

ALLEGATO A

UNIVERSITÀ DEGLI STUDI DI MILANO

Procedura di selezione per la chiamata a professore di II fascia da ricoprire ai sensi dell'art. 18, commi 1 e 4, della Legge n. 240/2010 per il settore concorsuale 02/B2, (settore scientifico-disciplinare FIS/03 FISICA DELLA MATERIA) presso il Dipartimento di FISICA Aldo Pontremoli, Codice concorso 4584

Costantino Budroni

CURRICULUM VITAE

(N.B. IL CURRICULUM NON DEVE ECCEDERE LE 30 PAGINE E DEVE CONTENERE TUTTI GLI ELEMENTI UTILI ALLA VALUTAZIONE DEI TITOLI SOTTOPOSTI AL GIUDIZIO DELLA COMMISSIONE)

INFORMAZIONI PERSONALI (NON INSERIRE INDIRIZZO PRIVATO E TELEFONO FISSO O CELLULARE)

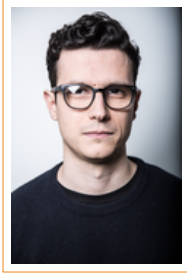
COGNOME	BUDRONI
NOME	COSTANTINO
DATA DI NASCITA	25 MAGGIO 1984

Data

4 giugno 2021

Luogo

Vienna



Costantino Budroni

Curriculum Vitae

PERSONAL INFORMATION

Current affiliation: University of Vienna and Institute for Quantum Optics and Quantum Information, Vienna, Austria

Citizenship: Italian

Place of Birth: Sassari, Italy

Date of Birth: 25th May 1984

Gender: Male

RESEARCH INTERESTS

Foundations of Quantum Mechanics and Quantum Information Theory: Bell Nonlocality, Contextuality, Einstein-Podolsky-Rosen Steering, Temporal Quantum Correlations, Quantum and Classical Causal Structures.

PROFESSIONAL EXPERIENCE

YIRG GROUP LEADER (APR. 2019 - NOW) University of Vienna and Institute for Quantum Optics and Quantum Information (IQOQI), Vienna, Austria,

POSTDOC (JAN. 2017 - MAR. 2019) Institute for Quantum Optics and Quantum Information (IQOQI), Vienna, Austria,
Prof. Časlav Brukner's group.

POSTDOC (OCT. 2014 - DEC. 2016) Naturwissenschaftlich-Technische Fakultät, Universität Siegen, Siegen, Germany,
Prof. Otfried Gühne's group.

EDUCATION

PHD (APR. 2012 - SEPT. 2014) PhD in Physics with highest honours (*summa cum laude*) Universität Siegen, Germany.
Supervisor: Prof. Otfried Gühne.

PHD (JAN. 2011 - MAR. 2012) PhD position at Universidad de Sevilla, Spain.
Supervisor: Prof. Adán Cabello.

MASTER'S DEGREE(2010-2011) in Physics and Mathematics, Universidad de Granada, Spain
Supervisor: Prof. Adán Cabello.

MASTER'S DEGREE(2007-2009) in Theoretical physics, with highest honours (110/110 *cum laude*), Università di Pisa, Italy
Supervisor: Prof. Giovanni Morchio.

BACHELOR'S DEGREE(2003-2007) in Physics, with highest honours (110/110 *cum laude*), Università di Pisa, Italy
Supervisor: Prof. Luciano Bracci.

TITLES, PRIZES AND GRANTS

- Four-year Young Independent Research Group (YIRG) grant from the Austrian Science Fund (FWF) 2019, [PI together with Ämin Baumeler and Yelena Guryanova, 1,806,050.07€].
- Italian habilitation (Abilitazione Scientifica Nazionale, II fascia). Valid from Aug. 2018.
- SFB grant for the project "BeyondC" (<https://www.beyondc.at/>) from the Austrian Science Fund (FWF) 2019 [co-PI together with Ämin Baumeler, PI Časlav Brukner (for our theory group of the consortium), 5,329,356.90€]
- Mini-grant from the Templeton World Charity Foundation for organizing a workshop on Quantum Contextuality. Nov. 2017 [2500\$].
- Two-year Lise-Meitner Post-doc fellowship from the Austrian Science Fund (FWF), 2016. [PI, 148,480.00€].
- Two-year Post-doc fellowship from the German Research Foundation (DFG), 2016. [I declined it as I accepted the FWF grant].
- Springer Thesis Prize 2015 for the PhD Thesis "Temporal Quantum Correlations and Hidden Variable Models".
- Preis der Universität Siegen für den internationalen Nachwuchs, 2014 (PhD thesis prize for international students of the University of Siegen).

TEACHING

Summer term 2016: Lecture "*Foundational aspects of Quantum Mechanics*" (Independent lecturer, Universität Siegen)

Summer term 2014: Exercises for "*Quantum Information Theory*" (Lecturer: Prof. O. Gühne,

Universität Siegen)

Winter term 2013/14: Exercises for “*Foundations of Quantum Mechanics*” (Lecturer: Prof. O. Gühne, Universität Siegen)

Winter term 2012/13: Exercises for “*Quantum Information Theory*” (Lecturer: Prof. O. Gühne, Universität Siegen)

Student supervision

Supervision of the master thesis of Jannik Hoffmann (Universität Siegen 2016).

Supervision of internship program of Lucien Jezequel (from ENS Lyon at IQOQI Vienna, 2019)

Supervision of the PhD student Lucas Vieira (Universität Wien and IQOQI Vienna, 2020-ongoing).

Student seminars

Organization of weekly journal club for students and postdocs of the YIRG group.

CONFERENCES, WORKSHOPS, AND PRESENTATIONS

INVITED SPEAKER:

4th workshop on Quantum Contextuality in Quantum Mechanics and Beyond (QCQMB), online meeting, May 17-21 2021.

Quantum Contextuality in Quantum Mechanics and Beyond (QCQMB) Colloquium, online meeting, Mar. 5 2021.

International conference: Quantum Frontiers and Fundamentals 2020, Raman Research Institute, Bangalore, India, Jan. 13-18 2020.

Wiener Memorial Lecture: Probability and Contextuality, Purdue University, USA, Nov. 9-12, 2018

2nd Workshop on Quantum Contextuality in Quantum Mechanics and Beyond, Prague, Czech Republic, May 19-20, 2018.

International conference: Quantum Frontiers and Fundamentals 2018, Raman Research Institute, Bangalore, India, Apr. 30-May 4 2018.

657. WE-Heraeus-Seminar: Quantum Correlations in Space and Time, Bad Honnef, Germany, Dec. 10-13, 2017.

Workshop on EPR steering, temporal steering, and correlations in quantum theory, RIKEN Tokyo, Feb. 6-16 2017.

Workshop on Quantum Networks, Natal, Brazil, Nov. 21-26 2016.

2nd International Conference on Quantum Foundations 2016, Patna, India, Oct. 17-21 2016.

FQXi workshop “Contextuality: why and how”, Linköping, Sweden Aug. 24-27 2015.

Symposium SAMOP Dissertation-Prize, DPG-Frühjahrstagung 2015, Heidelberg, Germany, Mar. 23-27 2015.

Entanglement Detection and Quantification Bilbao 2014, Bilbao, Spain, Mar. 10-13, 2014.

Workshop on Quantum Correlations, Contextuality and All That, Natal, Brazil, Dec. 9-13, 2013.

FQXi Workshop on Quantum Contextuality and Sequential Measurements, Sevilla, Spain, Nov. 4-6, 2013.

3rd International Workshop on Quantum Entanglement and its Detection, Bilbao, Spain, Sep. 3-7 2012.

CONTRIBUTED SPEAKER:

Central European conference on Quantum Information Processing (CEQIP), Skalica, Slovakia, Jun. 3-6, 2019.

Quantum Causal Structure intermediate workshop, JTF Consortium, Oxford, UK, Jun. 13-16, 2018.

Italian quantum information conference 2016, Rome, Italy, Sep. 20-23 2016
 Workshop on Quantum Bayesian Networks, Barcelona, Spain, Mar. 30 - Apr. 1 2016
 DPG-Frühjahrstagung 2103, 2014, 2015, 2016, 2017 (Hannover, Berlin, Heidelberg, Hannover, Mainz) Germany.
 586. WE-Heraeus-Seminar: Quantum correlations beyond entanglement, Apr. 13-15 2015, Bad Honnef, Germany.
 FQXi Workshop on Quantum Sequential Measurements and Complexity, Sept. 22-25 2014, Siegen, Germany.

INVITATION TO, AND TALK GIVEN AT, THE FOLLOWING UNIVERSITIES: University of Linköping, University of Vienna, University of Bonn, University of Düsseldorf, University of Köln, University of Freiburg, Imperial College London, University of Nottingham, University of Pisa, National Cheng Kung University (Taiwan), Federal University of Minas Gerais (Brazil), University of the Basque Country (Bilbao), University of Sevilla, Institute of photonic sciences (ICFO) Barcelona.

OTHER PROFESSIONAL ACTIVITIES

- Referee for *Nature Communications*, *Nature Photonics*, *Physical Review Letters*, *Physical Review X*, *Physical Review X Quantum*, *Physical Review A*, *New Journal of Physics*, *Journal of Physics A*, and *Quantum*.
- Organization of the Vienna Quantum Foundations Conference 2020 (<https://vqf.iqoqi.univie.ac.at/>), postponed to 2021 due to COVID-19.
- Organization of the *Mini-workshop on the foundation of quantum mechanics* at IQOQI Vienna, Dec. 10-12 2018, (<https://www.iqoqi-vienna.at/detail/news/mini-workshop-on-the-foundations-of-quantum-mechanics-1/>).
- Organization of the workshop *Temporal quantum correlations and Steering* at the University of Siegen, Oct. 4-6 2016 (http://www.physik.uni-siegen.de/tqo/conferences/temporal_correlations.html).
- Organization of the *FQXi Lectures Series 2015* at the University of Siegen, a series of lectures on fundamental problems in physics intended for an audience of non-specialists (<http://www.physik.uni-siegen.de/tqo/conferences/fqxi2015.html>).

BRIEF DESCRIPTION OF SCIENTIFIC CAREER

I obtained my PhD at the University of Siegen (Germany) in 2014 under the supervision of Prof. Otfried Gühne. During my PhD, I focused on the characterization of quantum correlations, such as, e.g., entanglement, nonlocality, and quantum contextuality, with a particular emphasis on the temporal scenario. In particular, this work led to important results on the characterization of temporal correlations [C. Budroni et al., *Phys. Rev. Lett.* 111, 020403 (2013), C. Budroni et al., *Phys. Rev. Lett.* 113, 050401 (2014)]. As a recognition for this work, I received the prize of the University of Siegen for international PhD students, I have been one of the four finalists of the 2015 SAMOP (atomic-molecular-optics-plasma section) Dissertation Prize from the German Physical Society (DPG), and my thesis has been selected by Springer to be published as a book in the Springer Theses series.

As a postdoc at the University of Siegen, I worked on a broader range of topics, from experimental proposals of Leggett-Garg tests [C. Budroni et al., *Phys. Rev. Lett.* 115, 200403 (2015)] to Einstein-Podolsky-Rosen steering [R. Uola, C. Budroni et al. *Phys. Rev. Lett.* 115, 230402 (2015), S.-L. Chen, C. Budroni et al., *Phys. Rev. Lett.* 116, 240401 (2016)], and finally to causal structures

[R. Chaves and C. Budroni, Phys. Rev. Lett. 116, 240501 (2016), C. Budroni et al. Phys. Rev. A 94 042127 (2016)].

In 2017, I received a Lise-Meitner fellowship from the Austrian Science Fund (FWF) to join Prof. Brukner's group at the Institute for Quantum Optics and Quantum Information (IQOQI) of the Austrian Academy of Science in Vienna. There, I continued my work on causal structures and, in particular, on the theoretical possibility of a quantum superposition of causal orders [N. Miklin et al., New J. Phys. 19 113041 (2017), P. Allard-Guerin et al. New J. Phys. 21, 012001 (2019), L. J. Henderson et al. Phys. Rev. Lett. 25 131602 (2020)], on the relation between measurement incompatibility and quantum correlations [M.T. Quintino, C. Budroni et al., Phys. Rev. Lett. 123, 180401 (2019), R. Uola, G. Vitagliano and C. Budroni Phys. Rev. A 100, 042117 (2019)] and the characterization of correlations in time for system with finite memory [J. Hoffmann et al. New J. Phys. 20, 102001 (2018), C. Budroni et al. New J. Phys. 21, 093018 (2019)].

Together with my colleagues Āmin Baumeler and Yelena Guryanova, we've been awarded in 2019 the Young-Independent-Research-Group (YIRG) grant from the FWF, a highly prestigious grant awarded to only 7 groups across all disciplines in Austria in 2019 (ours was the only one in physics), to start an independent group working on a research project proposal that we autonomously developed. The group consists of three co-leaders (Baumeler, Budroni, Guryanova), two postdocs, and two phd students. Our research project, titled "Emergence of causal order in quantum theory and beyond", focuses on the notion of causality from an interdisciplinary perspective (physics and computer science) and combines ideas and approaches coming from quantum information, quantum thermodynamics, and computational complexity theory.

FULL PUBLICATION LIST

PEER-REVIEWED

1. S.-L. Chen, N. Miklin, C. Budroni, Y.-N. Chen, *Device-independent quantification of measurement incompatibility*, Phys. Rev. Research 3, 023143 (2021)
2. C. Spee, C. Budroni, and O. Gühne, *Simulating extremal temporal correlations*, New J. Phys. **22**, 103037 (2020).
3. L.J. Henderson, A. Belenchia, E. Castro-Ruiz, C. Budroni, M. Zych, Č. Brukner, R. B. Mann, *Quantum Temporal Superposition: The Case of Quantum Field Theory*, Phys. Rev. Lett. **125**, 131602 (2020).
4. C. Budroni, G. Fagundes, and M. Kleinmann, *Memory cost of temporal correlations*, New J. Phys. **21**, 093018 (2019).
5. M. T. Quintino, C. Budroni, E. Woodhead, A. Cabello, and D. Cavalcanti, *Device-independent tests of structures of measurement incompatibility*, Phys. Rev. Lett. **123**, 180401 (2019).
6. R. Uola, G. Vitagliano, and C. Budroni, *Leggett-Garg macrorealism and the quantum nondisturbance conditions*, Phys. Rev. A **100**, 042117 (2019).
7. C. Budroni *Contextuality, memory cost and non-classicality for sequential measurements*, Phil. Trans. R. Soc. A **377**: 20190141. (2019)
8. M. Navascués and C. Budroni, *Theoretical research without projects*, PLoS ONE **14**(3): e0214026 (2019).
9. P. Allard Guérin, M. Krumm, C. Budroni, Č. Brukner, *Composition rules for quantum processes: a no-go theorem*, New J. Phys. **21**, 012001 (2019).
10. J. Hoffmann, C. Spee, O. Gühne, and C. Budroni, *Structure of temporal correlations of a qubit*, New J. Phys. **20**, 102001 (2018).

11. S.-L. Chen, C. Budroni, Y.-C. Liang, Y.-N. Chen, *Exploring the framework of assemblage moment matrices and its applications in device-independent characterizations*, Phys. Rev. A **98**, 042127 (2018).
12. H.-Y. Ku, S.-L. Chen, C. Budroni, A. Miranowicz, Y.-N. Chen, and F. Nori, *Einstein-Podolsky-Rosen steering: Its geometric quantification and witness*, Phys. Rev. A **97**, 022338 (2018).
13. N. Miklin, A. A. Abbott, C. Branciard, R. Chaves, and C. Budroni, *The entropic approach to causal correlations*, New J. Phys. **19** 113041 (2017).
14. J. Kiukas, C. Budroni, R. Uola, and J.-P. Pellonpää, *Continuous variable steering and incompatibility via state-channel duality*, Phys. Rev. A **96**, 042331 (2017).
15. C. Budroni, N. Miklin, and R. Chaves, *Indistinguishability of causal relations from limited marginals*, Phys. Rev. A **94**, 042127 (2016).
16. R. Chaves and C. Budroni, *Entropic nonsignalling correlations*, Phys. Rev. Lett. **116**, 240501 (2016).
17. S.-L. Chen, C. Budroni, Y.-C. Liang, Y.-N. Chen, *Natural Framework for Device-Independent Quantification of Quantum Steerability, Measurement Incompatibility, and Self-Testing*, Phys. Rev. Lett. **116**, 240401 (2016).
18. M. Gachechiladze, C. Budroni, and O. Gühne, *Extreme violation of local realism in quantum hypergraph states* Phys. Rev. Lett. **116**, 070401 (2016).
19. R. Uola, C. Budroni, O. Gühne, J.-P. Pellonpää, *A one-to-one mapping between steering and joint measurability problems*, Phys. Rev. Lett. **115**, 230402 (2015).
20. C. Budroni, G. Vitagliano, G. Colangelo, R. J. Sewell, O. Gühne, G. Toth, M. Mitchell, *Quantum non-demolition measurement enables macroscopic Leggett-Garg tests*, Phys. Rev. Lett. **115**, 200403 (2015).
21. A. Asadian, C. Budroni, F. E. S. Steinhoff, P. Rabl, and O. Gühne, *Contextuality in phase space*, Phys. Rev. Lett. **114**, 250403 (2015).
22. A. Cabello, M. Kleinmann, and C. Budroni, *Necessary and sufficient condition for state-independent contextuality*, Phys. Rev. Lett. **114**, 250402 (2015).
23. C. Budroni and C. Emary, *Temporal quantum correlations and Leggett-Garg inequalities in multi-level systems*, Phys. Rev. Lett. **113**, 050401 (2014).
24. O. Gühne, C. Budroni, A. Cabello, M. Kleinmann, and J.-Å. Larsson, *Bounding the quantum dimension with contextuality*, Phys. Rev. A **89**, 062107 (2014).
25. M. Araújo, M.T. Quintino, C. Budroni, M. Terra Cunha, and A. Cabello, *All noncontextuality inequalities for the n -cycle scenario*, Phys. Rev. A **88**, 022118 (2013).
26. C. Budroni, T. Moroder, M. Kleinmann, and O. Gühne, *Bounding temporal quantum correlations*, Phys. Rev. Lett. **111**, 020403 (2013).
27. E. Amselem, M. Bourennane, C. Budroni, A. Cabello, O. Gühne, M. Kleinmann, J.-Å. Larsson, and M. Wieśniak, *Comment on "State-Independent Experimental Test of Quantum Contextuality in an Indivisible System"*, Phys. Rev. Lett. **110**, 078901 (2013).
28. M. Kleinmann, C. Budroni, J.-Å. Larsson, O. Gühne, and A. Cabello, *Optimal inequalities for state-independent contextuality*, Phys. Rev. Lett. **109**, 250402 (2012).
29. C. Budroni and A. Cabello, *Bell inequalities from variable elimination methods*, J. Phys. A: Math. Theor. **45**, 385304 (2012).
30. C. Budroni and G. Morchio, *Bell inequalities as constraints on unmeasurable correlations*, Found. Phys. **42**, 544 (2012).
31. C. Budroni and G. Morchio, *The extension problem for partial Boolean structures in quantum mechanics*, J. Math. Phys. **51**, 122205 (2010).

PREPRINTS

1. L. Vieira and C. Budroni, *Temporal correlations in the simplest measurement sequences*, arXiv:2104.02467
2. C. Budroni, A. Cabello, O. Gühne, M. Kleinmann, J.-Å. Larsson, *Quantum Contextuality*, arXiv:2102.13036 [Review paper commissioned by Rev. Mod. Phys. (editor D. P. DiVincenzo), submitted and currently under review.]
3. M. Navascues, C. Budroni, Y. Guryanova, *Disease control as an optimization problem*, arXiv:2009.06576
4. C. Budroni, G. Vitagliano, M. P. Woods, *Nonclassical temporal correlations enhance the performance of ticking clocks*, arXiv:2005.04241

BOOKS

- C. Budroni, *Temporal Quantum Correlations and Hidden Variable Models*, Springer Theses Series 2016

Date: Vienna, 4 June 2021.