Giuseppe Vitagliano

Curriculum Vitae

Languages

Italian	**Mothertongue**	
English	**Advanced**	*Conversationally fluent*
Spanish	**Advanced**	*Conversationally fluent*
German	**Intermediate**	*B1 Certificate*
Catalan	**Basic**	*Basic words and phrases only*
Basque	**Basic**	*Basic words and phrases only*

Research interests: keywords

Quantum Information and its interplay with Many-Body Physics, Entanglement theory, Foundations of Quantum Physics, Quantum metrology, Cold Atom Physics, Temporal quantum correlations, Quantum thermodynamics, Quantum Optics

Education

2024 **Italian habilitation for Associate Professor**, *section Condensed Matter Theory*. (Professore di seconda fascia sett. 02/B2)

2010–2015 **Ph. D. in Quantum Science and Technology**, *University of The Basque Country*, Bilbao.
Highest Honours

2007–2010 **Masters in Theoretical Physics**, *University of Pisa*, Pisa.
Highest Honours

2004–2007 **Bachelors in Physics**, *University of Pisa*, Pisa.
Highest Honours

Ph. D. Thesis

Title *Spin Squeezing, Macrorealism and the Heisenberg uncertainty principle*

Supervisors Prof. Géza Tóth

Description Entanglement, spin squeezing and tests of quantum mechanical principles in atomic ensembles

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Masters Thesis

Title *Area laws for Entanglement, QMA-completeness of the local Hamiltonian problem and the simulation of Quantum Mechanics*

Supervisors Prof. José Ignacio Latorre & Prof. Pasquale Calabrese

Description Entanglement and its scaling in equilibrium states of spin-chains, in relation with computational problems

Bachelors Thesis

Title *Cilindri Rotanti e Possibilitá di CTC in Relativitá Generale*

Supervisors Prof. Enrico Meggiolaro

Description Study of causality violations in General Relativity

Current position

Nov 2023– **Principal Investigator of FWF Stand-Alone projects**, Atominstitut, TU Wien.

Past employments and career breaks

May 2023–Oct 2023 **Career break: Paternity leave**.

Jun 2022–Apr 2023 **Principal Investigator of FWF Stand-Alone project**, Atominstitut, TU Wien.

Apr 2021–May 2022 **Senior postdoc**, *YIRG group*, Institute for Quantum Optics and Quantum Information (IQOQI), Austrian Academy of Sciences.

Jun 2019–Mar 2021 **Senior postdoc (Lise-Meitner fellow)**, *Huber group*, Institute for Quantum Optics and Quantum Information (IQOQI), Austrian Academy of Sciences.

Sep 2018–Jun 2019 **Career break: Paternity leave**.

May 2018–Sep 2018 **Senior postdoc (Lise-Meitner fellow)**, *Huber group*, Institute for Quantum Optics and Quantum Information (IQOQI), Austrian Academy of Sciences.

Apr 2017–Apr 2018 **Postdoctoral Researcher**, *Huber group*, Institute for Quantum Optics and Quantum Information (IQOQI), Austrian Academy of Sciences.

Oct 2015–Mar 2017 **Postdoctoral Researcher**, *Géza Tóth group*, University of the Basque Country (UPV/EHU).

Dec 2010–Oct 2015 **PhD student**, *Géza Tóth group*, University of the Basque Country (UPV/EHU).

Research Projects Participations

Research Projects as a Principal Investigator

Dec 2022–Mar 2026 **Stand-Alone project P 36633-N**, *Non-equilibrium quantum working fluids: dynamics and usage (NEQFLUYDIM)*, (∼ 400.000 €, PI Giuseppe Vitagliano), Austrian Science Fund (FWF), DOI: 10.55776/P36633.
Role: Principal Investigator

June 2022–Dec 2026 **Stand-Alone project P 35810-N**, *Spatio-temporal correlations in many-body quantum systems (MANYSTRCORR)*, (∼ 410.000 €, PI Giuseppe Vitagliano), Austrian Science Fund (FWF), DOI: 10.55776/P35810 .
Role: Principal Investigator

May 2018–Mar 2021 **Lise-Meitner project M 2462-N27**, *Macroscopic Quantum Coherence: detection and quantification (MAQUACOH)*, (∼ 170.000 €, PI Giuseppe Vitagliano), Austrian Science Fund (FWF), DOI: 10.55776/M2462.
Role: Principal Investigator

Further Research Projects participations

May 2019 – June 2022 **Young Independent Research Group project ZK 3** , *Emergence of causal order in quantum theory and beyond*, (∼ 1.8 Million €, PI: Guryanova, Baumeler, Budroni), Austrian Science Fund (FWF), DOI: 10.55776/ZK3.
Role: postdoctoral team member, co-leader of research line

Apr 2017–June 2022 **START project Y879-N27**, *The role of quantum information in thermodynamics*, (∼ 1.2 Million €, PI: Marcus Huber), Austrian Science Fund (FWF), DOI: 10.55776/Y879.
Role: postdoctoral team member

2010–2017 **ERC Starting grant**, *Generation and detection of entanglement in quantum optical systems (GEDENTQOPT)*, (PI: Géza Tóth), European Research Council (ERC).
Role: PhD student

2012–2014 **CHIST-ERA project**, *Quantum States: Analysis and Realizations (QUASAR)*, (∼ 1.2 Million €, PI: H. Weinfurter, G. Tóth, R. Demkowicz-Dobrzanski, O. Guhne, P. Mataloni, S. Pitassi, A. Zeilinger, M. Zukowski), European Union.
Role: PhD student

Summary of publication record

- 6 preprints, 24 peer-reviewed articles (1 Science, 1 Nature Reviews, 5 Phys. Rev. Lett. (1 Editor's suggestion), 3 PRX Quantum, 1 Phys. Rev. Research, 4 Phys. Rev. A (1 Editor's suggestion, 1 Rapid communication, 1 invited perspective), 2 New J. Phys., 1 J. Phys. A, 4 Quantum, 1 invited book chapter)
- >1900 citations (h-index 18) in Google scholar

Dissemination activities

- 4 Scientific event organizations:
  1. Workshop on Quantum Metrology in Many-body and Open Systems, 9–13 Feb 2026 (∼ 40 invited speakers ∼ 70 expected participants)

2. Workshop on entanglement quantification in cold gases, 3–6 Feb 2020 (~ 20 invited speakers and ~ 50 participants)
3. Mini-workshop on the foundations of quantum mechanics, 10–12 Dec 2018, IQOQI-Vienna (~ 20 invited speakers and ~ 50 participants)
4. International Workshop on Cold Gases in Quantum Information, 30 June–1 July 2015, UPV/EHU (~ 20 invited speakers and ~ 100 participants)

- Several short and long-term visits including: University of Paris Cergy, University Paris 13 (Paris), University of Siegen, University of Pisa, University of Bilbao, University of Ulm, University of Barcelona, ICFO (Barcelona), IQOQI-Vienna, ISI-foundation (Torino)

- > 20 conference talks (6 invited) and > 20 poster presentations in quantum information conferences and workshops.

- Several popular-science publications about some of my works (e.g., Science **360** 416–418 (2018) and Phys. Rev. Lett. **112**, 155304 (2014))

Selected conference presentations

1. Spin-squeezing and many-body entanglement estimation, Invited speaker at conference, *Geometry of quantum dynamics* , Aug 28 - 30, 2024, Siegen (Germany).
2. Recent advancements in entanglement detection with spin-squeezing methods, Invited speaker at conference *Quantum Corona II*, Oct 2 - 6, 2023, Siegen (Germany).
3. Spin squeezing and entanglement detection via uncertainty relations in cold atoms, Speaker at conference *DICE2022: Spacetime - Matter - Quantum Mechanics*, Sep 19-23, 2022, Castiglioncello (Italy).
4. Quantum field thermal machines, Poster at conference *Bose-Einstein Condensation 2021*, Sep 11 - 17, 2021, Sant Feliu de Guixols (Spain).
5. Spin-squeezing and entanglement quantification in spin-j atomic gases, Invited speaker at conference *Entanglement in quantum fields*, Jun 28 - 30, 2021, Heidelberg (Germany).
6. $SU(d)$-squeezing and many-body entanglement detection with uncertainty relations, Invited speaker at conference *Entanglement days 2018*, Sep 26 - 28, 2018, Budapest (Hungary).
7. Generalized spin squeezing in the vicinity of Dicke states, Contributed talk at *XXXV Reunion Bienal RSEF*, Jul 13 - 17, 2015, Gijón (Spain).
8. Spin-squeezing and entanglement for arbitrary spin, Poster at *Quantum Information Processing and Communication International Conference (QIPC2013)*, Jun 30 - Jul 5, 2013, Florence (Italy).
9. Spin squeezing for higher spins, Invited talk at *2nd International Workshop on Quantum Entanglement and its Detection (QED2)*, Sep 21 - 26, 2011, Siegen (Germany).
10. Spin squeezing inequalities for higher spin particles, Invited talk at *COQUIT Workshop*, Sep 11 - 16, 2012, ISI Foundation, Torino (Italy).

Grants and Awards

2025 Ramón y Cajal fellowship (~ 310.000)€, Spanish ministry of science, innovation and universities (MICIU)

2022 Stand-alone grant (~ 400.000)€, Austrian Science Fund (FWF)

2022 Stand-alone grant (~ 410.000)€, Austrian Science Fund (FWF)

2018 Lise-Meitner 2-year senior postdoc fellowship (~ 170.000)€, Austrian Science Fund (FWF)

2010 Ph.D grant from SISSA (Trieste), section Condensed Matter Physics (declined)

2009

- Master Thesis grant from the University of Pisa, February-October 2009
- Erasmus grant from the University of Pisa, February-October 2009

2002-2004 Several regional and national prizes for high school scientific competitions (IMO, IPho, International Mathematical Championship (Bocconi University, Milan), E. R. Caianiello prize (University of Salerno))

Bio and research interests

I did my studies in Pisa (after an excellent track in high-school with numerous prizes, e.g., Mathematics and Physics Olympics) and defended my degrees with highest honours "cum laude". My contribution to research started with my masters' thesis, in the group of Josè Ignacio Latorre in Barcelona, with a grant from the University of Pisa. The topic was entanglement theory applied to many-body physics, supervised also by Pasquale Calabrese in Pisa, resulting in a high-impact publication (New J. Phys. 12 113049 (2010), currently with $>$ 150 citations).

I was then awarded a PhD grant in the "International School of Superior and Advanced Studies (SISSA)" in Trieste, which however I declined for focusing on more abstract topics in quantum information theory. I did my PhD in the group of Géza Tóth in Bilbao, where I worked in generalizing the state-of-art on spin squeezing, extensively developing the tools currently employed to detect entanglement in cold-atom experiments (PRL 107, 240502 (2011), PRL 112, 155304 (2014), Science 360 416–418 (2018) among others). Furthermore, I developed novel witnesses of temporal quantum correlations applicable to experiments with atomic ensembles (PRL 115, 200403 (2015)). Already during my PhD I worked in close contact with experimental (Mitchell, Klempt) and theoretical groups (Gühne, Plenio) and showed a high degree of independence and research maturity, being the main driving force of my PhD projects and even the starter of some of them. My PhD works had quite a widespread impact beyond the research field, and even reached the general public (some of them were covered in several popular articles).

Afterwards, I moved to the group of Marcus Huber at IQOQI-Vienna and I was awarded a Lise-Meitner grant, becoming a fully autonomous PI. I worked on entanglement theory connected with many-body physics, also contributing to a review on entanglement detection (Nat. Rev. Phys. 1, 72-87 (2019)). I also investigated the foundations of quantum thermodynamics, like the role of correlations (JPA: Math. Theo. 52 (46), 465303 (2019), Chapter 30 of Thermodynamics in the Quantum Regime (invited book chapter)) and the ultimate limits of refrigeration (PRX Quantum 4, 010332 (2023)). I also participated in a wide collaboration that aims at investigating thermodynamics in the quantum regime with an experimental perspective (PRX Quantum 2, 030310 (2021)).

In parallel, I contributed to ideate and write an interdisciplinary research proposal, that resulted in the creation of a "Young Independent Research Group" led by Yelena Guryanova, Ämin Baumeler and Costantino Budroni. I was co-leading the research line on temporal quantum correlations, with Costantino Budroni and also contributed to the overall organization of the group. I fully joined the group after the end of my Lise-Meitner grant. In this time I widened my investigation on quantum foundations including questions related to causality, metrology and time measurement (e.g., PRR 3,

033051 (2021), Quantum 8, 1224 (2024)). I was also the leading author of an invited perspective article on temporal quantum correlations (PRA 107, 040101 (2023)).

At the same time, I was developing my totally independent research line, connecting entanglement, thermodynamics and quantum metrology, which led me to write two research projects, both eventually funded by FWF Stand-alone grants. During this period I started co-supervising MSc and PhD students, (Shuheng Liu and Julia Mathé among others), as well as younger researchers. In particular, Julia Mathé has now joined my group at Atominstitut in Vienna and Shuheng Liu, who is now a very successful postdoctoral researcher in Beijing, has joined our research area as a visiting postdoc with his own funds.

I am currently the PI of two FWF Stand-Alone grants (810.000 euros total) and built my own group at Atominstitut in TU Wien (3 PhD students (Dimpi Thakuria, Julia Mathé and Bita Olamaei) + 1 postdoc and 1-2 master students to join soon) and I obtained the Italian habilitation as an Associate Professor in condensed matter theory. Moreover, I recently was awarded the prestigious Ramón y Cajal fellowship by the Spanish Ministry of science, innovation and universities (MICIU), which leads to a Tenure-Track position in a host Spanish institution that I am currently arranging.

My current research area ranges from quantum information, especially entanglement theory and quantum metrology to foundations of quantum physics and thermodynamics, touching also questions of many-body and condensed matter physics.

Key past collaborators

Prof. Yaron Bromberg (Jerusalem), Prof. Qiongyi He (Peking), Dr. Matteo Fadel (Zürich), Prof. Marcus Huber (Vienna), Dr. Matej Pivoluska (Brno), Dr. Costantino Budroni (Vienna), Prof. Jens Eisert (Berlin), Prof. Otfried Gühne (Siegen), Prof. Carsten Klempt (Hannover), Prof. José Ignacio Latorre (Barcelona), Prof. Morgan Mitchell (Barcelona), Prof. Yasser Omar (Lisbon), Prof. Martin Plenio (Ulm), Prof. Jörg Schmiedmayer (Vienna), Prof. Géza Tóth (Basque Country)

Teaching and supervision

- Responsible of two masters courses: Quantum Information theory II (5 CFU); Quantum Sensing (5 CFU) at FH Technikum Wien (winter semester 2025)
- Co-Supervision of master and PhD students (Paul Appel, Shuheng Liu (PhD defense 2023), Julia Mathé, Dimpi Thakuria, Bita Olamaei)
- External member of PhD committee: Merid Tufa, Addiss Ababa University (PhD defense 2021); Jérôme Denis, University of Liége, (PhD defense September 2025)

Other academic activities

- Referee for several top-journals in quantum science, including (Phys. Rev. Lett, X, A, D, E, Quantum, New J. Phys., J. Phys. A among others)

Full publication list

Non peer reviewed publications

1. *S. Liu, J. Guo, M. Fadel, Q. He, M. Huber, G. Vitagliano*, Entanglement Dimensionality of Continuous Variable States From Phase-Space Quasi-Probabilities arXiv:2509.02743 (2025)
2. *J. Mathé, A. Usui, O. Gühne, G. Vitagliano*, Estimating entanglement monotones of non-pure spin-squeezed states, arXiv:2504.07814 (2025)
3. *S. Du, S. Liu, M. Fadel, G. Vitagliano, Q. He*, Quantifying entanglement dimensionality from the quantum Fisher information matrix arXiv:2501.14595 (2025)
4. *S. Du, S. Liu, F. E. S. Steinhoff, G. Vitagliano*, Characterizing resources for multiparameter estimation of $SU(2)$ and $SU(1,1)$ unitaries, arXiv:2412.19119 (2024)
5. *S. Liu, Q. He, M. Huber, G. Vitagliano*, A nonlinear criterion for characterizing high-dimensional multipartite entanglement, arXiv:2405.03261 (2024)
6. *O. Marty, M. Cramer, G. Vitagliano, G. Toth, M. B. Plenio*, Multiparticle entanglement criteria for nonsymmetric collective variances, arXiv:1708.06986 (2017)

Peer reviewed publications

1. *G. Vitagliano, O. Gühne, G. Tóth*, $su(d)$-squeezing and many-body entanglement geometry in finite-dimensional systems, Quantum **9**, 1844 (2025), DOI:10.22331/q-2025-09-03-1844
2. *O. Lib, S. Liu, R. Shekel, Q. He, M. Huber, Y. Bromberg, G. Vitagliano*, Experimental certification of high-dimensional entanglement with randomized measurements, Phys. Rev. Lett. **134**, 210202 (2025) 10.1103/PhysRevLett.134.210202
3. *S. Liu, M. Fadel, Q. He, M. Huber, G. Vitagliano*, Bounding entanglement dimensionality from the covariance matrix, Quantum **8**, 1236 (2024), DOI:10.22331/q-2024-01-30-1236
4. *L. B. Vieira, S. Milz, G. Vitagliano and C. Budroni*, Witnessing environment dimension through temporal correlations, Quantum **8**, 1224 (2024), DOI:10.22331/q-2024-01-10-1224
5. *G. Vitagliano, C. Budroni*, Leggett-Garg Macrorealism and temporal correlations, Phys. Rev. A **107**, 040101 (2023), DOI:10.1103/physreva.107.040101 (invited perspective article)
6. *S. Liu, Q. He, M. Huber, O. Gühne, G. Vitagliano*, Characterizing entanglement dimensionality from randomized measurements, PRX Quantum **4**, 020324 (2023) DOI:10.1103/prxquantum.4.020324
7. *P. Taranto, F. Bakhshinezhad, A. Bluhm, R. Silva, N. Friis, M. P. E. Lock, G. Vitagliano, F. C. Binder, T. Debarba, E. Schwarzhans, F. Clivaz, M. Huber*, Landauer vs. Nernst: What is the True Cost of Cooling a Quantum System?, PRX Quantum **4**, 010332 (2023) DOI:10.1103/PRXQuantum.4.010332
8. *G. Vitagliano, M. Fadel, I. Apellaniz, M. Kleinmann, B. Lücke, C. Klempt, G. Tóth*, Number-phase uncertainty relations and bipartite entanglement detection in spin ensembles, Quantum 7, 914

(2023). DOI:10.22331/q-2023-02-09-914

9. *P. Appel, A. J. Heilman, E. W. Wertz, D. W. Lyons, M. Huber, M. Pivoluska, G. Vitagliano*, Finite-Function-Encoding Quantum States, Quantum **6**, 708 (2022). DOI:10.22331/q-2022-05-09-708

10. *M. Gluza*, J. Sabino*, N. H. Y. Ng*, G. Vitagliano*, M. Pezzutto, Y. Omar, I. Mazets, M. Huber, J. Schmiedmayer, J. Eisert*, Quantum field thermal machines, PRX Quantum **2**, 030310 (2021) DOI:10.1103/PRXQuantum.2.030310

11. *C. Budroni*, G. Vitagliano*, M. P. Woods**, Ticking-clock performance enhanced by nonclassical temporal correlations, Phys. Rev. Research **3**, 033051 (2021) DOI:10.1103/PhysRevResearch.3.033051

12. *M. Fadel, A. Usui, M. Huber, N. Friis, G. Vitagliano*, Entanglement Quantification in Atomic Ensembles, Phys. Rev. Lett. **127**, 010401 (2021) DOI:10.1103/PhysRevLett.127.010401

13. *F. Bakhshinezhad*, F. Clivaz*, G. Vitagliano, P. Erker, A. T. Rezakhani, M. Huber, and N. Friis*, Thermodynamically optimal creation of correlations, J. Phys. A: Math. Theo. **52** (46), 465303 (2019) DOI:10.1088/1751-8121/ab3932

14. *R. Uola*, G. Vitagliano*, C. Budroni**, Leggett-Garg macrorealism and the quantum nondisturbance conditions, Phys. Rev. A **100**, 042117 (2019) DOI:10.1103/physreva.100.042117

15. *N. Friis, G. Vitagliano, M. Malik, M. Huber*, Entanglement certification from theory to experiment, Nature Reviews Physics **1**, 72-87 (2019) DOI:10.1038/s42254-018-0003-5

16. *G. Vitagliano, C. Klöckl, M. Huber, N. Friis*, Trade-off Between Work and Correlations in Quantum Thermodynamics, in: Thermodynamics in the Quantum Regime, Chapter 30, F. Binder, L. A. Correa, C. Gogolin, J. Anders, and G. Adesso (eds.), Springer International Publishing, (2019) DOI:10.1007/978-3-319-99046-0_30

17. *K. Lange, J. Peise, B. Lücke, I. Kruse, G. Vitagliano, I. Apellaniz, M. Kleinmann, G. Toth, C. Klempt*, Entanglement between two spatially separated atomic modes, Science **360** 416–418 (2018) DOI:10.1126/science.aao2035

18. *G. Vitagliano, G. Colangelo, F. Martin Ciurana, M. W. Mitchell, R. J. Sewell and G. Tóth*, Entanglement and extreme planar spin squeezing, Phys. Rev. A **97** 020301(R) (2018) DOI:10.1103/PhysRevA.97.020301

19. *G. Vitagliano, I. Apellaniz, M. Kleinmann, B. Lücke, C. Klempt and G. Tóth*, Entanglement and extreme spin squeezing of unpolarized states, New J. Phys. **19** 013027 (2017) DOI:10.1088/1367-2630/19/1/013027

20. *C. Budroni, G. Vitagliano, G. Colangelo, R. J. Sewell, O, Gühne, G. Tóth, M.W. Mitchell*, Quantum non-demolition measurement enables macroscopic Leggett-Garg tests, Phys. Rev. Lett. **115**, 200403 (2015) DOI:10.1103/PhysRevLett.115.200403

21. *B. Lücke, J. Peise, G. Vitagliano, J. Arlt, L. Santos, G. Tóth, and C. Klempt*, Detecting multiparticle entanglement of Dicke states, Phys. Rev. Lett. **112**, 155304 (2014)
Editors' Suggestion; synopsis at physics.aps.org; article in the Revista Española de Física DOI:10.1103/PhysRevLett.112.155304

22. *G. Vitagliano, I. Apellaniz, I.L. Egusquiza, and G. Tóth*, Spin squeezing and entanglement for arbitrary spin, Phys. Rev. A **89**, 032307 (2014) DOI:10.1103/PhysRevA.89.032307

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23. *G. Vitagliano, P. Hyllus, I. L. Egusquiza and G. Tóth*, Spin Squeezing Inequalities for Arbitrary Spin , Phys. Rev. Lett. **107**, 240502 (2011) DOI:10.1103/PhysRevLett.107.240502

24. *G. Vitagliano, A. Riera and J.I. Latorre*, Volume-law scaling for the entanglement entropy in spin-1/2 chains, New J. Phys. **12** 113049 (2010) DOI:10.1088/1367-2630/12/11/113049

Monografies

1. *G. Vitagliano*, Spin Squeezing, Macrorealism and the Heisenberg uncertainty principle, (Ph. D. thesis), University of the Basque Country (2015)
http://arxiv.org/abs/1511.08104

2. *G. Vitagliano*, Area laws for Entanglement, QMA-completeness of the local Hamiltonian problem and the simulation of Quantum Mechanics, (Masters' thesis), University of Pisa (2010)
https://etd.adm.unipi.it/t/etd-01022010-142422/

3. *G. Vitagliano*, Cilindri Rotanti e Possibilitá di CTC in Relativitá Generale, (Bachelors' thesis), University of Pisa (2007)

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