

# Curriculum vitæ for Géza Tóth

January 14, 2025

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|----------------------|---|---|-----------|
| <b>Date of birth</b> | August, 1971  | <b>Citizenship</b>  | Hungarian |
| <b>Contact</b>       | Department of Theoretical Physics,<br>University of the Basque Country UPV/EHU,<br>P.O. Box 644, E-48080 Bilbao, Spain. | Phone: +34-94-601-7926 (office)<br>E-mail: geza.toth@ehu.eus<br><a href="http://www.gtoth.eu/">http://www.gtoth.eu/</a> |           |
|                      | Wigner Research Centre for Physics,<br>P.O. Box 49, H-1525 Budapest, Hungary.   | E-mail: toth.geza@wigner.mta.hu<br><a href="http://optics.szfki.kfki.hu/~toth">http://optics.szfki.kfki.hu/~toth</a>    |           |

## Working experience

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| Sep 2008              | Research Professor of IKERBASQUE, the Basque Foundation for Science (permanent),<br>Dept. of Theoretical Physics, University of the Basque Country UPV/EHU, Bilbao, Spain.<br>Also researcher associated to the Donostia International Physics Center (DIPC),<br>San Sebastian, Spain from 2019. |
| Feb 2007              | <u>Research fellow</u> at the Institute of Photonic Sciences, ICFO (M. Lewenstein), Barcelona, Spain.  |
| Feb 2006              | <u>Postdoctoral research associate</u> at the Department of Quantum Optics and<br>Quantum Information, Wigner Research Centre for Physics, Budapest, Hungary.  |
| Jan 2003              | <u>Postdoctoral research associate</u> at the Theoretical Division (J. I. Cirac),<br>Max Planck Institute for Quantum Optics, Munich, Germany.   |
| Oct 2000-<br>Sep 2002 | <u>Postdoctoral research associate</u> at the sub-department of theoretical physics (J. Yeomans),<br>University of Oxford, UK.   |

## Degrees

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| Aug 2000  | Ph. D. in Electrical Engineering from the University of Notre Dame (C. S. Lent), Indiana, USA.<br>Average grade (GPA): 3.875 (maximum: 4.00).  |
| June 1994 | Diploma (M. Sc.) in Electrical Engineering <i>with honor</i> from the Budapest University of<br>Technology and Economics and the Computer and Automation Research Institute<br>(A. Radványi and T. Roska). |

**Awards:** Bessel Research Award of the Humboldt Foundation

**Grants as PI:** ERC Starting Grant GEDENTQOPT (individual, 1.3 million euros, 5 years),  
QuantERA CEBBEC, MENTA (collaborative project, 3 years),  
CHIST-ERA QUASAR (collaborative project, 1.3 million euros, 2 years),  
Ramon y Cajal Fellowship of the Spanish Ministry of Education (5 years),  
Marie Curie Intra-European (Individual) Fwsp of the EU (2 years), etc. [see full list later]

**Referee for:** Science, Nature, Nat. Commun., Phys. Rev. Lett. (> 60), Phys. Rev. A/X, New J. Phys.,  
ERC, START (FWF, Austria), DFG, Feodor Lynen Fellowship (Germany), NSERC (Canada),  
OTKA (Hungary), NCN (Poland) [see full list later]

**Pub. stat.:** 79 papers: 2 Science, 1 Nat. Commun., 19 Phys. Rev. Lett. (2 Editors' Suggestion, 1 Synopsys),  
5 Appl. Phys. Lett., 1 Phys. Rep., 2 Quantum, 7 NJP, 3 PRResearch, 23 PRA, 1 PRB, 1 PRE  
> 8300 citations, h-index: 44 (ISI), see <http://www.researcherid.com/rid/A-6693-2008>  
> 13000 citations, h-index: 53 (Google Scholar)

## Theses

- March 2021 D. Sc. in Physical Sciences from the Hungarian Academy of Sciences,  
Thesis: Entanglement detection and quantum metrology in quantum optical systems,  
<http://real-d.mtak.hu/1230/>
- Aug 2000 Ph. D. in Electrical Engineering from the University of Notre Dame (C. S. Lent), Indiana, USA.  
Thesis: Coherence and Correlation in Quantum-dot Cellular Automata.  
Average grade (GPA): 3.875 (maximum: 4.00).
- June 1994 Diploma in Electrical Engineering *with honor* from the Budapest University of Technology and  
Economics and the Computer and Automation Research Institute (A. Radványi and T. Roska),  
Thesis: Depth detection using cellular neural networks - Three dimensional reconstruction  
of incompletely defined surfaces. Later research associate at the same institute.

## Awards

- 2019 **Friedrich Wilhelm Bessel Research Award**  
Alexander von Humboldt Foundation, Germany

## Fellowships, projects and grants as PI

- 2022-2025 **Quantum Science and Technologies**  
Ministerio de Ciencia, Innovación y Universidades (MCIU), PID2021-126273NB-I00  
PI: S. Martínez-Garaot and G. Tóth (before E. Rico and G. Tóth)
- 2022-2025 **Accessible Quantifiers of Multipartite Entanglement in Atomic Systems (MENTA)**  
QuantERA, PCI2022-132947  
PI of Spanish group: G. Tóth, International PI: C. Westbrook.  
PIs of other groups: C. Klempt, A. Smerzi, J. Schmiedmayer
- 2021-2026 **Entanglement detection and quantum metrology in quantum optical systems**  
NKFIH Élvonal (Hungary)
- 2018-2022 **Controlling EPR and Bell correlations in Bose-Einstein condensates (CEBBEC).**  
QuantERA, PCI2018-092896  
PI of Spanish group: G. Tóth, International PI: C. Westbrook.  
PIs of other groups: C. Klempt, A. Smerzi, M. Bonneau
- 2016-2020 **Quantum Technologies in Space (QTSpace)**  
COST Action, CA15220  
Proposer of the Action: A. Bassi  
Management Committee of Hungary: L. Diósi, G. Tóth.
- 2012-2014 **Quantum States: Analysis and Realizations (QUASAR).**  
CHIST-ERA, PRI-PIMCHI-2011-0904  
PI of Spanish group: G. Tóth, International PI: H. Weinfurter.  
PIs of other groups: R. Demkowicz-Dobrzanski, O. Gühne,  
P. Mataloni, S. Pitassi, A. Zeilinger, M. Zukowski.
- 2011-2017 **Generation and detection of entanglement in quantum optical systems**  
European Research Council (ERC) Starting Grant, GEDENTQOPT (258647)  
PI: G. Tóth (Individual grant). Employment of several postdocs and students.
- Sep 2009-Aug 2011 **Start-up grant of IKERBASQUE, the Basque Foundation for Science**

## Fellowships, projects and grants as PI (continued)

- 2010-2012      **Quantum control of microscopic and mesoscopic systems.**  
Project of the Spanish Ministry of Education, FIS2009-12773-C02-02  
PI: G. Tóth (Coordinator: J.G. Muga.)
- Feb 2007-Aug 2008      **Quantum Information: Multi-party Quantum Entanglement and its Applications in Physical Systems.**  
Five-year Ramon y Cajal Fellowship of  
the Spanish Ministry of Education and Science, RYC-2005-002007.  
[Discontinued due to taking a permanent research position of IKERBASQUE.]
- Sep 2006-Jan 2007      **Three-year Bolyai Research Scholarship of the Hungarian Academy of Sciences**  
[Discontinued due to taking the Ramon y Cajal Fellowship.]
- Feb 2006-Jan 2007      **Multi-partite entanglement in quantum optical systems.**  
Three-year Postdoctoral Grant of the National Research Fund of Hungary OTKA, PF63908.  
[Discontinued due to taking the Ramon y Cajal Fellowship.]
- Feb 2006-Jan 2007      **Multi-partite entanglement in quantum optical systems.**  
Marie Curie European Reintegration Grant of the European Union, MERG-CT-2005-029146.  
PI: G. Tóth (Individual grant).  
Employment of:
  - 3 Ph.D. students (Sep-Dec 2006, Sep-Dec 2006, Jan-Aug 2006),
  - 1 post-doctoral assistant (March-Aug 2006).
- Jan 2004-Dec 2005      **Entanglement Creation and Detection in Quantum Optical Systems.**  
Marie Curie Intra-European Fellowship of the European Union, MEIF-CT-2003-500183.  
PI: G. Tóth (Individual grant).

## Fellowships, projects and grants as senior participant

- 2021-      **Quantum Information, Science and Technology**  
Project of the Basque Government, IT1470-22  
PI: M. Modugno
- 2018-2020      **Mathematical examination of quantum communication tasks**  
Project of the National Research, Development and Innovation Office (Hungary) NKFIH, KH129601  
PI: M. Mosonyi
- 2017-2021      **Dynamics and measurement in coherent and open quantum information networks**  
Project of the National Research, Development and Innovation Office (Hungary) NKFIH, K124351  
PI: T. Kiss
- 2018-2023      **Physics for quantum technologies**  
Project of the Spanish Ministry of Education, PGC2018-101355-B-I00 (MCIU/AEI/FEDER,UE)  
PI: J. G. Muga co-PI: J. Siewert
- 2016-2021      **Quantum Information, Science and Technology**  
Project of the Basque Government, IT986-16  
PI: J. G. Muga
- 2016-2018      **Quantum matter: From foundations to applications**  
Project of the Spanish Ministry of Education, FIS2015-67161-P (MINECO/FEDER)  
PI: J. G. Muga co-PI: M. Modugno

|               |  |
|---------------|--|
| 2012-2014     | <b>Financial support for our Unidad de Formación e Investigación (UFI)</b><br>Funded by: University of the Basque Country UPV/EHU, Bilbao, UFI 11/55<br>PI: J. G. Muga<br>Participants: M. Modugno, I. Lizuain, M. Pons, J. Siewert, G. Tóth,<br>D. Sokolovski, E. Solano, L. A. Wu.   |
| 2013 Sept     | <b>Financial support for the 4th International Conference on Quantum Entanglement and its Detection (QED4), Siegen</b><br>Partly funded by: J. Phys. A, organizers: O. Gühne and G. Tóth   |
| 2013-2016     | <b>Quantumness, quantum control and devices</b><br>Project of the Spanish Ministry of Education, FIS2012-36673-C03-03<br>PI: L. A. Wu (Coordinator: J.G. Muga.)  |
| 2012 Sept     | <b>Financial support for the 3rd International Conference on Quantum Entanglement and its Detection (QED3), Bilbao</b><br>Partly funded by: J. Phys. A, organizers: G. Tóth and O. Gühne   |
| 2011-2014     | <b>Quantum optical and quantum information processing networks and their nonclassical properties</b><br>Participant in the project of the National Research Fund of Hungary OTKA, K83858.<br>PI: T. Kiss, 11 people.   |
| 2010-2015     | <b>Quantum Information, Science and Technology</b><br>Project of the Basque Government, IT4720-10<br>PI: J. G. Muga<br>[90 points: fourth group in the category of consolidated groups (A) in the Basque Country.]   |
| 2009          | <b>Quantum State Engineering of Ultracold Atomic Systems</b><br>Full-time participant of the project of the Spanish Ministry of Education, FIS2008-00784<br>PI: M. Lewenstein<br>[G. T. left the project before its start due to taking a permanent research position of IKERBASQUE and applying to a project of the Spanish Ministry of Education as a PI.] |
| Jun 2007-     | <b>Quantum Optical Information Technology</b><br>Incorporated into the Consolider-Ingenio 2010 Project of the Spanish Ministry of Education<br>Coordinator J. Eschner.   |
| Feb 2006-2010 | <b>Quantum optical systems and applications in quantum informatics</b><br>Participant in the project of the National Research Fund of Hungary OTKA, T049234.<br>PI: J. Janszky, ca. 10-15 people.  |

## External funding of group members





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| 2010 | I. Urizar-Lanz, M.Sc. and Ph.D. Grant of the Basque Government (advisor G. Tóth, 4 years)      |
| 2012 | P. Hyllus, Ikerbasque Research Fellowship (5 years)  |
| 2015 | M. Kleinmann, Individual Grant of the German Research Foundation (DFG), KL 2726/2-1 (2 years), |
| 2015 | G. Fagundes, Brazilian grant to visit our group as a Ph.D. student of M. Kleinmann (11 months) |
| 2015 | M. Kleinmann, FQXI Large Grant, FQXi-RFP-1608 (2 years)  |
| 2023 | I. Apellaniz, tenure-track position "Professor Ayudante Doctor" at UPV/EHU (6 years)           |

## Preprints


1. S. Imai, and O. Gühne, G. Tóth,  
**Reference-frame-independent quantum metrology**,  
arXiv:2410.10518.
2. G. Tóth and Sz. Szalay,  
**Alternatives of entanglement depth and metrological entanglement criteria**,  
arXiv:2408.15350.
3. G. Vitagliano, O. Gühne, and G. Tóth,  
 **$su(d)$ -squeezing and many-body entanglement geometry in finite-dimensional systems**,  
arXiv:2406.13338.
4. Á. Lukács, R. Trényi, T. Vértesi, and G. Tóth,  
**Optimizing local Hamiltonians for the best metrological performance**,  
arXiv:2206.02820.
5. O. Marty, M. Cramer, G. Vitagliano, G. Tóth, and M. B. Plenio,  
**Multiparticle entanglement criteria for nonsymmetric collective variances**,  
arXiv:1708.06986.
6. G. Tóth,  
**Lower bounds on the quantum Fisher information based on the variance and various types of entropies**,  
arxiv:1701.07461.
7. L. Knips, C. Schwemmer, N. Klein, J. Reuter, G. Tóth, and H. Weinfurter,  
**How long does it take to obtain a physical density matrix?**,  
arxiv:1512.06866.
8. Z. Kádár, M. Keyl, R. Matjeschk, G. Tóth, and Z. Zimborás,  
**Simulating continuous quantum systems by mean field fluctuations**,  
arXiv:1211.2173.















## Refereed articles in journals











All publications in Phys. Rev. Lett. are open access. All publications from 2016 are open access, except for Science 360, 416 (2018).









1. S. Imai, G. Tóth, and O. Gühne,  
**Collective randomized measurements in quantum information processing**,  
Phys. Rev. Lett. 133, 060203 (2024) ; arXiv:2309.10745.
2. R. Trényi, Á. Lukács, P. Horodecki, R. Horodecki, T. Vértesi, and G. Tóth,  
**Activation of metrologically useful genuine multipartite entanglement**,  
New J. Phys. 26, 023034 (2024) ; arXiv:2203.05538.
3. G. Tóth and J. Pitrik,  
**Quantum Wasserstein distance based on an optimization over separable states**,  
Quantum 7, 1143 (2023) ; arXiv:2209.09925.
4. F. Iglói and G. Tóth,  
**Entanglement witnesses in the XY-chain: Thermal equilibrium and post-quench non-equilibrium states**,  
Phys. Rev. Research 5, 013158 (2023) ; arXiv:2207.04842.

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\*  denotes open access.


5. 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) ; arXiv:2104.05663.
6. G. Tóth and F. Fröwis,  
**Uncertainty relations with the variance and the quantum Fisher information based on convex decompositions of density matrices**,  
Phys. Rev. Research 4, 013075 (2022) ; arXiv:2109.06893.
7. K. F. Pál, G. Tóth, E. Bene, and T. Vértesi,  
**Bound entangled singlet-like states for quantum metrology**,  
Phys. Rev. Research 3, 023101 (2021) ; arXiv:2002.12409.
8. G. Tóth, T. Vértesi, P. Horodecki, and R. Horodecki,  
**Activating hidden metrological usefulness**,  
Phys. Rev. Lett. 125, 020402 (2020) ; arXiv:1911.02592.
9. J. Kong, R. Jiménez-Martínez, C. Troullinou, V. G. Lucivero, G. Tóth, and M. W. Mitchell,  
**Measurement-induced, spatially-extended entanglement in a hot, strongly-interacting atomic system**,  
Nat. Commun. 11, 2415 (2020) .
10. I. Apellaniz, I. Urizar-Lanz, Z. Zimborás, P. Hyllus, and G. Tóth,  
**Precision bounds for gradient magnetometry with atomic ensembles**,  
Phys. Rev. A 97, 053603 (2018) ; arXiv:1703.09056.
11. K. Lange, J. Peise, B. Lücke, I. Kruse, G. Vitagliano, I. Apellaniz, M. Kleinmann, G. Tóth, and C. Klempt,  
**Entanglement between two spatially separated atomic modes**,  
Science 360, 416 (2018); arXiv:1708.02480.
12. 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) ; arXiv:1705.09090.
13. G. Tóth and T. Vértesi,  
**Quantum states with a positive partial transpose are useful for metrology**,  
Phys. Rev. Lett. 120, 020506 (2018) ; arXiv:1709.03995.
14. E. P. Blair, G. Tóth, and C. S. Lent,  
**Entanglement loss in molecular quantum-dot qubits due to interaction with the environment**,  
J. Phys.: Cond. Mat. 30, 195602 (2018) ; arXiv:1702.06051.
15. I. Apellaniz, M. Kleinmann, O. Gühne, and G. Tóth,  
**Optimal witnessing of the quantum Fisher information with few measurements**,  
Phys. Rev. A 95, 032330 (2017) , Editors' Suggestion; arXiv:1511.05203.
16. 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) ; arXiv:1605.07202.
17. S. Altenburg, S. Wölk, G. Tóth, and O. Gühne,  
**Optimized parameter estimation in the presence of collective phase noise**,  
Phys. Rev. A 94, 052306 (2016) ; arXiv:1607.05160.
18. C. Budroni, G. Vitagliano, G. Colangelo, R. J. Sewell, O. Gühne, G. Tóth, and M. Mitchell,  
**Quantum non-demolition measurement enables macroscopic Leggett-Garg tests**,  
Phys. Rev. Lett. 115, 200403 (2015) ; arxiv:1503.08433.
19. I. Apellaniz, B. Lücke, J. Peise, C. Klempt, and G. Tóth,  
**Detecting metrologically useful entanglement in the vicinity of Dicke states**,  
New J. Phys. 17, 083027 (2015) ; arXiv:1412.3426.

20. C. Eltschka, G. Tóth, and J. Siewert,  
**Partial transposition as a direct link between concurrence and negativity**,  
Phys. Rev. A 91, 032327 (2015); Editors' Suggestion; arxiv:1505.01833.
21. G. Tóth, T. Moroder, and O. Gühne,  
**Evaluating convex roof entanglement measures**,  
Phys. Rev. Lett. 114, 160501 (2015) ; arxiv:1409.3806.
22. G. Tóth and I. Apellaniz,  
**Quantum metrology from a quantum information science perspective**,  
J. Phys. A: Math. Theor. 47, 424006 (2014) , special issue "50 years of Bell's theorem"; arxiv:1405.4878.
23. N. Behbood, F. Martin Ciurana, G. Colangelo, M. Napolitano, G. Tóth, R.J. Sewell, and M.W. Mitchell,  
**Generation of macroscopic singlet states in a cold atomic ensemble**,  
Phys. Rev. Lett. 113, 093601 (2014) ; Editors' Suggestion; arxiv:1403.1964.
24. C. Schwemmer, G. Tóth, A. Niggebaum, T. Moroder, D. Gross, O. Gühne, and H. Weinfurter,  
**Experimental Comparison of Efficient Tomography Schemes for a Six-Qubit State**,  
Phys. Rev. Lett. 113, 040503 (2014) ; arxiv:1401.7526.
25. 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, featured in physics.aps.org and in the Revista Española de Física; arxiv:1403.4542.
26. G. Vitagliano, I. Apellaniz, I. L. Egusquiza, and G. Tóth,  
**Spin squeezing and entanglement for arbitrary spin**,  
Phys. Rev. A 89, 032307 (2014) ; arxiv:1310.2269.
27. I. Urizar-Lanz, P. Hyllus, I. L. Egusquiza, M.W. Mitchell, and G. Tóth,  
**Macroscopic singlet states for gradient magnetometry**,  
Phys. Rev. A 88, 013626 (2013); arxiv:1203.3797.
28. G. Tóth and D. Petz,  
**Extremal properties of the variance and the quantum Fisher information**,  
Phys. Rev. A 87, 032324 (2013) ; arxiv:1109.2831.
29. T. Moroder, P. Hyllus, G. Tóth, C. Schwemmer, A. Niggebaum, S. Gaile, O. Gühne, and H. Weinfurter,  
**Permutationally invariant state reconstruction**,  
New J. Phys. 14, 105001 (2012) , Focus issue on Quantum Tomography; arXiv:1205.4941.
30. P. Hyllus, L. Pezzé, A. Smerzi, and G. Tóth,  
**Entanglement and Extreme Spin Squeezing for a Fluctuating Number of Indistinguishable Particles**,  
Phys. Rev. A 86, 012337 (2012); arxiv:1204.5329.
31. G. Tóth,  
**Multipartite entanglement and high precision metrology**,  
Phys. Rev. A 85, 022322 (2012); arxiv:1006.4368.
32. G. Vitagliano, P. Hyllus, I. L. Egusquiza, and G. Tóth,  
**Spin squeezing inequalities for arbitrary spin**,  
Phys. Rev. Lett. 107, 240502 (2011) ; arxiv:1104.3147.
33. E. Alba, G. Tóth, and J. J. García-Ripoll,  
**Mapping the spatial distribution of entanglement in optical lattices**,  
Phys. Rev. A 82, 062321 (2010); arxiv:1007.0985.
34. G. Tóth, W. Wieczorek, D. Gross, R. Krischek, C. Schwemmer and H. Weinfurter,  
**Permutationally invariant quantum tomography**,  
Phys. Rev. Lett. 105, 250403 (2010) ; arxiv:1005.3313.

35. I. Urizar-Lanz and G. Tóth,  
**Number operator-annihilation operator uncertainty as an alternative of the number-phase uncertainty relation**,  
Phys. Rev. A 81, 052108 (2010); arxiv:0907.3147.
36. G. Tóth and M. W. Mitchell,  
**Generation of macroscopic singlet states in atomic ensembles**,  
New J. Phys. 12, 053007 (2010) ; arxiv:0901.4110.
37. G. Tóth and O. Gühne,  
**Separability criteria and entanglement witnesses for symmetric quantum states**,  
Appl. Phys. B 98, 617 (2010); arxiv:0908.3679.  
[Special Issue: "Selected Papers Presented at the 2009 Spring Meeting of the Quantum Optics and Photonics Section of the German Physical Society", Guest Editor: M. Fleischhauer. The special issue presents papers based on the contributions selected by chairmen and chairwomen of various sessions.]
38. G. Tóth, W. Wieczorek, R. Krischek, N. Kiesel, P. Michelberger, and H. Weinfurter,  
**Practical methods for witnessing genuine multi-qubit entanglement in the vicinity of symmetric states**,  
New J. Phys. 11, 083002 (2009) ; arxiv:0903.3910.
39. W. Wieczorek, R. Krischek, N. Kiesel, P. Michelberger, G. Tóth, and H. Weinfurter,  
**Experimental entanglement of a six-photon symmetric Dicke state**,  
Phys. Rev. Lett. 103, 020504 (2009) ; arxiv:0903.2213.
40. O. Gühne and G. Tóth,  
**Entanglement detection (*review article*)**,  
Phys. Rep. 474, 1 (2009); arxiv:0811.2803.
41. G. Tóth and O. Gühne,  
**Entanglement and permutational symmetry**,  
Phys. Rev. Lett. 102, 170503 (2009) ; arxiv:0812.4453.
42. G. Tóth, C. Knapp, O. Gühne, and H.J. Briegel,  
**Spin squeezing and entanglement**,  
Phys. Rev. A 79, 042334 (2009) ; arxiv:0806.1048.
43. G. Tóth,  
**QUBIT4MATLAB V3.0: A program package for quantum information science and quantum optics for MATLAB**,  
Comput. Phys. Comm. 179, 430 (2008); arxiv:0709.0948.
44. G. Tóth, C. Knapp, O. Gühne, and H.J. Briegel,  
**Optimal spin squeezing inequalities detect bound entanglement in spin models**,  
Phys. Rev. Lett. 99, 250405 (2007) ; quant-ph/0702219.
45. M. L. Almeida, S. Pironio, J. Barrett, G. Tóth, and A. Acín,  
**Noise robustness of the nonlocality of entangled quantum states**,  
Phys. Rev. Lett. 99, 040403 (2007) ; quant-ph/0703018.
46. G. Tóth and J. J. García-Ripoll,  
**Efficient algorithm for multi-qudit twirling**,  
Phys. Rev. A 75, 042311 (2007); quant-ph/0609052.
47. G. Tóth,  
**Detection of multipartite entanglement in the vicinity of Dicke states with many excitations**,  
J. Opt. Soc. Am. B 24, 275 (2007), Feature issue on *Optical quantum information science* (Eds. B. Sanders, Y. Yamamoto, and A. Zeilinger); quant-ph/0511237.
48. N. Kiesel, C. Schmid, G. Tóth, E. Solano, and H. Weinfurter,  
**Experimental Observation of Four-Photon Entangled Dicke State with High Fidelity**,  
Phys. Rev. Lett. 98, 063604 (2007) ; quant-ph/0606234.




49. G. Tóth and A. Acín,  
**Genuine three-partite entangled states with a local hidden variable model**,  
Phys. Rev. A 74, 030306(R) (2006); quant-ph/0512088.
50. O. Gühne, M. Mechler, G. Tóth, and P. Adam,  
**Entanglement criteria based on local uncertainty relations are strictly stronger than the computable cross norm criterion**,  
Phys. Rev. A 74, 010301(R) (2006); quant-ph/0604050.
51. O. Gühne and G. Tóth,  
**Energy and multipartite entanglement in multidimensional and frustrated spin models**,  
Phys. Rev. A 73, 052319 (2006); quant-ph/0510186.
52. G. Tóth, O. Gühne, and H. J. Briegel,  
**Two-setting Bell inequalities for graph states**,  
Phys. Rev. A 73, 022303 (2006) ; quant-ph/0510007.
53. G. Tóth and O. Gühne,  
**Detection of multipartite entanglement with two-body correlations**,  
Appl. Phys. B 82, 237 (2006); quant-ph/0602068.  
[Special Issue: "Selected Papers Presented at the 2006 Spring Meeting of the Quantum Optics and Photonics Section of the German Physical Society", Guest Editors: Marciej Lewenstein and Cornelia Denz. The special issue presents papers based on the contributions selected by chairmen and chairwomen of various sessions.]
54. N. Kiesel, C. Schmid, U. Weber, G. Tóth, O. Gühne, R. Ursin, H. Weinfurter,  
**Experimental Analysis of a 4-Qubit Cluster State**,  
Phys. Rev. Lett. 95, 210502 (2005) ; quant-ph/0508128.
55. O. Gühne, G. Tóth, and H. J. Briegel,  
**Multipartite entanglement in spin chains**,  
New J. Phys. 7, 229 (2005) ; quant-ph/0502160.
56. O. Gühne, G. Tóth, P. Hyllus, and H. J. Briegel,  
**Bell Inequalities for Graph States**,  
Phys. Rev. Lett. 95, 120405 (2005) ; quant-ph/0410059.
57. G. Tóth and O. Gühne,  
**Detecting Multi-Party Entanglement in the Stabilizer Formalism**,  
Phys. Rev. A 72, 022340 (2005) ; quant-ph/0501020.
58. G. Tóth, O. Gühne, M. Seevinck, and J. Uffink,  
**Addendum to “Sufficient conditions for three-particle entanglement and their tests in recent experiments”**,  
Phys. Rev. A 72, 014101 (2005); quant-ph/0505100.
59. G. Tóth and O. Gühne,  
**Detecting Genuine Multipartite Entanglement with Two Local Measurements**,  
Phys. Rev. Lett. 94, 060501 (2005) ; quant-ph/0405165.
60. G. Tóth,  
**Entanglement Witnesses in Spin Models**,  
Phys. Rev. A 71, 010301(R) (2005); quant-ph/0406061.
61. G. Tóth,  
**Entanglement Detection in Optical Lattices of Bosonic Atoms with Collective Measurements**,  
Phys. Rev. A 69, 052327 (2004); quant-ph/0310039.
62. G. Tóth, C. Simon and J. I. Cirac,  
**Entanglement Detection Based on Interference and Particle Counting**,  
Phys. Rev. A 68, 062310 (2003); quant-ph/0306086.

63. G. Tóth, C. Denniston and J. M. Yeomans,  
**Hydrodynamics of domain growth in nematic liquid crystals**,  
Phys. Rev. E 67, 051705 (2003); cond-mat/0207322.
64. G. Tóth, C. Denniston and J. M. Yeomans,  
**Hydrodynamics of topological defects in nematic liquid crystals**,  
Phys. Rev. Lett. 88, 105504 (2002) ; cond-mat/0201378.
65. G. Tóth, C. Denniston and J. M. Yeomans,  
**Modelling nematohydrodynamics in liquid crystal devices**,  
Comp. Phys. Communications Vol. 147/1-2, 7 (2002); cond-mat/0204318.
66. R. K. Kumamuru, J. Timler, G. Tóth, C. S. Lent, R. Ramasubramaniam, A. O. Orlov, G. H. Bernstein and G. Snider,  
**Power Gain in a Quantum-dot Cellular Automata Latch**,  
Appl. Phys. Lett. 81, 1332-1334 (2002).
67. C. Denniston, G. Tóth and J. M. Yeomans,  
**Domain motion in confined liquid crystals**,  
J. Stat. Phys. 107, 187 (2002); cond-mat/0108112.
68. G. Tóth and C. S. Lent,  
**The Role of Correlation in the Operation of Quantum-dot Cellular Automata**,  
J. Appl. Phys. 89, 7943 (2001); cond-mat/0104406.
69. G. Tóth and C. S. Lent,  
**Quantum Computing with Quantum-dot Cellular Automata**,  
Phys. Rev. A 63, 052315 (2001).
70. A. O. Orlov, R. K. Kumamuru, R. Ramasubramaniam, G. Tóth, C. S. Lent, G. H. Bernstein and G. L. Snider  
**Experimental Demonstration of a Latch in Clocked Quantum-dot Cellular Automata**,  
Appl. Phys. Lett. 78, 1625, (2001).
71. A. Orlov, I. Amlani, R. K. Kumamuru, R. Ramasubramaniam, G. Tóth, C. S. Lent, G. H. Bernstein and G. L. Snider,  
**Experimental Demonstration of the Clocked Single-Electron Switching in Quantum-dot Cellular Automata**,  
Appl. Phys. Lett. 77, 295 (2000).
72. G. Tóth, A. Orlov, I. Amlani, C. S. Lent, G. H. Bernstein and G. L. Snider,  
**Conductance Suppression due to Correlated Electron Transport in Coupled Double-dots**,  
Phys. Rev. B 60, 16906 (1999); cond-mat/9911173.
73. A. Orlov, I. Amlani, G. Tóth, C. S. Lent, G. H. Bernstein and G. L. Snider,  
**Experimental demonstration of a binary wire for quantum-dot cellular automata**,  
Appl. Phys. Lett. 74, 2875 (1999).
74. I. Amlani, A. Orlov, G. Tóth, G. H. Bernstein, C. S. Lent and G. L. Snider,  
**Digital Logic Gate Using Quantum-dot Cellular Automata**,  
Science 284, 289 (1999).
75. G. Tóth and C. S. Lent,  
**Quasiadiabatic switching for metal-island quantum-dot cellular automata**,  
J. Appl. Phys. 85, 2977 (1999); cond-mat/0004457.
76. A. G. Radványi, L. Gáspár, and G. Tóth,  
**CNNUM Architecture and 3D Template Design Techniques**,  
Int. J. of Circuit Theory and Application 27, 25 (1999).
77. A. Orlov, I. Amlani, G. Tóth, C. S. Lent, G. H. Bernstein, and G. L. Snider,  
**Correlated Electron Transport in Coupled Metal Double-dots**,  
Appl. Phys. Lett., 73, 2787 (1998).

78. G. Tóth, C. S. Lent, P. D. Tougaw, Y. Brazhnik, W. Weng, W. Porod, R.-W. Liu, and Y.-F. Huang,  
**Quantum Cellular Neural Networks**,  
Superlattices and Microstructures 20, 473 (1996); cond-mat/0005038.
79. L. Nemes, G. Tóth, T. Roska, and A. Radványi,  
**Analogic CNN algorithms for 3D interpolation-approximation and object rotation using controlled switched templates**,  
Int. J. Circuit Theory and Application 24, 409 (1996).

## Perspective articles

1. G. Tóth,  
**Stretching the limits of multiparticle entanglement**,  
Quantum Views 4, 30 (2020) ; arxiv:2212.00111.

## Book chapters

1. C. Schmid, N. Kiesel, W. Laskowski, E. Solano, G. Tóth, M. Zukowski, and H. Weinfurter,  
**The Entanglement of the Symmetric Four-Photon Dicke State**,  
chapter from page 113 in book: *Quantum communication and security*,  
M. Zukowski, S. Kilin, and J. Kowalik (Eds.),  
Proceedings of the NATO Advanced Research Workshop on Quantum Communication and Security,  
Gdansk, Poland, 10-13 Sept. 2006,  
IOS Press, Netherlands, 2007,  
ISBN 978-1-58603-749-9.
2. M. Koniorczyk and G. Tóth,  
**Introduction to quantum entanglement** (in Hungarian),  
chapter on pages 95-106 in book: *New results in quantum optics and quantum electronics*,  
Zs. Heiner and K. Osvey (Eds.),  
Department of Optics and Quantum Electronics, University of Szeged, Szeged, Hungary, 2006,  
ISBN 963-482-779-9.

## Conference proceedings and research reports

1. N. Behbood, M. Napolitano, G. Colangelo, B. Dobust, S. Palacios Alvarez, R. Sewell, G. Tóth, and M. W. Mitchell,  
**Generation of a macroscopic singlet state in an atomic ensemble, in Conference on Lasers and Electro-Optics 2012**,  
OSA Technical Digest (Optical Society of America, 2012), paper QF3E.3. doi:10.1364/QELS.2012.QF3E.3
2. N. Behbood, M. Napolitano, G. Colangelo, B. Dubost, S. Palacios Alvarez, R. J. Sewell, G. Toth, and M. W. Mitchell,  
**Generation of a Macroscopic Singlet State in an Atomic Ensemble, in Research in Optical Sciences**,  
OSA Technical Digest (Optical Society of America, 2012), paper QM1B.2. doi:10.1364/QIM.2012.QM1B.2
3. C. Schwemmer, G. Tóth, W. Wiczorek, D. Gross, R. Krischek, and H. Weinfurter,  
**Permutationally invariant tomography of a four-qubit symmetric Dicke state**,  
Proceedings of the Conference on Lasers and Electro-Optics Europe (CLEO EUROPE/EQEC), 2011 Conference on and 12th European Quantum Electronics Conference, Munich, Germany, 22-26 May 2011.  
doi:0.1109/CLEOE.2011.5943393

4. N. Behbood, B. Dubost, M. Napolitano, M. Koschorreck, R. Sewell, G. Tóth, and M. W. Mitchell,  
**Generation of macroscopic singlet states in atomic ensembles**,  
Proceedings of the Conference on Lasers and Electro-Optics Europe (CLEO EUROPE/EQEC), 2011 Conference on and 12th European Quantum Electronics Conference Munich, Germany, 22-26 May 2011.  
doi:10.1109/CLEOE.2011.5942915
5. N. Behbood, B. Dubost, M. Napolitano, M. Koschorreck, R. Sewell, G. Tóth, and M. W. Mitchell,  
**Generation of macroscopic singlet states in atomic ensembles**, **Abstract for The 17th Central European Workshop on Quantum Optics (CEWQO)**,  
St. Andrews, Scotland, UK, on 6th-11th June, 2010. [www.st-andrews.ac.uk/~cewqo10/submission/f5505.pdf](http://www.st-andrews.ac.uk/~cewqo10/submission/f5505.pdf)
6. W. Wiczorek, R. Krischek, A. Ozawa, G. Tóth, N. Kiesel, P. Michelberger, T. Udem and H. Weinfurter,  
**Six-photon entangled Dicke state enabled by a UV enhancement cavity as novel SPDC photon source** (invited paper, keynote presentation),  
Proceedings of SPIE 7727, 77270L, 1-11 (2010). doi:10.1117/12.853599
7. G. Tóth, C. Knapp, O. Gühne, and H. J. Briegel,  
**Generalized spin squeezing criteria: Entanglement detection with collective observables**,  
Proceedings of The Ninth International Conference on Quantum Communication, Measurement and Computing (QCMC08), AIP Conf. Proc. 1110, 41 (2009). doi:10.1063/1.3131365
8. G. Tóth and O. Gühne,  
**Two measurement settings can suffice to verify multipartite entanglement**,  
Proceedings of The Seventh International Conference on Quantum Communication, Measurement and Computing (QCMC04), AIP Conf. Proc. 734, 234 (2004); quant-ph/0409132. doi:10.1063/1.1834423
9. R. K. Kumamuru, A. O. Orlov, G. Tóth, J. Timler, R. Ramasubramaniam, C. S. Lent, G. H. Bernstein and G. L. Snider,  
**Power Gain in a Quantum-dot Cellular Automata Latch**,  
Proceedings of the First IEEE Conference on Nanotechnology (IEEE-NANO 2001), Hawaii, USA, 28-30 October, 2001.
10. G. Tóth and C. S. Lent,  
**The Role of Correlation in the Operation of Quantum-dot Cellular Automata**,  
Proceedings of the European Conference on Circuit Theory and Design (ECCTD'01), Helsinki, August 2001.
11. C. Gerousis, X. Wang, G. Tóth, S. M. Goodnick, W. Porod, C.S. Lent and Á. Csurgay,  
**Modeling Nanoelectronic CNN Cells: CMOS, SETs and QCAs**,  
Proceedings of the IEEE International Symposium on Circuits and Systems (ISCAS'00), Geneva, May 2000.
12. C. Gerousis, S. M. Goodnick, X. Wang, W. Porod, Á. Csurgay, G. Tóth and C. Lent,  
**Modeling Nanoelectronic CNN Cells: CMOS, SETs and QCAs**,  
Proceedings of the European Conference on Circuit Theory and Design (ECCTD '99), Stresa, Italy, 1999.
13. G. Tóth, J. Timler and C. S. Lent,  
**Quantum Computing with Quantum-dot Cellular Automata using Coherence Vector Formalism**,  
Proceedings of the IEEE International Workshop on Computational Electronics (IWCE-6), Osaka, 1998.
14. W. Porod, C. S. Lent, G. Tóth, H. Luo, Á. Csurgay, Y.-F. Huang, and R.-W. Liu,  
**Quantum-dot Cellular Nonlinear Networks: Computing with Locally-Connected Quantum Dot Arrays**,  
Proceedings of the IEEE International Symposium on Circuits and Systems (ISCAS'97), 745-748, Hong Kong, 1997.
15. G. Tóth, C. S. Lent, P. D. Tougaw, Y. Brazhnik, W. Weng, W. Porod, R.-W. Liu and Y.-F. Huang,  
**Quantum Cellular Neural Networks**,  
Third International Symposium on Nanostructures and Mesoscopic Devices (NanoMES96), Santa Fe, 1996.

16. C. S. Lent, P. D. Tougaw, G. Tóth, W. Weng, Y. Brazhnik, and W. Porod,  
**Quantum Cellular Neural Networks**,  
Proceedings of the fourth Workshop on Physics and Computation (PhysComp96), Boston University, 22-24 November, 1996.
17. G. Tóth, P. Földesy, and T. Roska,  
**Distance preserving 1D Turing-wave models via CNN, implementation of complex-valued CNN, and solving a simple inverse pattern problem (detection)**,  
Proceedings of the IEEE International Workshop on Cellular Neural Networks and their Applications (CNNA-96), 109-114, Seville, 1996.
18. G. Tóth, P. Földesy, and T. Roska,  
**Distance preserving 1D Turing-wave models via CNN, implementation of complex-valued CNN, and solving a simple inverse pattern problem (detection)**,  
DNS-3-1996 (SzTAKI Research Report), Budapest, 1996.
19. B. Fehér, P. Szolgay, T. Roska, A. Radványi, T. Szirányi, M. Csapodi, G. Tóth, K. László, and I. Szatmári,  
**CNN-ACE: A Digital Floating Point CNN Emulator Engine**,  
Proceedings of the IEEE International Workshop on Cellular Neural Networks and their Applications (CNNA-96), 273-278, Seville, 1996.
20. G. Tóth, T. Roska and A. Radványi,  
**Analogic CNN Algorithm for 3D Interpolation-Approximation**,  
DNS-2-1995 (SzTAKI Research Report), Budapest, 1995.
21. M. Csapodi, L. Nemes, G. Tóth, T. Roska, and A. Radványi,  
**Some novel analogic CNN algorithms for object rotation, 3D interpolation-approximation, and a door-in-a-floor problem**,  
Proceedings of the Third IEEE International Workshop on Cellular Neural Networks and their Applications (CNNA-94), 435-439, Rome, 1994.

## Invited conference talks

1. *Number-phase uncertainty relations and bipartite entanglement detection in spin ensembles*, 7th Basque Quantum Science and Technology Workshop, organized by the Donostia International Physics Center (DIPC) and the EHU Quantum Center of the University of the Basque Country (UPV/EHU) in Donostia/San Sebastián, Spain, October 4, 2024
2. *Detecting bipartite and multipartite entanglement in cold gases close to Dicke states*, Workshop on continuously monitored quantum systems (CMONS 2023), University of Warsaw, Poland, 11-13 December 2023.
3. *Activation of metrologically useful genuine multipartite entanglement*, XIV Symposium KCIK-ICTQT on Quantum Information, Sopot (Gdansk), Poland, 18-20 May 2023. (Paweł and Ryszard Hordecki)
4. *Detecting metrologically useful multipartite entanglement in cold gases*, Quantum Interactive Dynamics II (QID-2) (organized by Alessio Leroze, Vir B. Bulchandani and Shivaaji Sondhi), Rudolf Peierls Centre for Theoretical Physics, Oxford University, Oxford, UK, 27–29 March 2023.
5. *Uncertainty relations with the variance and the quantum Fisher information*, Entanglement in action (organized by G. Gour, B. Kraus, J. I. Latorre, and K. Życzkowski), Centro de Ciencias de Benasque Pedro Pascual, Benasque, Spain, 15-20 May 2022.
6. *Semidefinite programming in quantum information theory, Quantum information theory and optimization theory (Kvantuminformáció és optimalizálás)*, Pécs, Hungary, 26-27 October 2021.
7. *Entanglement between two spatially separated atomic modes*, Workshop on Entanglement Quantification in Cold Gases (organized by G. Vitagliano and M. Fadel), Austrian Academy of Sciences, Vienna, Austria, 3-6 February 2020.

8. *Entanglement between two spatially separated atomic modes*, 45-minute plenary talk on the XVI International Conference on Quantum Optics and Quantum Information, Minsk, Belarus, May 13-17, 2019.
9. *Tutorial: Quantum metrology from a quantum information science perspective*, Conference of the German Physical Society, Rostock, Germany, 10 March 2019.
10. *How long does it take to obtain a physical density matrix?*, Mini-workshop on the foundations of quantum mechanics (organized by C. Budroni and G. Vitagliano), IQOQI, Wien, Austria, 10-12 December, 2018.
11. *Quantum Fisher information and entanglement*, Conference on Quantum Information Theory and Mathematical Physics (organized by M. Mosonyi), Dedicated to the memory of Dénes Petz (1953-2018), Mathematical Institute of the Budapest University of Technology and Economics, Budapest, 20-21 September, 2018.
12. *Entanglement between two spatially separated atomic modes*, Symposium: "Quantum Resources", National Quantum Information Centre, National Quantum Information Centre (KCIK), Sopot (Gdansk), Poland, 24-26 May 2018.
13. *Entanglement between two spatially separated atomic modes*, Workshop "Observability and Estimation in Quantum Dynamics", Institut Henri Poincaré (IHP), Paris, France, May 15-17, 2018.
14. *Optimal witnessing of the quantum Fisher information with few measurements*, ICTP-SISSA Advanced Workshop on Quantum Science and Quantum Technologies (organized by F. Illuminati, M. B. Plenio, V. Karimipour, U. Sen; local organiser: R. Fazio), ICTP, Trieste, Italy, September 11-15, 2017.
15. *Detecting metrologically useful multiparticle entanglement with few measurements: recent results*, Quantum metrology workshop (connected to the CRC DQ-mat), University of Hannover, Germany, 9-10 February 2017.
16. *Detecting metrologically useful multiparticle entanglement of Dicke states*, Recent Advances in Quantum Metrology (RAQM 2016), Warsaw, Poland, 2-4 March 2016.
17. *Quantum Information and Quantum Metrology (overview talk)*, Basque Quantum Science and Technologies Workshop, nanoGUNE, Donostia San-Sebastian, Spain, June 14, 2016.
18. *Detecting metrologically useful multiparticle entanglement of Dicke states*, 589. Wilhelm and Else Heraeus-Seminar Continuous Variable Entanglement in Atomic Systems: Fundamentals and Applications (organized by M. Oberthaler and P. Treutlein), Physikzentrum, Bad Honnef, Germany, 11-15 May 2015.
19. *Detecting multiparticle entanglement of Dicke states*, 7th Italian Quantum Information Science Conference (IQIS2014), Palazzo Fruscione, Salerno, Italy, September 15-19, 2014.
20. *Entanglement detection close to multi-qubit Dicke states in photonic experiments*, Workshop on the dynamics and asymptotics in the Dicke model and quantum networks, Mátraháza, Hungary, 3-7 May, 2012.
21. *Optimal spin squeezing inequalities for arbitrary spin*, Quantum Computing, Control and Communication Workshop 2011, Bernried (Munich), Germany, 8-11 October, 2011.
22. *Permutationally invariant quantum tomography*, Workshop on "New Trends in Quantum Dynamics and Entanglement", Abdus Salam ICTP, Trieste, Italy, 21 to 25 February 2011.
23. *Permutationally invariant quantum tomography*, International School and Conference on Quantum Information Processing and Applications (QIPA-2011), Harish-Chandra Research Institute (HRI), Allahabad, India, 14-20 February 2011.
24. *Generalized spin squeezing of unpolarized atomic ensembles and its modeling with Gaussian states*, 1st COQUIT Workshop, Institut für Theoretische Physik, Hannover, Germany, 18-20 November, 2010. (1 hour talk)
25. *Multipartite entanglement and its experimental detection*, Summer School "Modern Results in Quantum Theory" of the Roland Eötvös Physical Society (Atomic physics-quantum electronics and Particle physics divisions), Tihany, Hungary, August 30-September 3, 2010. ( $2 \times 50$  minute lecture)

26. *Multipartite entanglement and its experimental detection*, Quantum Information with Atoms, Photons and Solid State Systems, Grenoble, France, 17-19 June, 2010. (1 hour lecture)
27. *Entanglement and permutational symmetry*, Leuven Mathematical Physics Days (M. Fannes), Leuven, Belgium, 6-7 May, 2010.
28. *Entanglement detection using generalized spin squeezing inequalities*, Mini-Workshop on Quantum Statistics, Organizer: Dénes Petz, Rényi Institute of Mathematics, Budapest, Hungary, December 12, 2008.
29. *Generalized spin squeezing inequalities and metrological applications of entangled states*, Ringberg meeting of the Theory group of the Max Planck Institute for Quantum Optics, Germany, 11 December, 2007.
30. *Entanglement detection with the stabilizer formalism*, First International Workshop *Information and Quantum Physics*, Vienna, Austria, 31 October, 2004.

## Contributed conference talks

*Quantum Wasserstein distance based on an optimization over separable states*, ICE- 9 Quantum Information in Spain, Tenerife, Spain, November 11-16, 2024.

*Quantum Wasserstein distance based on an optimization over separable states*, APS March meeting (online), March 20-22, 2023.

*Quantum Wasserstein distance based on an optimization over separable states*, DPG Spring Meeting of the Atomic, Molecular, Quantum Optics and Photonics Section (SAMOP), Hannover, Germany, March 5-10, 2023.

*Number-phase uncertainty relations and bipartite entanglement detection in spin ensembles*, DPG Spring Meeting of the Atomic, Molecular, Quantum Optics and Photonics Section (SAMOP), Hannover, Germany, March 5-10, 2023.

*Uncertainty relations with the variance and the quantum Fisher information*, DPG Meeting of the Condensed Matter Section (SKM), Regensburg, Germany, 4-9 September 2022.

*Uncertainty relations with the variance and the quantum Fisher information*, *Quantum sensors and tests of new physics (QSNP)*, Hannover, Germany, 4-7 October 2022. (poster)

*Uncertainty relations with the variance and the quantum Fisher information*, Conference of the Roland Eötvös Physical Society, Veszprém, Hungary, August 21-24, 2022.

*Uncertainty relations with the variance and the quantum Fisher information*, New trends in complex quantum systems dynamics 2022, San Sebastian, 20-24 June, 2022.

*Uncertainty relations with the variance and the quantum Fisher information*, International Conference on Reduced Density Matrix Theory for Quantum Many-Fermion Systems (RDM2022), San Sebastian, 15-17 June, 2022.

*Activating hidden metrological usefulness*, *2nd European Quantum Technologies Conference (EQTC)*, 29 November-2 December 2021. (online poster, 1 December)

*Activating hidden metrological usefulness*, Quantum Information and Measurement VI (QIM), 1-5 November 2021. (online)

*Activating hidden metrological usefulness*, Virtual DPG-Tagung (DPG Meeting) of the Atomic, Molecular, Plasma Physics and Quantum Optics Section (SAMOP), 20-24 September 2021. (online)

*Activating hidden metrological usefulness*, *Quantum Optics X*, Torun, Poland, 5-11 September 2021. (online poster, 8 September)

*Activating hidden metrological usefulness*, March Meeting of the American Physical Society (APS), 15-19 March 2021. (online)

*Quantum states with a positive partial transpose are useful for metrology*, Quantum Speed Limits and Thermodynamics, UPV/EHU, Bilbao, 30 October 2019.

*Entanglement between two spatially separated atomic modes*, Conference of the Roland Eötvös Physical Society, Sopron, Hungary, 21-24 August 2019.

*Quantum states with a positive partial transpose are useful for metrology*, Engineering Quantum Open Systems 2019, UPV/EHU, Bilbao, 12 February 2019.

*Quantum states with a positive partial transpose are useful for metrology*, DPG-Frühjahrstagung, Erlangen, Germany, March 4-9, 2018.

*Lower bounds on the quantum Fisher information based on the variance and various types of entropies*, DPG-Frühjahrstagung, Erlangen, Germany, March 4-9, 2018.

*New types of entangled states for metrology in space*, 2nd Quantum Technology Workshop - Implementations for Space, ESA/ESTEC, The Netherlands, 14-15 November 2017. (5 minutes "elevator pitch" presentation)

*How long does it take to obtain a physical density matrix?*, New trends on complex quantum system dynamics, Universidad Politécnica de Cartagena, Cartagena, 8-12 May 2017.

*Witnessing metrologically useful multiparticle entanglement*, 11th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC2016), Berlin, 27-29 September 2016.

*Witnessing metrologically useful multiparticle entanglement*, Frontiers of Matter Wave Optics (FOMO 2016), Arcachon, France, 10-17 September 2016.

*Detecting metrologically useful multiparticle entanglement of Dicke states*, Entanglement Day 2, Wigner Research Centre for Physics, 24-25 September, 2015.

*Detecting multiparticle entanglement of Dicke states*, 12th International Conference on Quantum Communication, Measurement and Computing (QCMC2014), University of Science and Technology of China (USTC), Hefei, Anhui, China, November 2-6, 2014.

*Entanglement witnesses*, Entanglement Day (E-Day), Wigner Research Centre for Physics, Budapest, 4-5 September, 2014.

*Quantum metrology from a quantum information science perspective*, Entanglement Day (E-Day), Wigner Research Centre for Physics, Budapest, 4-5 September, 2014.

*Detection of multipartite entanglement close to symmetric Dicke states*, Conference of the German Physical Society, Berlin, Germany, 17-21 March 2014.

*Quantum Fisher information as the convex roof of the variance and its relation to multipartite entanglement*, 4th International Workshop on Quantum Entanglement and its Detection (QED4), Siegen, Germany, 23-27 September, 2013.

*Spin-squeezing inequalities for entanglement detection in cold gases*, Quantum Information Processing and Communication International Conference (QIPC2013), University of Florence, Florence, Italy, June 30-July 5, 2013.

*Spin-squeezing inequalities for entanglement detection in cold gases*, 13th International Conference on Squeezing and Uncertainty Relations (ICSSUR 2013), Nürnberg, Germany, 24-28 June, 2013.

*Permutationally Invariant Quantum Tomography and State Reconstruction*, Workshop Cartagena: New Trends in Complex Quantum System Dynamics, Universidad Politécnica de Cartagena, Cartagena, Spain, 8-12 April



2013.

*Multipartite entanglement and high precision metrology*, Conference of the German Physical Society, Hannover, Germany, 18-22 March 2013.

*Extremal properties of the variance and the quantum Fisher information*, Conference of the German Physical Society, Hannover, Germany, 18-22 March 2013.

*Permutationally Invariant Quantum Tomography and State Reconstruction*, Workshop on Mathematical Methods of Quantum Tomography, Fields Institute, Toronto, Canada, February 19-22, 2013.

*Quantum Chromodynamics meets Quantum Information*, 3rd Workshop on the QCD Structure of the Nucleon (QCD-N'12), Bilbao, Spain, 22-26 October, 2012.

*Permutationally invariant quantum tomography*, Workshop on Quantum Simulations, Bilbao, Spain, 22-25 October 2012.

*My major research topics: Spin squeezing et al.*, Workshop Información Cuántica en España (ICE-0), Madrid, 17-19 September 2012.

*Optimal generalized variance and quantum Fisher information*, Conference of the German Physical Society, Stuttgart, Germany, 12-16 March, 2012.

*Mapping the spatial distribution of entanglement in optical lattices*, Conference of the German Physical Society, Stuttgart, Germany, 12-16 March, 2012.

*Detecting  $k$ -particle entanglement with spin squeezing inequalities*, 2nd International Workshop on Quantum Entanglement and its Detection (QED2), University of Siegen, Germany, 19 September, 2011.

*Permutationally invariant quantum tomography*, Conference of the German Physical Society, Dresden, Germany, 13-18 March, 2011.

*Permutationally invariant quantum tomography*, International Conference on Quantum Information and Computation, Stockholm, Sweden, October 4-8, 2010. (30 minute talk)

*Entanglement and permutational symmetry*, 1st International Workshop on Quantum Entanglement and its Detection (QED2010), University of the Basque Country UPV/EHU, Leioa/Bilbao, Spain, 27-28 April, 2010.

*Practical methods for witnessing genuine multi-qubit entanglement in the vicinity of symmetric states*, Conference of the German Physical Society, Hannover, Germany, 8-12 March, 2010.

*Generation of macroscopic singlet states in atomic ensembles*, Conference of the German Physical Society, Hannover, Germany, 8-12 March, 2010.

*Generation of macroscopic singlet states in atomic ensembles*, 11th International Conference on Squeezed States and Uncertainty Relations (ICSSUR'09), Olomouc, Czech Republic, 22-26 June, 2009.

*Entanglement and permutational symmetry*, Conference of the German Physical Society, Hamburg, Germany, 2-6 March, 2009.

*Spin squeezing and entanglement*, 40th Symposium on Mathematical Physics, Toruń, Poland, 25-28 June, 2008.

*Efficient algorithm for multi-qudit twirling for ensemble quantum computation*, Spring Meeting of the German Physical Society, Düsseldorf, Germany, 19-23 March, 2007.

*Detection of multipartite entanglement in the vicinity of symmetric Dicke states*, 6th Joint Conference on Mathematics and Computer Science, Quantum Information Processing Workshop, University of Pécs, Pécs, Hungary, 13-15 June 2006.

*Two-setting Bell inequalities for graph states*, Spring Meeting of the German Physical Society, Frankfurt, 13-17 March, 2006.

*Genuine three-partite entangled states with a local hidden variable model*, Spring Meeting of the German Physical Society, Frankfurt, 13-17 March, 2006.

*Entanglement detection in the stabilizer formalism*, Quantum Physics Of Nature & 6th European QIPC Workshop, Vienna, Austria, 20-26 May, 2005.

*Detecting Entanglement with the stabilizer formalism*, 9th International Conference on Squeezed States and Uncertainty Relations, Besancon, France, 2-6 May, 2005.

*Entanglement witnesses in spin models*, Conference of the German Physical Society, Berlin, Germany, 4-9 March, 2005.

*Detecting Entanglement with the stabilizer formalism*, Conference of the German Physical Society, Berlin, Germany, 4-9 March, 2005.

*Detecting genuine multi-qubit entanglement with two local measurement settings*, Quantum Optics II, Cozumel, Mexico, 6-9 December, 2004.

*Hydrodynamics of topological defects in liquid crystals*, Liquid Crystal Colloid Meeting, Sheffield Hallam University, UK, April 2002.

*The role of correlation in the operation of quantum-dot cellular automata*, European conference on Circuit Theory and Design (ECCTD'01), Helsinki, August 2001.

*The role of correlation in the operation of quantum-dot cellular automata*, International Workshop and Seminar on Coherent Evolution in Noisy Environments, Max Planck Institute at Dresden, Germany, April 2001.

*Domain motion in confined liquid crystals*, conference of the British Liquid Crystal Society, Oxford, UK, March 2001.

*Approximate Quantum Dynamics of Coupled Two-state Systems*, APS March Meeting, Minneapolis, USA, March 2000.

*Quantum Computing with Quantum-dot Cellular Automata*, TMR Network School on Quantum Computation and Quantum Information Theory, Villa Gualino, Torino, Italy, 12-23 July, 1999.

*Quantum Computing with Quantum-dot Cellular Automata*, APS Centennial Meeting, Atlanta, USA, March 1999.

*Quantum Computing with Quantum-dot Cellular Automata using Coherence Vector Formalism*, IEEE International Workshop on Computational Electronics (IWCE-6), Osaka, Japan, 19-21 October 1998.

## Talks

[invited] *Number-phase uncertainty relations and bipartite entanglement detection in spin ensembles*, Colloquium within the Collaborative Research Centre “Designed Quantum States of Matter” (DQ-mat) at the University of Hannover, Hannover, Germany, 4 May 2023.

[invited] *Uncertainty relations with the variance and the quantum Fisher information*, University of Tübingen, Tübingen, Germany, 30 September 2022.

[invited] *Quantum states with a positive partial transpose are useful for metrology: numerical and analytical examples*, Kwek Leong Chuan’s theory group at the Center for Quantum Technologies, Singapore, 9 November 2021. (online)

[invited] *Quantum entanglement and its use in metrology*, Szilárd Leó Colloquium, Building F, lecture hall 213, Department of Physics, Budapest University of Technology and Economics, Budapest, 2 November 2021.

*Activating hidden metrological usefulness*, Quantum Information Seminar, Faculty of Physics, University of Warsaw, 4 March 2021. (online)

[invited] *Quantum metrology from quantum information science perspective*, Quantum Computer Science Seminar Budapest, 25 February 2021. (online)

*Quantum states with a positive partial transpose are useful for metrology*, University of Cologne, Cologne, Germany, 12 November 2019.

*Quantum metrology*, Colloquium at the University of Siegen, Siegen, Germany, 7 November 2019.

*Entanglement between two spatially separated atomic modes*, Donostia International Physics Center (DIPC), San Sebastian, Spain, 6 February 2019.

[invited] *Lower bounds on the quantum Fisher information based on the variance and various types of entropies*, Grup d'Informació Quàntica, Universitat Autònoma de Barcelona, Barcelona, 9-12 January, 2018.

*Witnessing metrological useful entanglement*, Institute for Nuclear Research (ATOMKI), Hungarian Academy of Sciences, Debrecen, Hungary, 22-23 November 2017.

[invited] *Quantum states with a positive partial transpose are useful for metrology*, Quantum Information Center in Gdansk (KCIK), Gdansk, Poland, 23-27 October 2017.

*How long does it take to obtain a physical density matrix?*, Wigner Research Centre for Physics, Budapest, Hungary, 26 January 2017.

*Witnessing metrologically useful multipartite entanglement*, ICFO, Barcelona, 12:00, 7 June 2016.

[invited] *Detecting metrologically useful multiparticle entanglement of Dicke states*, Colloquium at the Graduate College of the the Research Training Group 1729, Institute for Quantum Optics (group of C. Klempt) at the University of Hannover, Germany, 2 June, 2016; visit between 31 May-3 June, 2016.

G. Tóth, *Detecting metrologically useful multiparticle entanglement of Dicke states*, University of Firenze and LENS, Italy, 7-11 December 2015.

G. Tóth, *Detecting metrologically useful multiparticle entanglement of Dicke states*, Center for Quantum Dynamics Colloquium at the Kirchhoff-Institute, University of Heidelberg, Germany, 27-30 October 2015.

[invited] *Detecting metrologically useful multiparticle entanglement of Dicke states*, Department of Theoretical Physics, Budapest University of Technology, 28 September 2015.

*Introduction to entanglement theory & Detection of multipartite entanglement close to symmetric Dicke states*, Donostia International Physics Center (DIPC), San Sebastian, Spain, 10 February 2015.

*Introduction to entanglement theory & Detection of multipartite entanglement close to symmetric Dicke states*, Basque Center for Applied Mathematics (BCAM), Bilbao, Spain, 27 January 2015.

[invited] *Spin-squeezing inequalities for entanglement detection in cold gases*, Institute of Theoretical Physics, University of Ulm, Germany, 13 November, 2013.

*Spin-squeezing inequalities for entanglement detection in cold gases*, Wigner Research Centre for Physics, Budapest, Hungary, 29 July, 2013.

*Efficient algorithm for multi-qudit twirling for ensemble quantum computation*, Wigner Research Centre for Physics, Budapest, Hungary, 25 July, 2013.

[invited]*Spin-squeezing inequalities for entanglement detection in cold gases*, Group of Theoretical Physics: Quantum Information and Quantum Phenomena of the Universitat Autònoma de Barcelona (J. Calsamiglia), Barcelona, 11 June, 2013.

[invited]*Spin-squeezing inequalities for entanglement detection in cold gases*, Colloquium at the Graduate College of the the Research Training Group 1729, Theoretical Quantum Optics Group (L. Santos) at the University of Hannover, Germany, May 21, 2013; visit between 20-23 May, 2013.

[invited]*Permutationally invariant tomography*, Institute for Experimental Physics, University of Innsbruck, Innsbruck, Austria, 30 May, 2011.

*Multipartite entanglement and high precision metrology*, Department of Mathematics, Budapest University of Technology and Economics, Budapest, Hungary, 25 August, 2010.

[invited lecture in a lecture series] *Quantum entanglement and its detection with few measurements*, Grupo de Información y Computación Cuánticas, Departamento de Física Teórica I, Facultad de Ciencias Físicas, Universidad Complutense, Madrid, Spain, 3 December, 2009. ( $2 \times 45$  minute lecture)

*Separability of symmetric states*, talk on one of the von Neumann Seminars organized by D. Petz, Department of Mathematics, Budapest University of Technology and Economics, Budapest, Hungary, 25 August, 2009.

*Generation of macroscopic singlet states in atomic ensembles*, Center for Quantum Optics, Niels Bohr Institute, Copenhagen, Denmark, 16 June, 2009.

*Entanglement and Permutational Symmetry*, Quantum Information Theory group, ICFO-The Institute of Photonic Sciences, Barcelona, Spain, 28 May, 2009.

*Generation of macroscopic singlet states in atomic ensembles*, Theory group at the Max Planck Institute for Quantum Optics, Munich, Germany, 16 December, 2008.

[invited]*Spin squeezing and entanglement*, Centre for Quantum Optics and Quantum Information, Innsbruck, Austria, 7 May, 2008.

*Optimal spin squeezing inequalities detect bound entanglement in spin models*, Autonomous University of Barcelona (Universitat Autònoma de Barcelona), Barcelona, Spain, 15 April, 2008.

*Optimal spin squeezing inequalities detect bound entanglement in spin models*, Quantum Information and Computation Group, University of Barcelona, Barcelona, Spain, 4 April, 2008.

[invited]*Optimal spin squeezing inequalities detect bound entanglement in spin models*, Theoretical Physics Laboratory, IRSAMC, CNRS, Paul Sabatier University, Toulouse, France, 5 February, 2008.

*Efficient algorithm for multi-qudit twirling*, talk on one of the von Neumann Seminars organized by D. Petz, Department of Mathematics, Budapest University of Technology and Economics, Budapest, Hungary, 19 December, 2007.

[invited lecture in a lecture series]*Entanglement and its experimental detection*, Quantum Information and Computation Group, Theoretical Physics Department 1, Faculty of Science, Universidad Complutense, Madrid, Spain, 21 November, 2007.

*Experimental detection of quantum entanglement*, Research Institute for Solid State Physics and Optics, Hungarian Academy of Sciences, Budapest, Hungary, 23 August, 2007.

*Optimal spin squeezing inequalities detect entanglement in spin models*, Theory Division, Max Planck Institute for Quantum Optics, Garching bei München, Germany, 21 May, 2007.

*Entanglement Detection with Witness Operators*, talk on one of the von Neumann Seminars organized by D. Petz, Department of Mathematics, Budapest University of Technology and Economics, Budapest, Hungary, 9

October, 2006.

[invited] *Genuine three-partite state with a local hidden variable model and multi-qudit twirling*, Centre for Quantum Optics and Quantum Information, Innsbruck, Austria, 28 September, 2006.

[invited] *Entanglement detection in the stabilizer formalism*, Institute of Photonic Sciences (ICFO), Barcelona, 26 October, 2005.

[invited] *Entanglement Detection with Witness Operators*, Department of Physics of Complex Systems, Eötvös University (ELTE), Budapest, 4 October, 2005.

[invited] *Entanglement and quantum optical systems*, Research Institute for Solid State Physics and Optics, Budapest, 21 June, 2005.

[invited] *The role of entanglement in quantum information*, Institute for Nanoelectronics, Technical University of Munich, Germany, 2 June, 2005.

[invited] *Entanglement detection in spin chains and optical lattices of two-state atoms*, Research Center for Quantum Information, Bratislava, Slovakia, 19 October, 2004.

[invited] *Detecting Genuine Multipartite Entanglement with Two Local Measurements*, Centre for Quantum Optics and Quantum Information, Innsbruck, Austria, 23 June, 2004.

*Many-qubit Entanglement Witnesses based on Simple Measurements*, Department of Nonlinear and Quantum Optics, Research Institute for Solid State Physics and Optics, Budapest, 15 June, 2004.

[invited] *Witnessing Many-Qubit Entanglement with Very Few Local Measurements*, Institut für Experimentalphysik, Universität Wien, Austria, 29 March, 2004.

*Muti-party entanglement detection with simple measurements*, Department of Theoretical Physics, Szeged University, Hungary, 18 December, 2003.

[invited] *Muti-party entanglement detection in spin chains and optical lattices of bosonic atoms with collective measurements*, Theoretical Quantum Optics Group at the University of Hannover, Germany, 10 December, 2003.

*Removing the redundancy from the density matrix and the state vector: alternative quantum state descriptions based on the hierarchy of correlations*, Centre for Quantum Computation, Oxford, UK, 5 December, 2001.

*The role of correlation in the operation of quantum-dot cellular automata*, Centre for Quantum Optics and Quantum Information, Innsbruck, Austria, 14 November, 2001.

*The role of correlation in the operation of quantum-dot cellular automata*, T-6 (W. H. Zurek), Los Alamos, USA, 26 October, 2001.

*Liquid crystal hydrodynamics with the Lattice Boltzmann method*, Workshop on Multiscale Algorithms for the Simulation of Materials and Fluids, Department of Mathematics, Imperial College, London, UK, 2 April, 2001.

*Quantum-dot Cellular Automata*, Semiconductor Physics Group, Cavendish Laboratory, Cambridge, UK, 1 February, 1999.

## Posters

*Activating hidden metrological usefulness*, Quantum Information and Measurement VI (QIM), 1-5 November 2021. (online, on 4 November 2021)

*Activating hidden metrological usefulness*, Quantum Optics X, Torun, Poland, 5-11 September 2021. (online poster)

*Detecting metrologically useful entanglement in Dicke states*, Conference and Working Group meeting of COST CA15220 QTSpace, Malta, 26-31 March, 2017.

*Spin squeezing and entanglement*, The Ninth International Conference on Quantum Communication, Measurement and Computing (QCMC), University of Calgary, Canada, 19-24 August, 2008.

*Optimal spin squeezing inequalities for entanglement detection with collective measurements*, Solvay Workshop on "Bits, Quanta and Complex Systems: modern approaches to photonic information processing", Belgium, 30 April-3 May, 2008.

*Optimal spin squeezing inequalities for entanglement detection with collective measurements*, EuroQUAM Inauguration Conference (Cold gases), Barcelona, Spain, 7-9 April, 2008.

*Optimal spin squeezing inequalities detect bound entanglement in spin models*, QIPC 2007 International Conference on Quantum Information Processing and Communication, Barcelona, Spain, 15-19 October, 2007.

*Optimal spin squeezing inequalities detect bound entanglement in spin models*, Symposium on the Foundations of Modern Physics, Vienna, Austria, 7-10 June 2007.

*Entanglement detection based on an upper bound on variances of collective observables for separable states*, Workshop on Quantum - Classical Transition and Quantum Information, Benasque, Spain, 18-23 June, 2006.

*Entanglement detection based on an upper bound on variances of collective observables for separable states*, Gordon Research Conference on Quantum Information, Il Ciocco, Barga, Italy, 7-12 May, 2006.

*Detecting Genuine Multipartite Entanglement with Only Two Measurement Settings*, Workshop on Entanglement and Transfer of Quantum Information, Isaac Newton Institute, Cambridge, UK, 26-30 September, 2004.

*Entanglement Witnesses with Simple Local Decomposition*, The Seventh International Conference on Quantum Communication, Measurement and Computing (QCMC2004), Glasgow, Scotland, 25-28 July, 2004.

*Entanglement Witnesses with Simple Local Decomposition*, Conference of the German Physical Society, Munich, Germany, 22-26 March, 2004.

*Entanglement Witnesses with Simple Local Decomposition*, Gordon Research Conference on Quantum Information, Ventura, California, USA, 22-27 February, 2004.

*Entanglement detection in continuous variable systems*, Euro Summer School on Quantum Gases in Low Dimensions, Les Houches, France, 15-25 April, 2003.

*Hydrodynamics of topological defects in liquid crystals*, 19th International Liquid Crystal Conference, Edinburgh, UK, 30 June-5 July, 2002.

*Hydrodynamics of topological defects in nematic liquid crystals*, Europhysics conference on discrete simulation of fluid dynamics, Cargèse, Corsica, France, July 2001.

## Research Group

- Employing Research Fellows and Senior Research Fellows

- 2011-2012: Dr. Philipp Hyllus
- 2012-2014: Dr. Zoltán Zimborás
- 2014: Dr. Iñigo Urizar-Lanz
- 2014 jan-jun (short stay): Dr. Charlotte van Hulse
- 2015-2017: Dr. Giuseppe Vitagliano
- 2017-2018, 2021-2023: Dr. Iagoba Apellaniz (tenure-track position "Professor Ayudante Doctor" at UPV/EHU (6 years), 2023)

- 2016-2017: Dr. Gael Sentís
  - 2014-2017: Dr. Matthias Kleinmann [ from June 2015 to May 2017 funded by an individual grant of M. K. of the German Research Society (DFG) ]
  - 2020-2022: Dr. Árpád László Lukács
  - 2021-: Dr. Róbert Trényi
  - 2021-: Dr. József Pitrik
  - 2021-2022: Dr. Szilárd Szalay
- Advising and employing Ph.D. students
    - 2010-2014: Iñigo Urizar-Lanz (Ph.D. grant of the Basque Government), Ph.D. thesis: "Quantum Metrology with Unpolarized Atomic Ensembles", 2014 (Theoretical Physics, UPV/EHU).  
Result: Sobresaliente cum laude.
    - 2011-2015: Giuseppe Vitagliano. Visited Prof. P. Calabrese, Department of Physics, University of Pisa, Italy. International Ph.D. thesis: "Spin squeezing, macrorealism and the Heisenberg uncertainty principle", 2015 (Theoretical Physics, UPV/EHU).  
Result: Sobresaliente cum laude.
    - 2013-2017: Iagoba Apellaniz. Visiting the group of Prof. O. Gühne, University of Siegen, Siegen, Germany, 2 months in 2014. Visiting the group of Prof. A. Smerzi, University of Florence, Italy, 1 month in 2016. International Ph.D. thesis: "Lower Bounds on Quantum Metrological Precision", 2017 (Theoretical Physics, UPV/EHU).  
Result: Sobresaliente cum laude.
  - Advising Master's students
    - 2009-2010: Iñigo Urizar-Lanz (M.Sc. and Ph.D. grant of the Basque Government). Thesis: "Number operator-annihilation operator uncertainty as an alternative for the number-phase uncertainty relation", 2010 (Theoretical Physics, UPV/EHU).
  - Master's students advised by Research Fellows of the group
    - 2011-2012: Iagoba Apellaniz. Thesis: "Quantum Limits on the Measurement Precision of a Magnetic Field Gradient", 2012 (Theoretical Physics, UPV/EHU). Advisor: P. Hyllus.
    - 2016-2017: Nuria Muñoz, Thesis: "Operational differences between complex and real quantum mechanics", 2017 (Theoretical Physics, UPV/EHU). Advisor: M. Kleinmann.
  - Short term employment from a one-year Marie Curie Reintegration Grant
    - March-Aug 2006: Attila Kárpáti (Ph.D. student)
    - Sep-Dec 2006: Zoltán Kurucz (Ph.D. student)
    - Jun-Dec 2006: Aurél Gábris (Ph.D. student)
    - Jan-Aug 2006: Dr. Máttyás Koniorczyk (postdoctoral research fellow)
  - Scientists visiting our group
    - Sanah Altenburg (Ph.D. student of O. Gühne at the U. of Siegen), 4 months, 2015.
    - Gabriel Fagundes (Ph.D. student of M. Kleinmann), 11 months in 2015-2016.
    - Satoya Imai (Ph.D. student O. Gühne at the U. of Siegen), 2 months in 2022.

## Conference organization (international)

1. Organized together with M. Koniorczyk and P. Adam, Quantum Information Processing Workshop at the 6th Joint Conference on Mathematics and Computer Science (MaCS), University of Pécs, Pécs, Hungary, 13-15 June 2006. 22 talks, 25 invited participants:

- Austria: J. Asbóth, O. Gühne.
  - Czech Republic: J. Bouda, I. Jex, H. Lavička, M. Stefanak, T. Tyc.
  - Germany: J.J. García-Ripoll, G. Giedke, P. Hyllus, N. Kiesel, C. Schmid, N. Schuh.
  - Hungary: P. Ádám, M. Benedict, P. Domokos, P. Földi, A. Gábris, J. Janszky, A. Kárpáti, T. Kiss, M. Koniorczyk, Z. Kurucz, D. Nagy, D. Petz, S. Varró.
2. Organizers: G. Tóth, O. Gühne, and E. Solano, 1st International Workshop on Quantum Entanglement and its Detection (QED2010), University of the Basque Country UPV/EHU, Leioa/Bilbao, Spain, 27-28 April, 2010. 7 invited talks:
- IQOQI, Austria: O. Gühne, B. Jungnisch, S. Niekamp,
  - Bilbao: J. Siewert, G. Tóth, I. Urizar-Lanz,
  - Belgium: T. Bastin.
- 10-15 participants.
3. Organizers: O. Gühne and G. Tóth, 2nd International Workshop on Quantum Entanglement and its Detection (QED2), University of Siegen, Germany, 23-26 September 2011. 8 invited talks:
- Austria: Julio de Vicente (Innsbruck).
  - Belgium: Thierry Bastin (Liege), Jean-Daniel Bancal (Genf).
  - Switzerland: David Gross (Zürich).
  - France: Daniel Braun (Toulouse).
  - Germany: Christian Schwemmer (München), Hermann Kampermann (Düsseldorf), M. Johanning (Siegen).
  - Spain: Jens Siewert (Bilbao), Remigiusz Augusiak (Barcelona).
- About 20-25 participants, C. Eltschka (Regensburg) together with the group members from Siegen (O. Gühne) and Bilbao (G. Tóth).
4. Organizers: G. Tóth and O. Gühne, 3rd International Workshop on Quantum Entanglement and its Detection (QED3), University of the Basque Country UPV/EHU, Leioa/Bilbao, Spain, 7-12 September 2012. With the support of Journal of Physics A. 10 contributed talks, 8 invited talks:
- Germany: Andreas Osterloh (Duisburg), David Gross (Freiburg), Christian Schwemmer (München).
  - Poland: Paweł Horodecki (Gdansk).
  - Spain: Lucas Lamata (Bilbao), Jens Siewert (Bilbao), Morgan W. Mitchell (Barcelona).
  - Great-Britain: Miguel Navascues (Bristol).
- About 25-30 participants, C. Eltschka (Regensburg) together with the group members from Siegen (O. Gühne) and Bilbao (G. Tóth). Local organizers: G. Tóth and I.L. Egusquiza.
5. Organizers: O. Gühne and G. Tóth, 4th International Workshop on Quantum Entanglement and its Detection (QED4), University of Siegen, Germany, 23-26 September 2014. With the support of Journal of Physics A. 17 contributed talks, 8 invited talks:
- Austria: Oleg Gittsovich (Innsbruck, Waterloo - Canada).
  - Slovakia: Mário Ziman (Bratislava).
  - Germany: Marcus Cramer (Ulm), Christian Schwemmer (München).
  - Poland: Rafal Demkowicz-Dobrzanski (Warsaw).
  - Spain: Jens Siewert (Bilbao), Marcus Huber (Barcelona), Remigiusz Augusiak (Barcelona).
- Altogether > 40 participants, mostly from the group of D. Bruß (Düsseldorf), O. Gühne (Siegen), and G. Tóth (Bilbao).
6. Organizers: G. Tóth, O. Gühne, and M. Cramer, International Conference on Entanglement Detection and Quantification, Bilbao, 10-13 March, 2014. Place: Sala Garate of the University of Deusto. Local organizers: G. Tóth, I.L. Egusquiza, C. Van Hulse, S. Nistal, G. Schnell.



- 16 invited talks: A. Acín (ICFO Barcelona), D. Bruß (U. Düsseldorf), M. Cheneau (Institut d'Optique, Paris), F. Illuminati (U. Salerno), F. Jelezko (U. Ulm), B. Kraus (U. Innsbruck), C. Klempt (U. Hannover), S. Kuhr (U. Strathclyde), M.W. Mitchell (ICFO Barcelona), M. Oberthaler (U. Heidelberg), P. Richerme (Uni Maryland & NIST), A. Sanpera (UAB Barcelona), R. Schmied (U. Basel), A. Smerzi (CNR-INO & LENS Florence), H. Weinfurter (LMU Munich), C. Wunderlich (U. Siegen).
  - 18 contributed talks: R. Sewell (ICFO Barcelona), C. Budroni (U. Siegen), J. Dunningham (U. Sussex), A. Gábris (Czech Technical University), M. Gessner (U. Freiburg), S.M. Giampaolo (U. Wien), M. Huber (UAB, Barcelona), H. Kampermann (U. Düsseldorf), N. Killoran (U. Ulm), Y.-C. Liang (ETH Zürich), O. Marty (U. Ulm), T. Moroder (U. Siegen), A. Osterloh (U. Duisburg-Essen), M. Ziman (Slovak Academy of Sciences), M. Sanz (UPV/EHU, Bilbao), J. Siewert (UPV/EHU, Bilbao), A. Stefanov (U. Bern), L. Tagliacozzo (ICFO Barcelona).
  - Around 30 posters, altogether 70-80 participants.
7. Local Organizing Committee: (co-chairs) L. Lamata, I. Egusquiza, (local organizers) M. Pons, M. Modugno, J. Siewert, G. Tóth, M. Kleinmann, G. Giedke, E. Solano, Workshop "Información Cuántica, España (ICE-2)" June 1-3, 2015. Annual quantum information conference for all Spain.
  8. Organizers: G. Vitagliano, I. Apellaniz, G. Tóth, International Workshop on Cold Gases in Quantum Information (CGQI), University of the Basque Country UPV/EHU, Leioa (Bilbao), 30 June-1 July, 2015.
    - 10 invited speakers: J. Asbóth (Wigner, Budapest), J. Calsamiglia (UAB, Barcelona), T. Grass (ICFO, Barcelona), P. Sinkovics (Wigner, Budapest), D. Spehner (Grenoble), Sz. Szalay (Wigner, Budapest), E. Szirmai (Wigner, Budapest), G. Szirmai (Wigner, Budapest), L. Tagliacozzo (ICFO, Barcelona), P. Venkatesh (IQOQI, Innsbruck).
    - 8 contributed talks from UPV/EHU: I. Apellaniz, I. L. Egusquiza, U. Las Heras, M. Modugno, G. Muga, E. Rico, M. Sanz, G. Vitagliano.
  9. Organizers: G. Tóth, Z. Zimborás, Sz. Szalay, J. Asbóth, Entanglement Days, Organized by the Wigner Research Centre for Physics, took place in Building "A", Budapest University of Technology and Economics, Budapest, 26-28 September, 2018.
    - 4 invited plenary talks: M. Huber (IQOQI, Vienna), O. Gühne (Siegen), K. Życzkowski (Crakow), T. Vértesi (ATOMKI, Debrecen).
    - 10 invited talks: I. Apellaniz (Bilbao), J. Calsamiglia (Barcelona), F. Huber (Siegen), I. Kovács (Boston), W. Laskowski (Gdansk), M. Oszmaniec (Gdansk), C. Schilling (Oxford), J. Siewert (Bilbao), G. Vitagliano (IQOQI, Vienna), M. Ziman (Bratislava).
    - 19 contributed talks: A. Streltsov (Gdansk), Z. Raissi (ICFO, Barcelona), N. Wyderka (Siegen), B. Dakić (IQOQI, Vienna), M. Farkas (Gdansk), R. Augusiak (Warsaw), M. Navascues (IQOQI, Vienna), A. Aloy (ICFO, Barcelona), L. Ostermann (Innsbruck), L. Knips (Max Planck Institute for Quantum Optics, Munich), J. Tura i Brugués (Max Planck Institute for Quantum Optics, Munich), B. Dóra (Budapest University of Technology and Economics), G. Sentís (Siegen), M. Kleinmann (Siegen), P. Vrana (Budapest University of Technology and Economics), J. Naudts (Antwerpen), A. Sawicki (Center for Theoretical Physics, Warsaw), T. Geszti (Eötvös University, Budapest), P. Vecsernyés (Wigner Research Centre for Physics).
    - > 25 posters, > 80 participants.
  10. Organizers: L. Diósi (Wigner RCP, Budapest), R. Kaltenbaek (University of Vienna), G. Tóth (Wigner RCP, Budapest and UPV/EHU, Bilbao), H. Ulbricht (University of Southampton), L. Wörner (University of Bremen), A. Xuereb (University of Malta). Local Organizer: Sz. Szalay (Wigner RCP, Budapest). Fundamental Quantum Physics and Applications in Space. Organized by the Wigner Research Centre for Physics, took place in Building "A", Budapest University of Technology and Economics, Budapest, 30 March-3 April, 2020. Our conference is organized in the context of, and is supported by, the COST Action "Quantum Technologies in Space" (QTSpace, CA15220). (Postponed due to the coronavirus outbreak.)
  11. In the program committee of AQIS 2023 (Seoul, Korea), chair Mark M. Wilde, steering committee chair: Jaewan Kim.

## Conference organization (national)

- Organizers: G. Tóth, J. Asbóth, Sz. Szalay, and I. Kovács, Entanglement Day, Wigner Research Centre for Physics, Budapest, 4-5 September, 2014; 14 talks, 43 participants. Talks by Sz. Szalay, P. Vrana, G. Tóth, P. Vecsernyés, L. Diósi, A. Szállás, Z. Zimborás, V. Eisler, I. Kovács, Ö. Legeza, J. Asbóth, M. Kormos, P. Dömötör, T. Kiss.
- Organizers: G. Tóth, J. Asbóth, Sz. Szalay, Entanglement Day, Wigner Research Centre for Physics, Budapest, 24-25 September, 2015; 11 talks, 19 participants. Talks by Sz. Szalay, P. Vrana, G. Tóth, Z. Zimborás, V. Eisler, Ö. Legeza, J. Asbóth, Á. Gali, G. Barcza, I. Hagymási, P. Lévy.
- Kvantuminformáció és optimalizálás, Hibrid munkakonferencia a magyar operációkutatási és kvantuminformatikai közösségek számára, 2021 október 26-27. (kedd, szerda) MTA Pécsi Akadémiai Bizottság Székháza, Pécs, Jurisics Miklós út 44. Szervező bizottság: Csentes Tibor (Szeged), Eisenberg-Nagy Marianna (Corvinus), Gazdag-Tóth Boglárka (Szeged), Illés Tibor (Corvinus), Kiss Tamás (Wigner), Koniorczyk Mátyás (Wigner), Pintér Miklós (Corvinus), Rigó Petra (Corvinus), Tóth Géza (Wigner), Zimborás Zoltán (Wigner).

## Referee for M. Sc., Ph. D. and Habilitation theses

1. Committee member (President) in the tribunal for the M. Sc. defense of Beñat Ibarra (J. Casanova) "Enhanced NMR spectroscopy for high concentrations of NV center", University of the Basque Country UPV/EHU, Bilbao, Spain, 18 September 2024.
2. In the committee as "gutachter" for the Ph. D. defense of S. Imai (advisor O. Gühne), University of Siegen, Siegen, Germany, 20 September 2023.
3. Committee member (President) in the tribunal for the M. Sc. defense of Juan Arnaudas (J. Siewert) "Maximally entangled mixed states", University of the Basque Country UPV/EHU, Bilbao, Spain, 14 September 2023.
4. Referee for the Habilitation of István Márton (Group of T. Vértesi), Institute for Nuclear Research (ATOMKI), Debrecen, Hungary, 11 September, 2023.
5. Committee member (Secretary) in the tribunal for the M. Sc. defense of Pol Alsina (J. G. Muga) "Cooling methods based on harmonic oscillators: analysis and comparison", University of the Basque Country UPV/EHU, Bilbao, Spain, 23 September 2022.
6. Committee member (Secretary) in the tribunal for the M. Sc. defense of Arturo Mena López (L. A. Wu) "Improving and Implementing a Protocol for Quantum Malware Prevention with Dynamical Decoupling: A Study Using IBMQ", University of the Basque Country UPV/EHU, Bilbao, Spain, 14 September 2022.
7. External referee for the habilitation ("venia docendi") in the field of "Theoretical Computer Science" of Dr. R. Küng, Johannes Kepler University Linz, Austria, 2022.
8. Committee member (Vocal) in the tribunal for the M. Sc. defense of Javier Alvarez Mazuelas (James R. Wootton, Iñigo L. Egusquiza) "Benchmarking repetition codes: Density Matrix and Pre-transpiling code", University of the Basque Country UPV/EHU, Bilbao, Spain, 19 October 2021.
9. Committee member (Secretary) in the tribunal for the M. Sc. defense of Beatriz Garcia (L. A. Wu) "Implementation of Leakage Elimination Operators", University of the Basque Country UPV/EHU, Bilbao, Spain, 24 September 2020.
10. Committee member (Secretary) in the tribunal for the M. Sc. defense of Antonio Cobos Luque (Jens Siewert.) "Geometry of two qubit states in a Bloch Representation", University of the Basque Country UPV/EHU, Bilbao, Spain, 22 September 2020.
11. Vocal in the tribunal for the M. Sc. defense of X. Gutiérrez de la Cal (advisor D. Sokolovski and M. Pons), University of the Basque Country UPV/EHU, Bilbao, Spain, 24 September 2019.

12. In the committee of the Ph. D. defense of Paul Erker (advisor S. Wolf, A. Winter, M. Huber), USI Lugano and UAB Barcelona, Lugano, Switzerland, 20 February 2019.
13. External referee ("Ko-gutachter") for the Ph. D. thesis of K. Lange (advisor C. Klempt), University of Hannover, Germany, 2018.
14. Vocal in the tribunal for the M. Sc. defense of N. Muñoz (advisor M. Kleinmann), University of the Basque Country UPV/EHU, Bilbao, Spain, 25 September 2017.
15. In the committee as "gutachter" for the Ph. D. defense of S. Altenburg (advisor O. Gühne), University of Siegen, Siegen, Germany, 19 May 2017.
16. President in the committee for the Ph. D. defense of G. Colangelo (advisor M. W. Mitchell and R. Sewell), ICFO-The Institute of Photonic Sciences, Barcelona, Spain, 16 December 2016.
17. External referee ("Ko-gutachter") for the Ph. D. thesis of I. Kruse (advisor C. Klempt), University of Hannover, Germany, 2015.
18. In the committee for the Ph. D. defense of N. Behbood (advisor M. W. Mitchell), ICFO-The Institute of Photonic Sciences, Barcelona, Spain, 17 April 2015.
19. External referee for the habilitation thesis of Dr. rer. nat. H. Kampermann, University of Düsseldorf (group of D. Brück), Germany, 2014.
20. Vocal in the tribunal for the M. Sc. defense of I. Apellaniz (advisor P. Hyllus), University of the Basque Country UPV/EHU, Bilbao, Spain, 27 September 2012.
21. External referee for the Ph. D. thesis of B. Jungnitsch (advisor O. Gühne), University of Siegen, Germany, 2012.
22. In the committee for the Ph. D. defense of M. K. Kubasik (advisor M. W. Mitchell and J. M. Peña), ICFO-The Institute of Photonic Sciences, Barcelona, Spain, May 15, 2009.

## Popular science articles about our work

1. C. Moskowitz,  
**Quantum Entanglement Creates New State of Matter**,  
Scientific American,  
<http://www.scientificamerican.com/article/quantum-entanglement-creates-new-state-of-matter1/>  
Popular explanation of the results of Behbood *et al.*, Phys. Rev. Lett. (2014).
2. M. Schriber,  
**Measuring Entanglement Among Many Particles**,  
Synopsis in physics.aps.org,  
<http://physics.aps.org/synopsis-for/10.1103/PhysRevLett.112.155304>  
Popular explanation of the results of Lücke *et al.*, Phys. Rev. Lett. (2014).
3. **Puntos de interés** (in Spanish),  
Revista Española de Física 28(2), 31 (2014).  
Popular explanation of the results of Lücke *et al.*, Phys. Rev. Lett. 112, 155304 (2014).
4. T. Braun,  
**A couple-of-minute interview: Géza Tóth** (in Hungarian),  
Élet és Tudomány ("Life and Science") 19, 598-599 (2010); also in the book T. Braun, Vándorbottal a tudományos kutatásban - Interdiszciplináris villáminterjúk kiemelkedő hazai természettudósokkal, Typotex kiadó, 2018; ISBN: 978-963-2799-57-5. (in Hungarian)

## 6502 machine code computer programs for Commodore VC20 (published in Hungarian)

1. G. Tóth,  
**TGBASIC**,  
Commodore Újság 2, 20-26 (1988).  
(Extension of the BASIC language of VC20)
2. G. Tóth,  
**VC20 F billentyűk programozása**,  
Ötlet (Bitlet) 11, 36 (1986).  
(Programming the Function Keys)
3. G. Tóth,  
**TGMON**,  
Commodore Újság 5, 17-20 (1986).  
(Assembler program)

## Recent classes

1. 2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020, 2020/2021, 2021/2022, 2022/2023, 2023/2024, 2nd trimester, Quantum information (G. Tóth 20 hours, L. A. Wu 20 hours). Graduate course in the Master's program in Quantum Science and Technology at UPV/EHU.
2. Introduction to quantum information science and quantum computation ( $4 \times 50$  minute lectures) within the class Temas de Física (J. M. M. Senovilla), University of the Basque Country UPV/EHU, February-March, 2015.
3. Introduction to quantum information science and quantum computation ( $2 \times 50$  minute lectures in Spanish) within the class Temas de Física (J. M. M. Senovilla), University of the Basque Country UPV/EHU, 5-6 May, 2014.

4. 2012-2013/2nd trimester. Quantum information (G. Tóth 12 hours, Z. Zimborás 8 hours, L. A. Wu 20 hours). Graduate course in the Master's program in Quantum Science and Technology at UPV/EHU.
5. 2011-2012/2nd trimester. Quantum information (G. Tóth 10 hours, P. Hyllus 10 hours, L. A. Wu 20 hours). Graduate course in the Master's program in Quantum Science and Technology at UPV/EHU.
6. (invited lecture in a lecture series) *Quantum entanglement and its detection with few measurements*, Grupo de Información y Computación Cuánticas, Departamento de Física Teórica I, Facultad de Ciencias Físicas, Universidad Complutense, Madrid, Spain, 3 December, 2009. ( $2 \times 45$  minute lecture)

## Board membership

1. Invited to be the member of the Program Direction Committee of the Hungarian National Quantum Information Laboratory. Meetings: 14 December 2020, 13 April 2021, 8 July 2021, 13 October 2021, 10 Jan 2022, 7 April 2022, 29 June 2022, 26 Sept 2022, 12 April 2023, 16 October 2023, 16 April 2024, 22 October 2024.
2. Fellow of the Editorial College of SciPost Physics, 2020-
3. ad hoc Editorial Board Member, Phys. Rev. Lett., 2018.
4. Invited to be in the Editorial Advisory Board of De Gruyter Open's Books Series program in Quantum Information, 2014.

## In evaluation panels

1. Review panel, Collaborative Research Centre/Transregio 183 "Entangled States of Matter", Berlin, February 6 and 7, 2024.
2. Expert for the Board of the Janos Bolyai Research Scholarship of the Hungarian Academy of Sciences, Hungary, 2022-2023.
3. Evaluating of the renewal of the Transregional Collaborative Research Center 183 ("Entangled States of Matter") of the German Research Foundation (DFG), Rehovot, Israel, 29-30 January, 2020.
4. Evaluation of projects submitted to the 2019 QuantERA call, Athens, 9-11 April, 2019, and Florence, 1-3 July, 2019.
5. Evaluating of the Transregional Collaborative Research Center 183 ("Entangled States of Matter") of the German Research Foundation (DFG), Köln, Germany, 21-22 January, 2016.

## Refereeing

1. Referee for: Science, Nature, Nat. Commun., Phys. Rev. Lett. ( $> 50$ ), Phys. Rev. X, Phys Rev. A, Quantum, NPJ Quantum Information, New J. Phys., etc.
2. German Research Foundation (DFG) 2024, Leibniz Prize 2023, 2021, 2019, 2018, 2016.
3. External expert for the Quantum Phenomena and Resources evaluation panel of the QuantERA Call 2023.
4. Ramon y Cajal 2022; Spanish Ministry of Economy and Competitivity (MINECO), 2019, 2017.
5. Swiss National Science Foundation, 2023, 2020, 2016.
6. OTKA (National Research Fund of Hungary) and NKFIH (National Research, Innovation and Development Office), 2022, 2009, 2008.
7. Austrian Science Fund (FWF), 2021, 2019, 2018, 2016.

8. Recommendation for an application for the Henriette Herz Scouting Programme of the Alexander von Humboldt Foundation, 2020.
9. Leverhulme Trust, UK, 2019.
10. START grant, Austrian Science Fund (FWF), 2019, 2012.
11. Erwin Schrödinger Fellowship of the Austrian Science Fund (FWF), 2018.
12. Momentum ("Lendület") program of the Hungarian Academy of Sciences, 2018, 2017. (Momentum grants are similar to ERC grants of the EU or to the START grants of Austria).
13. National Science Centre (Narodowe Centrum Nauki), Poland, 2016, 2015, 2013.
14. Doctoral Fellowship Programme of the Austrian Academy of Sciences, 2015.
15. European Research Council (ERC) Starting Grant, 2014.
16. NSERC (Natural Sciences and Engineering Research Council of Canada), 2011.
17. Expert reviewer for a Feodor Lynen Research Fellowship, 2010.
18. FONDECYT (Chilean government), 2010, 2008.

## Languages

1. English (fluent, official intermediate level examination in Hungary, Ph.D. studies in the United States)
2. German (good, official intermediate level examination in Hungary)
3. Spanish (good, project proposal and letter writing)
4. Russian (basic)
5. Hungarian (mother tongue)

## Bibliographic databases

|                                 |                     |
|---------------------------------|---------------------|
| Google Scholar:                 | 7NYQHqoAAAAJ        |
| ResearcherID:                   | A-6693-2008         |
| ORCID:                          | 0000-0002-9602-751X |
| ResearchGate:                   | Geza-Toth-2         |
| Arxiv:                          | toth_g_1            |
| Scopus:                         | 7202464630          |
| Hun. Sci. Bibliography (MTMT):  | 10018737            |
| Personal page, Hun. Acad. Sci.: | 32562               |