
- [77] G. Calcagni, *Multiscale spacetimes from first principles*, *Phys. Rev. D* **95**, 064057 (2017) [[arXiv:1609.02776](#)] [[INSPIRE-HEP](#)] (Q1*).
- [78] G. Calcagni, *Multifractional theories: an unconventional review*, *JHEP* **1703**, 138 (2017) [[arXiv:1612.05632](#)] [[INSPIRE-HEP](#)] (Q1*).
- [79] G. Calcagni, M. Ronco, D. Rodríguez Fernández, *Black holes in multifractional and Lorentz-violating models*, *Eur. Phys. J. C* **77**, 335 (2017) [[arXiv:1703.07811](#)] [[INSPIRE-HEP](#)] (Q1*).

Proceedings

- [80] G. Calcagni, *Braneworld cosmology almost without branes*, in *Proceedings of the NATO Advanced Study Institute on String Theory: From Gauge Interactions to Cosmology*, Cargèse, France, June 7-19, 2004, edited by L. Baulieu et al. *NATO Sci. Ser. II* **208**, 297 (2006) [[arXiv:hep-th/0409088](#)] [[INSPIRE-HEP](#)].
- [81] G. Calcagni, *Recent developments in braneworld cosmology*, in *Proceedings of the Yukawa International Seminar 2005 (YKIS2005): The Next Chapter in Einstein's Legacy*, edited by M. Sasaki, J. Soda, T. Tanaka, *Prog. Theor. Phys. Suppl.* **163**, 373 (2006) (Q4).

- [82] G. Calcagni, *Inflationary spectra and observations in loop quantum cosmology*, *J. Phys. Conf. Ser.* **360**, 012027 (2012) [[arXiv:1110.0291](#)] [[INSPIRE-HEP](#)].
- [83] G. Calcagni, *Introduction to multifractional spacetimes*, *AIP Conf. Proc.* **1483**, 31 (2012) [[arXiv:1209.1110](#)] [[INSPIRE-HEP](#)].
- [84] G. Calcagni, C. Kiefer, C.F. Steinwachs, *What can quantum cosmology say about the inflationary universe?*, *J. Phys. Conf. Ser.* **626**, 012003 (2015) [[arXiv:1503.08770](#)] [[INSPIRE-HEP](#)].

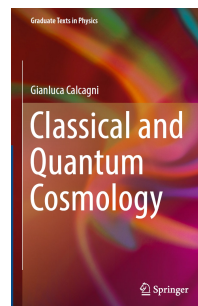
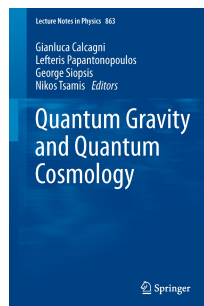
Preprints under review

- [85] M. Arzano, G. Calcagni, *Finite entanglement entropy and spectral dimension in quantum gravity*, submitted [[arXiv:1704.01141](#)] [[INSPIRE-HEP](#)].
- [86] G. Calcagni, *Complex dimensions and their observability*, submitted [[arXiv:1705.01619](#)] [[INSPIRE-HEP](#)].
- [87] G. Amelino-Camelia, G. Calcagni, M. Ronco, *Imprint of quantum gravity in the dimension and fabric of spacetime*, submitted [[arXiv:1705.04876](#)] [[INSPIRE-HEP](#)].
- [88] G. Calcagni, *The geometry of learning*, submitted to *J. Math. Psychol.* [[arXiv:1605.00591](#)].

Other scientific works

- G. Calcagni, *Patch cosmology and noncommutative braneworlds*. Talk given at DESY Theory Workshop 2004 (Hamburg, September 27 – October 1, 2004) [[arXiv:hep-th/0410015](#)] [[INSPIRE-HEP](#)].
- G. Calcagni, *Braneworld Cosmology and Noncommutative Inflation*, PhD thesis (Parma University, Italy, 2005) [[arXiv:hep-ph/0503044](#)] [[INSPIRE-HEP](#)].
- G. Amelino-Camelia, G. Calcagni, M. Ronco, *Dimensional flow in quantum gravity and distance-time uncertainties: emergence of stochastic spacetime*, to appear soon.
- S. Alexander, G. Calcagni, G. La Nave, P.W. Phillips, *Spectral dimension and entanglement entropy in AdS/CFT*, in progress.

Books



- B1 G. Calcagni, L. Papantonopoulos, G. Siopsis, N. Tsamis (eds.), *Quantum Gravity and Quantum Cosmology* (Springer, Heidelberg, Germany, 2013), *Lect. Notes Phys.* **863** (2013). ISBN: 978-3-642-33035-3 (Print), 978-3-642-33036-0 (Online). DOI: [10.1007/978-3-642-33036-0](#). Official Springer web page. Citations: 70; full-book downloads: 2000; combined downloads: **26k** (source: [Bookmetrix](#)).

- B2 G. Calcagni, *Classical and Quantum Cosmology* (Springer, Switzerland, 2017), Graduate Texts in Physics. ISBN: 978-3-319-41125-5 (Print), 978-3-319-41127-9 (Online). DOI: [10.1007/978-3-319-41127-9](https://doi.org/10.1007/978-3-319-41127-9). Official Springer web page. Citations: –; full-book downloads: 260; combined downloads: **5k** (source: [Bookmetrix](#)).
- B3 G. Calcagni, *Multi-scale Spacetimes: Foundations and Cosmology*, to be published by Imperial College Press / World Scientific (2017).

Classical and Quantum Cosmology: synopsis

This comprehensive textbook is devoted to classical and quantum cosmology, with particular emphasis on modern approaches to quantum gravity and string theory and on their observational imprint. It covers major challenges in theoretical physics such as the big bang and the cosmological constant problem. An extensive review of standard cosmology, the cosmic microwave background, inflation and dark energy sets the scene for the phenomenological application of all the main quantum-gravity and string-theory models of cosmology.

Born of the author’s teaching experience and commitment to bridging the gap between cosmologists and theoreticians working beyond the established laws of particle physics and general relativity, this is a unique text where quantum-gravity approaches and string theory are treated on an equal footing. As well as introducing cosmology to undergraduate and graduate students with its pedagogical presentation and the help of 45 solved exercises, this book, which includes an ambitious bibliography of about 3500 items, will serve as a valuable reference for lecturers and researchers.

A schematic table of contents is the following:

1. *Introduction.*
2. *Hot big bang model.* Cosmological standard model, content of the universe, thermal history.
3. *Cosmological perturbations.* Linear and non-linear perturbations, separate universe approach, Gaussian random fields.
4. *Cosmic microwave background.* CMB primer, Gaussian and non-Gaussian spectra, polarization.
5. *Inflation.* Problems of the cosmological standard model, cold big bang, scalar-field classical and quantum dynamics, model building, spectra and Gaussianity, open issues.
6. *Big-bang problem.* Classification of singularities, singularity theorems, mixmaster universe and BKL conjecture.
7. *Cosmological constant problem.* The problem in quantum field theory, quintessence, acceleration from modified gravity and alternatives models.
8. *The problem of quantum gravity.* Do we need to quantize gravity?, perturbative gravity, approaches to quantum gravity.
9. *Canonical quantum gravity.* Hamiltonian formalism in Schwinger, Ashtekar–Barbero and ADM variables, Wheeler–DeWitt equation, cosmological constant problem in canonical gravity.
10. *Canonical quantum cosmology.* Mini-superspace, Wheeler–DeWitt and loop quantum cosmology, big-bang and cosmological constant problems revisited, inhomogeneities and inflation.
11. *Cosmology of quantum gravities.* Asymptotic safety, causal dynamical triangulation, spin foams, group field theory, causal sets, non-commutative spacetimes, non-local gravity.
12. *String theory.* Overview, bosonic string, superstring, low-energy limits, branes and fluxes, compactification, Calabi–Yau spaces and orbifolds, moduli stabilization, dualities and M-theory.

13. *String cosmology*. String landscape, de Sitter vacua, cosmological constant problem, KKLT uplifting scenarios, large-volume uplifting scenarios, moduli inflation, axion inflation, warped D-brane inflation, slow-roll D-brane inflation, DBI inflation, braneworld cosmology, cosmological tachyon, higher-order string gravity, non-local string cosmology, pre-big-bang cosmology, string-gas cosmology, ekpyrotic universe, big bang problem, cosmological billiards.

14. *Perspective*.

Oral Contributions

I gave **22 invited presentations** as plenary speaker, **22 presentations** as registered speaker and **48 invited seminars** at international institutions in France, Germany, Greece, Italy, Netherlands, Portugal, Spain, Russia, UK, USA, Canada, Brazil, India and Japan. Talk titles in italics.

Invited presentations at conferences, advanced schools and workshops

1. *Nonlocal cosmology/Progress on cubic string field theory*, “24th IAGRG Meeting”, Delhi, India, 5-8/02/2007 ([webpage](#)).
2. *LQC tensor spectrum and its observability*, “Loop Quantum Cosmology Workshop”, Penn State University, University Park, PA, 23-25/10/2008.
3. *Hořava–Lifshitz gravity: What’s the matter?*, “Gravity at a Lifshitz Point Workshop”, Perimeter Institute, Waterloo, Canada, 8-10/11/2009 ([webpage](#)).
4. *Challenges in quantum gravity and cosmology and Fractal universe*, “Quantum Gravity Workshop”, Max Planck Institute for the Physics of Complex Systems, Dresden, Germany, 8-10/04/2010 ([webpage](#)).
5. *Quantum field theory and gravity in a fractal universe*, Workshop “Mathematical, Physical and Conceptual Aspects of Quantum Gravity”, Laboratoire APC, Université Paris 7, France, 23-25/03/2011 ([webpage](#)).
6. *Introduction to multiscale spacetimes*, WE-Heraeus-Seminar “Exploring Quantum Space-Time”, Physikzentrum, Bad Honnef, Germany, 5-7/03/2012 ([webpage](#)).
7. *Introduction to multiscale spacetimes*, Sixth International School on “Field Theory and Gravitation”, Petrópolis, Brazil, 23-27/04/2012.
8. *Introduction to multifractal spacetimes —Part I and II*, “Perspectives of Fundamental Cosmology”, Nordita, Stockholm, Sweden, 5-30/11/2012 ([webpage](#)).
9. *Field theory on multifractal spacetimes*, “CDT & Friends”, Radboud U., Nijmegen, The Netherlands, 11-14/12/2012 ([webpage](#)).
10. *LQC versus Wheeler–DeWitt*, “Quantum Gravity and Fundamental Cosmology 2013”, Albert Einstein Institute, Golm, Germany, 5-8/03/2013 ([webpage](#)).
11. *Field theory on multifractal spacetimes*, “Jarramplas ’13: Fifth Jerte Advanced Relativity Workshop”, Navaconcejo, Spain, 21-24/03/2013 ([webpage](#)).
12. *Cosmology of multiscale spacetimes*, “Seventh Aegean Summer School – Beyond Einstein’s Theory of Gravity”, Parikia, Greece, 23-28/09/2013 ([webpage](#)).
13. *Cosmology of multiscale spacetimes*, “Quantum Gravity and Fundamental Cosmology 2014”, Albert Einstein Institute, Golm, Germany, 3-6/03/2014 ([webpage](#)).
14. *Cosmology of multiscale spacetimes*, WE-Heraeus-Seminar “Quantum Cosmology”, Physikzentrum, Bad Honnef, Germany, 28/07-1/08/2014 ([webpage](#)).

15. *Cosmology and quantum gravities: Where are we?*, “Conceptual and Technical Challenges for Quantum Gravity 2014”, La Sapienza University, Rome, Italy, 8-12/09/2014 ([webpage](#)).
16. *Cosmology and quantum gravities: Where are we?*, “IberiCos 2015: X Iberian Cosmology Meeting”, Aranjuez, Spain, 30/03-1/04/2015 ([webpage](#)).
17. *The cosmological constant problem*, “2nd APCTP-TUS workshop on Dark Energy”, Tokyo University of Science, Japan, 3-5/08/2015 ([webpage](#)).
18. *The cosmological constant problem in quantum gravity*, “Mini-workshop on Quantum Gravity and Condensates”, Albert Einstein Institute, Golm, Germany, 14-16/09/2015.
19. *Multi-scale spacetimes, from theory to phenomenology: Standard Model, gravitational waves and CMB*, “XXV International Fall Workshop on Geometry and Physics”, CSIC, Madrid, Spain, 29/08-2/09/2016 ([webpage](#)).
20. *Cosmology of multifractional spacetimes*, “Segundo Encontro de Cosmologia e Gravitação à Beira da Serra da Estrela”, Covilhã, Portugal, 10-11/02/2017 ([webpage](#)).

Colloquia

21. *Multifractal spacetimes and quantum gravity*, Mainz U., Germany, 15/11/2011.
22. *Quantum cosmology and gravity*, IEM-CSIC, Madrid, Spain, 20/03/2014.

Other presentations at conferences, advanced schools and workshops

1. *Braneworld cosmology almost without branes*, Cargèse Summer School 2004, NATO Advanced Study Institute, Cargèse, France, 7-19/06/2004.
2. *Patch cosmology and noncommutative braneworlds*, DESY Theory Workshop 2004 “Particle Cosmology”, DESY, Hamburg, Germany, 27/09-1/10/2004.
3. *Recent developments in braneworld cosmology* (poster), Yukawa International Seminar 2005 (YKIS2005) “The Next Chapter in Einstein’s Legacy”, Yukawa Institute for Theoretical Physics, Kyoto, Japan, 27/06-1/07/2005.
4. *Cosmological tachyon from cubic string field theory*, “UK Particle Cosmology” Meeting, University of Newcastle upon Tyne, UK, 14/03/2006.
- 5-6. *Tachyon dark energy models: dynamics and constraints*, “UK Particle Cosmology” Meetings: ► University of Oxford, UK, 8/06/2006; ► University College of London, UK, 28/11/2007.
- 7-8. *Nonlocal cosmology/Progress on cubic string field theory*, ► “UK Beyond the Standard Model” Meeting, Liverpool U., UK, 29-30/03/2007; ► “COSMO 2007”, University of Sussex, Brighton, UK, 21-25/08/2007.
- 9-10. *Quantum gravity and the cosmological constant as superconducting phenomena* (talk and poster), ► “COSMO 2008”, University of Wisconsin, Madison, WI, 25-29/08/2008; ► Postdoctoral Research Exhibition, Penn State U., University Park, PA, 7/05/2009.
11. *Hořava–Lifshitz gravity: What’s the matter?*, 12th Eastern Gravity Meeting, Rochester Institute of Technology, Rochester, NY, 15-16/06/2009 ([webpage](#)).
12. *Fractal universe*, “20th Workshop on General Relativity and Gravitation in Japan” (JGRG20), Yukawa Institute for Theoretical Physics, Kyoto, Japan, 21-25/09/2010.
- 13-14. *Inflationary observables and observational constraints in loop quantum cosmology*, ► “Loops 2011”, CSIC, Madrid, Spain, 23-28/05/2011; ► “Ibéricos 2013: VIII Iberian Cosmology Meeting”, Granada, Spain, 24-26/04/2013.

15. *Cosmology of multifractal spacetimes*, “1st i-Link Workshop Macro-from-Micro: Quantum Gravity and Cosmology”, IEM-CSIC, Madrid, Spain, 24-27/06/2013 ([webpage](#)).
16. *Cosmology of multiscale spacetimes*, “Jarramplas ’14: Sixth Jerte Advanced Relativity Workshop”, Navaconcejo, Spain, 7-10/04/2014 ([webpage](#)).
17. *Cosmology and quantum gravities: Where are we?*, “2nd i-Link Workshop Macro-from-Micro: Quantum Gravity and Cosmology”, IEM-CSIC, Madrid, Spain, 15-18/09/2014 ([webpage](#)).
18. *Cosmological constant*, “Jarramplas ’15: Seventh Jerte Advanced Relativity Workshop”, Navaconcejo, Spain, 24-27/03/2015 ([webpage](#)).
19. *Status of multi-scale theory*, “IberiCos 2016: XI Iberian Cosmology Meeting”, Vila do Conde, Portugal, 29-31/03/2016 ([webpage](#)).
20. *Status of multi-scale theories: From QED to gravitational waves*, “Jarramplas ’16: Eighth Jerte Advanced Relativity Workshop”, Navaconcejo, Spain, 23-26/05/2016 ([webpage](#)).
21. *Quantum gravity and cosmology* [in Spanish], “XIV Curso de Iniciación a la Investigación en Estructura de la Materia”, IEM-CSIC, Madrid, Spain, 4-6/04/2017 ([webpage](#)).
22. *Finite entanglement entropy in quantum gravity*, “Jarramplas ’17: Ninth Jerte Advanced Relativity Workshop”, Navaconcejo, Spain, 28/04/-1/05/2017 ([webpage](#)).

Invited seminars

1. *Fractal dimensions and contractions*, Parma U., Italy, 15/05/2002.
2. *Introduction to cosmic microwave background and cosmology*, Parma U., Italy, 17/03/2004.
3. *Introduction to tachyon cosmology*, Perugia U., Italy, 23/03/2005.
- 4-5. *Patch cosmology and noncommutative braneworlds*, ► Waseda U., Tokyo, Japan, 11/05/2005; ► Tokyo Institute of Technology, Tokyo, Japan, 19/05/2005.
- 6-11. *Ghost constraints in Gauss–Bonnet cosmology*, ► IUCAA, Pune, India, 6/09/2006; ► Penn State U., University Park, PA, 12/10/2006; ► McGill U., Montréal, Canada, 19/10/2006; ► Columbia U., New York, NY, 2/11/2006; ► Imperial College, London, UK, 14/11/2006; ► HRI, Allahabad, India, 13/02/2007.
12. *Braneworld cosmology and noncommutative inflation*, ICG, Portsmouth U., UK, 6/10/2005.
- 13-14. *Tachyon dark energy models: dynamics and constraints*, ► Fermilab, Batavia, IL, 9/10/2006; ► CITA, Toronto, Canada, 23/10/2006.
15. *A cosmology primer*, Center for Theoretical Physics, Delhi, India, 18/09/2006.
- 16-18. *Nonlocal cosmology/Progress on cubic string field theory*, ► Oxford U., UK, 10/05/2007; ► Trento U., Italy, 22/05/2007; ► Centre for Gravitation and Fundamental Metrology, Moscow, Russia, 18/06/2007.
- 19-20. *Stability of multi-field cosmology*, ► Nottingham U., UK, 13/11/2007; ► Padova U., Italy, 14/02/2008.
21. *Introduction to cosmology*, Brescia U., Italy, 20/02/2008.
- 22-23. *Nonlocal dynamics and string field theory*, ► Penn State U., University Park, PA, 12/03/2008; ► Perimeter Institute, Waterloo, Canada, 8/04/2008.
24. *Cosmology of the separate universe and nonlinear inhomogeneities I & II*, Penn State U., University Park, PA, 20,23/04/2009.

25. *Hořava–Lifshitz gravity: What’s the matter?*, UC Santa Cruz, CA, 1/07/2009.
- 26-27. *String theory as a diffusing system*, ► Perimeter Institute, Waterloo, Canada, 12/11/2009; ► AEI, Golm, Germany, 16/11/2009.
- 28-29. *Fractal universe*, ► Institute for Theoretical Physics, Utrecht U., The Netherlands, 4/03/2010; ► AEI, Golm, Germany, 20/05/2010.
- 30-31. *Inflationary observables in loop quantum cosmology*, ► Imperial College, London, UK, 23/11/2010; ► International Loop Quantum Gravity Teleseminar, 18/01/2011 ([webpage](#)).
32. *Quantum field theory and gravity in a fractal universe*, FIAS, Goethe U., Frankfurt am Main, Germany, 25/01/2011.
- 33-34. *Inflationary observables and observational constraints in loop quantum cosmology*, ► Laboratoire APC, Université Paris 7, 28/03/2011; ► Köln U., Germany, 22/11/2011 ([webpage](#)).
- 35-36. *Multifractal spacetimes and quantum gravity*, ► Utrecht U., The Netherlands, 5/07/2011; ► Catania U., Italy, 20/10/2011.
37. *Diffusion in quantum gravity*, AEI, Golm, Germany, 12/06/2012.
38. *Introduction to multiscale spacetimes*, IEM-CSIC, Madrid, Spain, 12/09/2012.
39. *Introduction to multifractal spacetimes*, Nottingham U., UK, 14/12/2012.
- 40-41. *Field theory on multifractal spacetimes*, ► Turin U., Italy, 12/02/2013; ► U. Roma La Sapienza, Italy, 21/02/2013.
42. *Probing the quantum nature of spacetime by diffusion*, Asymptotic Safety Teleseminar, 13/05/2013 ([webpage](#)).
43. *Introduction to multifractional spacetimes*, Tokyo University of Science, Japan, 7/06/2013.
44. *Cosmology of multiscale spacetimes*, Tokyo University of Science, Japan, 29/11/2013.
45. *Quantum cosmology and gravity*, Complutense U., Madrid, Spain, 6/05/2014.
46. *Cosmological constant*, Nagoya U., Japan, 21/07/2015.
47. *Big bang, cosmological constant and quantum gravity: wonders of the Century* [in Spanish], IEM-CSIC, Madrid, Spain, 23/02/2017.
48. *Big bang, cosmological constant, and quantum gravity: wonders of the century*, OIST, Okinawa, Japan, 28/02/2017.

Attendance to Conferences and Workshops

► “Strings 2004”, Collège de France, Paris, France, 28/06-2/07/2004. ► Post-YKIS2005 “Gravity and Cosmology”, Yukawa Institute for Theoretical Physics, Kyoto, Japan, 4-29/07/2005. ► “UK Particle Cosmology” Meetings: University of Durham, UK, 19-20/09/2005; DAMTP, Cambridge University, UK, 15/12/2005; King’s College, London, UK, 13/12/2006. ► “Cambridge Workshop on Non-Gaussianity from Inflation”, DAMTP, Cambridge University, UK, 19-22/04/2006 (**invited** participant). ► “COSMO 2006”, UC Davis, CA, 25-29/09/2006. ► Meeting “Loop Quantum Cosmology”, Queen Mary, London, UK, 12/03/2007 (**invited** participant). ► “AbhayFest: A Conference on Classical and Quantum Gravity”, Penn State University, University Park, PA, 4-6/06/2009. ► “COSMO/CosPA 2010”, University of Tokyo, Tokyo, Japan, 27/09-1/10/2010. ► Workshop “Quantum Spacetime from Discreteness to Continuum”, LPT Orsay, France, 21-23/03/2011 (**invited** participant). ► ESF Exploratory Workshop “Gravity as Thermodynamics”, SISSA, Trieste, Italy, 5-8/09/2011 (**invited** participant). ► “X Avogadro Meeting on Strings, Supergravity and Gauge Theories”, Scuola Normale Superiore, Pisa, Italy, 17-19/12/2014. ► “XI Avogadro Meeting on Strings,

Supergravity and Gauge Theories”, University of Bologna, Italy, 16-18/12/2015. ► 3rd course “Starting Grants and Consolidator Grants 2017 for researchers. Writing Successful ERC StG & CoG Grant Proposals”, CSIC, Madrid, 3/10/2016. ► “First CANTATA Meeting”, Lisbon University, Portugal, 14-15/11/2016 (invited participant).

Member of Committees and Commissions of Trust

- 1995-2001: Scientific coordinator of Guido Ruggieri Observatory, Venice, Italy (coordination of the observational programme, director of the planetarium, organization of public events).
- 2006-2008: Organization of cycles of internal seminars of cosmology and theoretical physics, Department of Physics and Astronomy, University of Sussex, UK.
- Local organizer of the *Workshop on Loop Quantum Cosmology*, Penn State University, PA, October 23-25, 2008 ([webpage](#)).
- 2008-2011, Albert Einstein Institute, Golm, Germany: a) Coordinator of the visiting program of the research group. b) Member of panels selecting PhD students and postdocs. c) Participation in the drafting of technical and activity reports of the group activities for official evaluation by the committee “Fachbeirat” (Max-Planck-Gesellschaft).
- Member of the scientific committee and local organizer of the *Workshop on Spacetime as a Statistical System*, Albert Einstein Institute, Golm, Germany, July 21-23, 2010.
- Member of the scientific committee, course director and organizer of the *Sixth Aegean Summer School: Quantum Gravity and Quantum Cosmology*, Chora, Greece, September 19-24, 2011 ([webpage](#)).
- Course director and organizer of the *X and XI Curso de Introducción a la Investigación del Instituto de Estructura de la Materia* (X and XI Introductory Course on Research at the IEM), CSIC, Madrid, Spain, March 20-22, 2013 and April 9-11, 2014 ([webpage](#)).
- Initiator and main organizer of the *1st i-Link Workshop Macro-from-Micro: Quantum Gravity and Cosmology*, IEM-CSIC, Madrid, Spain, June 24-27, 2013 ([webpage](#)). And the *2nd i-Link Workshop Macro-from-Micro: Quantum Gravity and Cosmology*, IEM-CSIC, Madrid, Spain, September 15-18, 2014 ([webpage](#)).
- Panel member for the PhD dissertation of the thesis “Cosmología cuántica inhomogénea: teoría cuántica de campos y gravedad de lazos” by D. Martín de Blas, Complutense U., Madrid, Spain, September 17, 2013.
- 2015-present: a) Organizer of the cycle of theoretical-physics seminars *De Madrid al Cosmos*, taking place every other week alternatively at the IEM-CSIC and the Complutense University in Madrid ([webpage](#)). b) Participation in the drafting of technical and activity reports of the group activities for periodic official evaluations.
- Local organizer of the *XXV International Fall Workshop on Geometry and Physics*, CSIC, Madrid, Spain, August 29 – September 2, 2016 ([webpage](#)).
- **Associate Editor** of *Frontiers in Physics* ([webpage](#)) and *Frontiers in Astronomy and Space Sciences* ([webpage](#)). Editor of *ISRN Mathematical Physics* ([webpage](#)).
- Reviewer of research proposals for the Netherlands Organization for Scientific Research (Nederlandse Organisatie voor Wetenschappelijk Onderzoek, NWO), Netherlands.
- Reviewer of research proposals for the National Science Foundation (NSF), USA.
- Reviewer of research proposals for the National Agency of Evaluation and Perspective (Agencia Nacional de Evaluación y Prospectiva, ANEP), Spain.
- Participant of [CPAN](#) project (National Center for Particle, Astroparticle and Nuclear Physics).

Thesis Supervising and Tutoring

See Teaching Activity for full description.

Further Scientific and Popularizing Activities and Qualifications

- *Teaching* (see Teaching Activity for full description): ► 2004: Lecturer in the project “24 Hours for Physics” at Parma University. ► 2007: Attendance of the training course “Helping Students Learn —An introduction to teaching for postdoctoral research staff” at the University of Sussex. ► 2007: Lecturer at the University of Sussex (undergraduate course *Complex variables in physics*). ► 2008–2009: Lecturer at Penn State University (undergraduate courses *Quantum mechanics* and *Special and general relativity*; graduate course *Quantum gravity*). ► 2010–2012: Lecturer at Potsdam University (advanced undergraduate course *Classical and quantum cosmology*).
- *Refereeing activity* (2004–present): referee (on a monthly basis) for several journals of physics published by AIP (J. Math. Phys.), APS (Phys. Rev. Lett., Phys. Rev. D), Elsevier (Phys. Lett. B, Annals Phys., Commun. Nonlin. Sci. Num. Sim., J. Franklin Inst., Chaos Solitons Fractals, Physica A), IOP (JCAP, Class. Quantum Grav., J. Phys. A), NRC (Can. J. Phys.), Springer (JHEP, Gen. Rel. Grav., Eur. Phys. J. C, Eur. Phys. J. Plus, Found. Phys.), World Scientific (Int. J. Mod. Phys. D, Int. J. Geom. Methods Mod. Phys., Rept. Adv. Phys. Sci.), and others (SIGMA, Filomat).
- Short-listed for faculty positions at University of Hamburg, Germany (W1-Assistant Professor level, 11/2008), Scuola Normale Superiore of Pisa, Italy (Assistant Professor level, 11/2010), University of Canterbury, New Zealand (Lecturer level, 02/2011), University of Erlangen (W2-Associate Professor level, 06/2011), University of Turin, Italy (Assistant Professor level, 11/2011), INFN, Italy (Permanent Researcher level, 11/2016), OIST, Okinawa, Japan (Full Professor level, 12/2016). Tenured position offered at Fudan University, Shanghai, China (Associate Professor level, 06/2012, **declined**).
- *Popularizing science*: ► 1995–2001: Astronomy and astrophysics popularizing lectures in Venice and direction of the planetarium. ► 2013–2014: Acting in the Scientific Theatre group of CSIC, Madrid (director: José Vicente García Ramos). Show “Todo X la Ciencia: Cinco conversaciones ideadas, posibles e irreales y un monólogo que no ha sido”: Natural History Museum, Madrid, 15-17/11/2013; Teatro Trajano, Mérida, 05/12/2013; Centro Cívico Viñagrande, Alcorcón (Madrid), 18/01/2014; Residencia de Estudiantes, CSIC, Madrid, 30/04/2014.
- *Computer literacy*: Operative systems: Windows and Linux Ubuntu. Word processors: Openoffice Writer, Microsoft Word, L^AT_EX. Other programs: Microsoft Excel, Mathematica, COSMO MC. Basic C++, Fortran and Pascal programming.

Languages

- *Italian*: mother tongue.
- *English*: excellent spoken, reading and writing knowledge.
- *Spanish*: excellent spoken, reading and writing knowledge.
- *French*: very good spoken, excellent reading and good writing knowledge.
- *Japanese*: good spoken, basic reading and basic writing knowledge.
- *German*: basic spoken, reading and writing knowledge.

Short Stays at International Centres

- *Graduate stays* (6 in total): ► Parma U., Italy, 09/2001 (2 weeks). ► ICTP, Trieste, Italy, 06/2002 (2 w.); 04/2003 (2 w.); 06/2003 (2 w.). ► Gran Sasso National Laboratory, Assergi, Italy, 07/2002 (2 w.). ► Turin U., Italy, 01/2003 (1 w.). ► NATO Advanced Study Institute, Cargèse, France, 06/2004 (2 w.).
- *Postdoctoral stays* (44 in total): ► Perugia U., Italy, 03/2005 (1 w.). ► Waseda U., Tokyo, Japan, 05/2005 (1 w.). ► Tokyo Institute of Technology, Japan, 05/2005 (1 w.). ► Yukawa Institute for Theoretical Physics, Kyoto, Japan, 07/2005 (3 w.); 09/2010 (2 w.). ► ICG, Portsmouth, UK, 10/2005 (1 w.). ► DAMTP, Cambridge, UK, 04/2006 (1 w.). ► IUCAA, Pune, India, 09/2006 (3 w.). ► Center for Theoretical Physics, Delhi, India, 09/2006 (1 w.); 02/2007 (1 w.). ► Fermilab, Batavia, IL, 10/2006 (1 w.). ► CITA, Toronto, Canada, 10/2006 (1 w.). ► McGill University, Montréal, Canada, 10/2006 (1 w.). ► Penn State University, State College, PA, 10/2006 (1 w.). ► Columbia University, New York, NY, 11/2006 (1 w.). ► HRI, Allahabad, India, 02/2007 (1 w.). ► Moscow State University, Russia, 06/2007 (2 w.). ► Nottingham U., UK, 11/2007 (1 w.). ► Brescia U., Italy, 02/2008 (3 w.). ► Perimeter Institute, Waterloo, Canada, 04/2008 (1 w.); 11/2009 (1 w.). ► University of Wisconsin-Madison, WI, 08/2008 (1 w.). ► UC Berkeley, CA, 06/2009 (1 w.). ► Utrecht U., The Netherlands, 03/2010 (1 w.); 07/2011 (1 w.). ► Tokyo University of Science, Japan, 10/2010 (2 w.); 06/2013 (1 w.); 11/2013 (2 w.); 03/2015 (1 w.). ► Imperial College, London, UK, 11/2010 (1 w.). ► FIAS, Goethe U., Frankfurt am Main, Germany, 01/2011 (1 w.). ► Laboratoire APC, Université Paris 7, France, 03/2011 (1 w.). ► CSIC, Madrid, Spain, 05/2011 (1 w.). ► SISSA, Trieste, Italy, 09/2011 (1 w.). ► Catania U., Italia, 10/2011 (1 w.). ► National Laboratory of Scientific Computation (LNCC), Petrópolis, Brazil, 04/2012 (1 w.). ► Nordita, Stockholm, Sweden, 11/2012 (1 w.). ► University of Rome La Sapienza, Italy, 02/2013 (1 w.); 09/2013 (1 w.); 10/2016 (1 w.). ► Fudan U., Shanghai, China, 05/2013 (1 w.). ► University of Padua, Italy, 08-09/2014 (5 w.); 12/2014-02/2015 (9 w.). ► OIST, Okinawa, Japan, 02/2017 (1 w.).

Other Professional Activities

- 2003–2014: contributor in the art magazine ARTEiN (over 200 articles in Italian and English: reviews, critics and interviews); professional journalistic activity. Curator of photographic exhibitions.
- 2008–2014: English translator and subtitler of the films *Hristos Anesti!* by Andrea Foschi (Greece, 2008), *Tales of the Drina* by Andrea Foschi and Marco Neri, Italy/Bosnia-Herzegovina (Suttvuess, RTRS – Radio Televizija Republike Srpske, Nova Škola, 2010) and *Do you remember?* by Andrea Foschi, Italy (Nova Škola, 2014).

Interests

- Theravada Buddhist meditation (Samatha and Vipassanā).
- Travelling and photography (<http://www.flickr.com/photos/calcagni/sets>).
- Martial arts (Musō Shinden-ryū iaidō, kendō).
- Recreational scuba diving (certified PADI Rescue Diver).
- Dystopias.