# Curriculum Vitae of Stefano Liberati

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## Present position

- *Associate Professor*, SISSA, Trieste, Italy.
    - Holder of the Italian National Scientific Endorsement (ASN) to Full Professor 02/C1.
- Coordinator of the Astroparticle Physics Research Group/PhD in SISSA
- Italian representative in the steering committee of the International Society for General Relativity and Gravitation. (ISGRG).
- Member of the steering committee of the Società Italiana di Relatività Generale e Fisica della Gravitazione. (SIGRAV).
- Local coordinator of the INFN QUAGRAP Research Initiative.
- Incarico di Ricerca (lifetime associated member) INFN.
- Member of the Administrative Council of SISSA MediaLab.

## Career

2010-Today: Associate Professor, SISSA
2009-2010: Research Associate Professor, SISSA
2003-2009: Assistant Professor, SISSA.
2000-2003: Postdoctoral Research Associate, Gravity Theory Group, University of Maryland.

### Education

1995-2000 SISSA, Trieste, Italy, Ph.D. in Astrophysics. Supervisor Professor D.W. Sciama.
1997 National military service in the Italian Coast Guard
1989-1995 Università di Roma, "La Sapienza", Italy, Laurea in Fisica (110 with Laude)
1984-1989 Liceo Scientifico Amedeo Avogadro, Roma, Italy. 60/60.

## International Referees

Ted Jacobson, University of Maryland, USA. jacobson@physics.umd.edu
Matt Visser, Victoria University of Wellington, New Zealand. Matt.Visser@msor.vuw.ac.nz
Bill Unruh, University of British Columbia, Canada, unruh@physics.ubc.ca
Lee Smolin, Perimeter Institute, Waterloo, Canada, lsmolin@perimeterinstitute.ca
John Miller, Oxford University, UK. Miller John jcm@astro.ox.ac.uk

### International recognition

*Publications record* (March 2015):

inSPIRE: More than 130 citable papers, Total Citations 4641, h-index 35.
Google Scholar: Total Citations 61562, h-index 40.

*Awards and honours:*
Three "honourable mentions" for contributions to the Gravity Essay Competition: years 2000, 2001, 2003 • Invited contributor to Annals of Physics (2003), Living Review of Relativity (2005), Special Issue of IJMPD (2007), Annual review of particle physics (2009), Classical and Quantum gravity (2012). • Second prize winner FQXi essay context year 2010 • Fourth prize winner FQXi essay context year 2009 • FQXI honorary membership as second prize winner of the essay competition. • 2013, Elected as one of the two Italian members of the steering Committee of the International Society on General Relativity and Gravitation • Appointed member of SIGRAV steering Committee. • Invited Co-Chair of the parallel session "QFT in curved spacetime, quantum gravity phenomenology and analogue gravity" of the GR20 International Society on General Relativity and Gravitation Meeting, Warsaw 2013.

*Membership in International Academic Institutions and Research Organizations*

- International Society on General Relativity and Gravitation Membership
- Società Italiana di Relatività Generale e Fisica della Gravitazione.
- FQXi
- INFN

## Funding

- John Templeton Foundation. 2014, "*Probing the emergent spacetime fabric: theory and phenomenology*": €269000.
- Scientific PI of the Brazilian fellowship program "Ciência Sem Fronteiras" for a 1+1 postdoctoral fellowship. Started Oct.2014
- FQXi mini-grant 2013. "*Experimental Searches for Quantum Gravity: A conference for setting the next years agenda in quantum gravity phenomenology*": $5000
- FQXi mini-grant 2012. *"A tabletop black hole experiment"* : $10000
- ESF grant Exploratory Workshop "*Gravity as Thermodynamics*." 5-8 September 2011, SISSA. Trieste, Italy.; €13400
- FQXi mini-grant 2010. *"A Workshop on Emergent Gravity":* $5000
- Scientific PI of the reintegration grant FP7-PEOPLE-2011-CIG: Multidisciplinary Quantum Gravity; Weinfurtner.
- ESF grant conference "*From quantum to emergent gravity. Theory and phenomenology*". June 11-15 2007, SISSA, Trieste, Italy; €13000.
- Scientific PI of the Marie-Curie postdoc FP7-PEOPLE-2007-4-1-IOF: Emergent Spacetimes; Weinfurtner.
- Staff Member of the PRIN grants, 2006, 2008 in Astroparticle physics (National PI A. Masiero).

## Academic duties

2012-Present: Coordinator of SISSA Astroparticle Physics PhD/Research Group

2012-Present: Member of the Administration Council of SISSA MediaLab

2012- Present: Incarico di Ricerca INFN

2008-2012: Vice-director of Ulisse (http://ulisse.sissa.it), popular science website by SISSA

2005-2011: Member of the Scientific Council of SISSA MediaLab

2004: Co-founder of the INFN research initiative GS51 (Astroparticle-Quantum gravity phenomenology, now QUAGRAP) and local coordinator of the initiative in the Trieste INFN section

2004-2012: Associate member of the Istituto Nazionale di Fisica Nucleare (INFN)

2004: Co-Organizer of the Ph.D. in Astroparticle physics at SISSA member of the Astrophysics and Astroparticle Ph.D. curricula

2004: Co-organizer Open Day SISSA–ICTP.

1998-2000: Student Representative in the Administration Council of SISSA

## Mentoring and Supervisions

Mentored 4 postdocs (two of which now associate professor) and presently mentoring 3 (by fall 2015 all of them on external grants). Supervised 10 Ph.D. students, and currently supervising another 4. Of those already graduated, 8 have postdoctoral positions in internationally renowned institutions while the most senior former student is currently Reader at the University of Nottingham, UK.

*Past supervisions:*

- Ph.D. Co-supervision (with Professor J. Miller) of Thomas Sotiriou: Alternative theories of gravitation. Current position: Reader Nottingham University.
- Ph.D. Co-supervision (with Dr. Roberto Percacci) of Christoph Rahmede: Gravity renormalization group. Current position: postdoc. University of Sussex. Karlsruhe Institute of Technology,Germany

- Ph.D. Co-supervision (with Professor A. Celotti) of Luca Maccione: Astrophysical tests of fundamental symmetries of spacetime. Current position: postdoc. W. Heisenberg MPI, Munich.
- Ph.D. Supervisor of Lorenzo Sindoni: Quantum and emergent gravity phenomenology. Current position: postdoc. AEI, Potsdam, Germany.
- Ph.D. Supervision of Stefano Finazzi: Analogue models of gravity. Current position: postdoc. University of Paris 7, Paris, France.
- Ph.D. Supervision of Goffredo Chirco: Thermodynamic aspects of gravity. Current position: postdoc Aix-Marseille Université, Marseille, France.
- Ph.D. Supervision of Vincenzo Vitagliano: Cosmology in alternative theories of gravitation. Current position: postdoc. CENTRA, Lisbon.
- Ph.D. Supervision of Angus Prain : Analogue models of gravity. Current position: postdoc. Bishops University, Canada.
- Ph.D. Co-Supervision (with Prof. C. Baccigalupi ) of Dario Bettoni: Framing the Dark: Theory and phenomenology of a non-minimally coupled dark matter fluid. Current position: postdoc Haifa University. Israel.
- M.Sc. Co-Supervsion of Mattia Colombo (with Prof. Zerbini), University of Trento. Current position: PhD student in Physics, Nottingham University, UK.
- Ph.D. Co-Supervision (with Prof. S. Sonego) of Eolo di Casola: Sieving the Landscape of Gravity Theories

*Current supervisions:*

- Ph.D. Supervision of Bethan Cropp: Black Hole thermodynamics
- Ph.D. Supervision of Alessio Belenchia: Emergent gravity scenarios
- Ph.D. Supervision of Marco Letizia: Quantum gravity Phenomenology
- Ph.D. Supervision of Ramit Dey: Modified gravity and Dark Matter scenarios
- M.Sc. Supervision. Matteo Nori: Analogue models of Emergent Gravity.

**Teaching Experience**

- University of Maryland, College Park. USA. Lecturer of the undergraduate course Physics 117. (http://www.physics.umd.edu/courses/Phys117/). 2003
- University of Maryland, College Park. USA. Lecturer of the undergraduate course Physics 121. (http://www.physics.umd.edu/courses/Phys121/). 2003
- University of Maryland, College Park. USA. Lecturer of the undergraduate course Physics 122. (http://www.physics.umd.edu/courses/Phys122/). 2003
- SISSA. Introduction to quantum field theory. Astrophysics curriculum, SISSA, Trieste, Italy. Astroparticle curricula, SISSA, Trieste, Italy. 2004-2011

- SISSA. Advanced General Relativity and quantum field theory in curved spacetimes. Astrophysics and Astroparticle curricula, SISSA, Trieste, Italy. 2004-Present

**Participation to research organization**

Scientific Advisory Committee Marcel Grossman 2015, La Sapienza, Rome •Scientific Advisory Committee of Loop13, Perimeter Institute, Canada, 2013 • Local Organizing Committee of the Second Mediterranean conference on Classical and Quantum Gravity. Veli Losinj, Croatia 2013 • Co-Chair of

the parallel session QFT in curved spacetime, quantum gravity phenomenology and analogue gravity of the GR20 International Society on General Relativity and Gravitation Meeting, 2013 • Leading organizer of the ESF Exploratory Workshop Gravity as thermodynamics. SISSA • Scientific Advisory committee of SIGRAV Graduate School IX Edition "Analogue Gravity", Villa Olmo, Como, Italy, 2011 • Advisory Committee of the First Mediterranean conference on Classical and Quantum Gravity. Kolymbari, Crete, Greece 2009 • Organizing Committee of the Black hole in general relativity and string theory conference. Veli Losinj, Croatia. 2008 • Leading organizer of the international Workshop From Quantum to Emergent Gravity: Theory and Phenomenology. SISSA Winner of an ESF supporting grant. Lead editor for the workshop proceedings; published on PoS. • Co-organizer Open Day 2004 SISSA–ICTP.

**Referee for**

- *Journals*: Physical Review Letters, Physical Review D, JHEP, JCAP, Classical and Quantum Gravity, Journal of General Relativity, General Relativity and Gravitation, New Journal of Physics, Modern Physics Letters, International Journal of Modern Physics, International Journal of Theoretical Physics, Europhysics Letters.

- *Referee for Funding Agencies and Organizations*: Superior Council of the National Fund for Scientific & Technological Development (FONDECYT) • The Israel Research Foundation (ISF) • FQXi Macro-Grant review Panel 2010 * Natural Sciences and Engineering Research Council of Canada (NSERC).

**Activity in Academic Journals:**

Member of the Administration Council of SISSA MediaLab, Editorial Company of JHEP, JCAP, JSTAT, JINST.

## Current international collaborations

Ted Jacobson, University of Maryland, USA • Matt Visser, School of Mathematics, Statistics, and Computer Science, Victoria University of Wellington, New Zealand • Carlos Barcelo', Instituto de Astrofisica de Andalucia, Grandada, Spain • David Mattingly, University of New Hampshire, USA • Renaud Parentani, LPT Orsay, France • Silke Weinfurtner, University of Nottigham, UK.

**Track-Record :** Top 10 publications by citations *[citations from inSPIRE database **at March. 2015**]*

- "Analogue gravity".
  Carlos Barcelò, Stefano Liberati, Matt Visser.
  Living Rev.Rel. 8 (2005) 12, Living Rev.Rel. 14 (2011) 3
  Cited by 460 records. IF 22.33
- "Lorentz violation at high energy: Concepts, phenomena and astrophysical constraints".
  Ted Jacobson, Stefano Liberati, David Mattingly.
  Annals Phys. 321 (2006) 150-196
  Cited by 250 records. IF 2.857.
- "A Strong astrophysical constraint on the violation of special relativity by quantum gravity".
  T. Jacobson, Stefano Liberati, D. Mattingly.
  Nature 424 (2003) 1019-1021
  Cited by 214 records
- "Metric-affine f(R) theories of gravity".
  Thomas P. Sotiriou, Stefano Liberati.
  Annals Phys. 322 (2007) 935-966
  Cited by 191 records. IF 2.857
- TeV astrophysics constraints on Planck scale Lorentz violation
  Ted Jacobson, Stefano Liberati, David Mattingly

Phys.Rev. D66 (2002) 081302
Cited by 173 records. IF 4.558

- "Threshold effects and Planck scale Lorentz violation: Combined constraints from high-energy astrophysics".
  T. Jacobson, S. Liberati, D. Mattingly.
  Phys.Rev. D67 (2003) 124011
  Cited by 172 records. IF 4.558
- "New limits on Planck scale Lorentz violation in QED".
  Ted Jacobson, S. Liberati, D. Mattingly, F.W. Stecker.
  Phys.Rev.Lett. 93 (2004) 021101
  Cited by 148 records. IF 7.37
- "Analogue gravity from Bose-Einstein condensates"
  Carlos Barcelò, Stefano Liberati, Matt Visser.
  Class.Quant.Grav. 18 (2001) 1137
  Cited by 121 records. IF 3.562
- "Planck-scale modified dispersion relations and Finsler geometry".
  Florian Girelli, Stefano Liberati, Lorenzo Sindoni.
  Phys.Rev. D75 (2007) 064015
  Cited by 117 records. IF 4.558
- "Lorentz Violation: Motivation and new constraints".
  Stefano Liberati, Luca Maccione.
  Ann.Rev.Nucl.Part.Sci. 59 (2009) 245-267
  Cited by 88 records. IF 6.457

**Invited Seminars and Lectures**

December 2014, Invited plenary talk at DISCRETE2104, Kings College, London, UK* November 2104, Invited talk at George Ellis 75 years Celebration, Cape Town University, SA * August 2014, Invited seminar at IPA, Queen Mary College, London, UK * June 2104, Perimeter Institute Colloquium, PI, Waterloo, Canada * June 2014, Invited seminar at QG group, Perimeter Institute, Waterloo, Canada * May 2014, Invited talk at "Questioning Fundamental Physical Principles", CERN, Geneva, Switzerland * December 2013, Invited talk at Institut d'Astrophysique de Paris (IAP), Paris, France. * April 2013, Invited seminar at Nottingham University, Nottingham, UK * March 2013, Invited Seminar at Imperial College, London, UK. * February 2013, Invited Seminar at workshop "Focus week on Gravity and Lorentz violations", IPMU, Tokyo, Japan. * December 2012, Invited Seminar INFN Laboratories of Legnaro, Italy * October 2012, Invited seminar at workshop "Experimental Searches for Quantum Gravity: the hard facts", Perimeter Institute, Waterloo, Canada. * July 2012, Invited opening seminar at Workshop on Effective Gravity in Fluids and Superfluids, ICTP, Trieste, Italy. * October 2012, Experimental Search for Quantum Gravity, Perimeter Institute, Waterloo, Canada.* March 2012. Aalto Physics Colloquium, Helsinki University of Technology, Finland. * March 2012. Exploring Quantum Space-Time, Physikzentrum Bad Honnef, Germany. * January 2012. Plenary Talk APC Meeting on Superluminal Neutrinos APC, Paris, France. * October 2011. Gravity and Lorentz Violation, DAMTP, Cambridge, UK. * May 2011. Invited Seminar at Perimeter Institute, Waterloo, Canada. * March 2011. Invited Seminar at DAMTP, Cambridge, UK. * January 2011. Invited Colloquium at the Institute for the Physics and Mathematics of the Universe, Tokyo, Japan. * September 2010. Plenary talk at Spanish Relativity Meeting (ERE 2010), Granada, Spain. * July 2010. Experimental Search for Quantum Gravity, NORDITA, Stockholm, Sweden. * April 2010 University of Padua, Italy. * September 2009. 1st Mediterranean Conference, Kolymbari, Greece. * July 2009. Nice Colloquium on analogue gravity, Nice, France.* December 2008, DESY, Hamburg.* September 2008. Plenary Talk, SIGRAV 2008, Cosenza, Italy.* June 2008. QG2 2008 Quantum Geometry and Quantum Gravity Conference, Nottingham, UK.* May 2008. Gravitational scattering, black holes and the information paradox, Paris, France.* November 2007. Workshop on Experimental Search for Quantum Gravity, Perimeter Institute, Waterloo, Canada.* May 2006. Workshop on Frontier Objects in Astrophysics and Particle Physics, Vulcano, Italy.* August 2005. Analogue models of gravity meeting, COSLAB 2005,

Smolenice, Slovakia.* December 2005. University of California at Davis, Davis; USA.* December 2005. University of Maryland, College Park, USA.* September 2005. Fourth Meeting on Constrained Dynamics and Quantum Gravity, Cala Gonone. Italy.* August 2005 Analogue models of gravity meeting, COSLAB 2005, Smolenice, Slovakia.* March 2005. Instituto de Astrofisica de Andalucia, Granada. Spain.* March 2005. Zaragoza University, Zaragoza. Spain.* January 2005. Laboratori Nazionali del Gran Sasso, Assergi. Italy. * September 2004. Conference on Fundamental Symmetries and Fundamental Constants, ICTP, Trieste. * July 2004. GR17, Dublin. Ireland. * June 2004. University of Cagliari. Italy. * October 2003. University of Oxford, Oxford. * October 2003. Rutherford Appleton Laboratories, Oxford. Lecture on "the Casimir effect and its applications". *April 2003. American Physical Society Meeting, Philadelphia, USA. * May 2002. Quantum Vacuum Properties in Condensed Matter Physics and Cosmology, Tours; USA. * May 2002. University of Barcelona, Barcelona. Spain. * January 2002. University of Portsmouth, Portsmouth, UK. * October 2001. SISSA, Trieste; Università di Roma "La Sapienza", Roma; IAP, Paris. * June 2001. NIST, Gaithersburg. * May 2001. Black Holes III Conference, Kananaskis, Canada. * July 2000. IX Marcel Grossmann Meeting, Roma, Italy. * May 2000. Washington University, St. Louis; University of Maryland, College Park. * September 1999. Cosmo 99, ICTP, Trieste, Italy. * September 1999.Third Meeting on Constrained Dynamics and Quantum Gravity, Villa Simius, Italy. * May 1999. University of Texas, Austin; Texas A&M University, College Station. *April 1999 University of Maryland, College Park; Tufts University, Boston. * June 1998 Università di Perugia, Perugia. Italy. * July 1995 Fourth Italian-Korean meeting on relativistic astrophysics, Rome.

*Lectures at International schools:*

- March 2011. SIGRAV School Analogue Gravity. Villa Olmo, Como.
- August 2006. School on Particle Physics, Gravity and Cosmology, Dubrovnik, Croatia.
- February 2004. "Quantum Gravity Phenomenology School", Zakopane, Poland.

**Books**

Co-Editor of the Book: Analogue Garvity Phenomenology. Lecture Notes in Physics, Vol. 870.2103. Editors: Faccio, D.; Belgiorno, F.; Cacciatori, S.; Gorini, V.; Liberati, S.; Moschella, U. Spinger.

## Outreach

- **Popular science articles**

"Black stars not holes". Invited contribution for Scientific American.
Published in 2009 also in Italian, German, Spanish, Russian, Chinese and several other editions of Sci. Am.

- **Popular science seminars**

"Dalla Terra al Cielo", Open day Miramare Science Campus, ICTP, 2006.
"Lo spazio-tempo: alla scoperta della trama della realtà". Aosta, 2007.
"La natura dello spazio-tempo". FEST, Trieste, April 2008.
"La trama dello spazio-tempo". Vagabondi del Cosmo, Monfalcone, December 2009.
"La trama della realtà". IRSE, Pordenone, December 2009.
"La trama della realtà". Liceo Leopardi Majorana, Pordenone, December 2012.

- **Radio and Television**

Two interviews for RADIO3 Scienza in the Italian national public radio channel 3,

Interview in the Morning News Program of the National Broadcasting Company, RAI, Regional Channel.

## Scientific Profile

*Quantum gravity phenomenology:* Quantum gravity phenomenology is the name given to a booming field of research that aims at testing quantum gravity theories via possible relic signatures of quantum gravity below the Planck scale. While there are different classes of effects that can be looked for, a lot of attention has been given in recent years to departures from exact Lorentz invariance at ultra high energies (generally at the Planck scale). In 2002-2003, in collaboration with D. Mattingly and T. Jacobson, I have produced a stream of papers on astrophysical constraints that can be cast within an effective field theory framework on Planck scale suppressed departures from Lorentz violations. Among these results stands out the discovery of the extreme sensitivity of the synchrotron radiation to Lorentz breaking dispersion relations which lead to one of the strongest constraints up to date and was published in 2003 in *Nature*. In the years 2004 to 2012 these early results were extended to higher order dispersion relations (theoretically favoured) by applying standard techniques for the reconstruction of astrophysical spectra to the case of Lorentz breaking effective field theory and other dynamical framework (spacetime foam models from non-critical strings, Horava-Lifshiftz gravity). I am also author of several review papers on the state of the art of this field of research (some of them Top Cite on SPIRES) and of two invited contributions on the field one by the Annual Review of Nuclear and Particle science the other is a Topic Review for Classical and Quantum Gravity. Finally, I recently got a large grant for exploring quantum gravity phenomenology in Lorentz preserving scenarios.

*Analogue gravity:* Analogue gravity is a broad field of research aimed at using condensed matter system to simulate the dynamics of field on curved spacetimes. I have pioneered the field of analogue gravity and I am one of the co-authors (with C. Barcelò and M. Visser) of the Living Review of Relativity issue dedicated to this field. This review has currently more than 430 citations on SPIRES. I am also author of many original papers on the subject. I have been among the firsts to propose Bose-Einstein condensates as a viable system of analogue gravity studies in particular for observational tests of the Hawking effect in superfluid flows characterized by a region of supersonic flux, which for phonons would simulate a black hole. These ideas are now object of experimental efforts aimed at observing the analogue of Hawking radiation in these systems. As a spin-off of this research in analogue gravity I have been also among the proponents of the so called emergent gravity framework in particular by making use of the analogue gravity systems as toy models to explore the implications of the emergent gravity idea. This field of research is now a growing trend in gravitation theory.

*Thermodynamic aspects of Gravitation and Generalized Theories:* I have given recognized contribution to the well-established field of quantum field theory in curved spacetimes. In particular, in 2006-2008, I developed and studied (with few collaborators) the possibility of regular black hole spacetimes, not endowed with event horizons or in some cases even trapped regions (quasi-black holes) showing that many thermodynamic aspects of black hole physics could be preserved. Part of this research is reported in an invited paper in Scientific American that has been translated in several languages for the international editions of the magazine. I was invited by the International Society of General Relativity and Gravitation to co-chair the parallel section on quantum field theory in curved spacetime in the GR20 meeting to be held in Poland in the summer of 2013. I am also involved in research on the so-called thermodynamic aspects of spacetime. I have also given well-known contributions to the study of alternative theories of gravity. For example an Annual of Physics paper on the subjects now counts more than 180 citations on SPIRES.

*Wider societal impact:* I have given numerous public lectures, participated in radio programs. The result of my scientific work has received wide media attention worldwide (in particular for a paper showing the semiclassical instability of superluminal warp drives). I was actively involved, as vice-director, in the web site of popular science of SISSA, Ulisse, and I am currently a member of the Administration Council of SISSA MediaLab, the company producing JHEP and JCAP.