

Curriculum Vitae | Mgr. Daniel Nagaj, Ph.D.

dnagaj@gmail.com
www.tinyurl.com/danielnagaj
+421 949 587 270

Nám. sv. Františka 18
841 04 Bratislava
SLOVAKIA

EDUCATION

Massachusetts Institute of Technology, Cambridge, MA (USA) 2003 – 2008
MIT Center for Theoretical Physics
PhD. in theoretical physics, specialization: quantum information.
thesis: *Local Hamiltonians in Quantum Computation* (advisor: Prof. E. Farhi)

Comenius University, Bratislava, Slovakia 1998 – 2003
Faculty of Mathematics, Physics and Informatics
Magister of physics (undergraduate degree), specialization: theoretical physics
thesis: *Entanglement in Continuous Variables* (advisor: Prof. V. Bužek)

RESEARCH AND TEACHING EXPERIENCE

research fellow 1/2014 – 5/2014
Simons Institute for the Theory of Computing, UC Berkeley, USA

postdoctoral researcher (group of Prof. F. Verstraete) 9/2012 – 12/2013
University of Vienna, Vienna, Austria 10/2014 – present
(teaching: advanced quantum info., spring 2013, quantum information, fall 2013)

postdoctoral researcher (group of Prof. V. Bužek & Doc. M. Ziman) 7/2008 – 8/2012
Research Center for Quantum Information 6/2014 – 9/2014
Institute of Physics, Slovak Academy of Sciences, Bratislava, Slovakia

external lecturer, Comenius University, Bratislava, Slovakia 2011 – 2012
Faculty of Mathematics, Physics and Informatics
Introduction to Quantum Information (spring 2011, spring 2012).

physics and science popularization 2010 – 2012
Physics through the eyes of physicists (FoF project), Slovak Academy of Sciences
numerous talks on quantum and general physics at high schools in Slovakia

teaching assistant, MIT Physics Department 2004 – 2008
8.02x (E&M, fall 2004), 8.044 (stat.phys. I, spring 2005),
8.01t (class.mech., fall 2006), 8.33 (spec.relativ., iap 2008).

organizer, lecturer, technical redactor 1998 – 2003
Physics Correspondence Seminar (FKS, a competition for high school students)

RESEARCH INTERESTS

Hamiltonian complexity, adiabatic quantum computation and quantum annealing methods,
tensor product state methods, quantum walks

AWARDS

Best poster prize at QIP 2013 Beijing (*Quantum Speedup by Quantum Annealing*), Best poster prize at QIP 2012 Montreal (*Criticality without frustration*), Young researchers under 35 competition: 1st prize (Slovak Physics Society, 2011), Schwarz Postdoctoral Fellowship (Slovak Academy of Sciences, 2009-2012), MIT Presidential Fellowship (2003-2004).

PROJECT INVOLVEMENT

project leader: Slovak Ministry of Education Grant VEGA QWAEN (2011)

proposal contributor: 7th FP STREP project QUNET, *currently in the 2nd round of evaluation (as of 6/2013)*
EU project QESSENCE (2010-2013)
Slovak Research and Development Agency APVV QIMABOS (2013-2017),
Slovak Research and Development Agency APVV COQI (2011-2014),
Slovak Res. & Dev. Agency APVV QWAC LPP-0430-09 (2009-2012),
Slovak Res. & Dev. Agency meta-QUTE ITMS 26240120022 (2010-2012)

REFERENCES

Prof. Edward Farhi, MIT Center for Theoretical Physics, farhi@mit.edu
Prof. Peter Shor, MIT Applied Math Department, shor@math.mit.edu
Prof. Frank Verstraete, University of Vienna, frank.verstraete@univie.ac.at
Prof. RNDr. Vladimír Bužek, DrSc., Slovak Academy of Sciences, buzek@savba.sk

STUDENTS

Mgr. Libor Caha, diploma student, Masaryk University, Brno 2010 – 2012
diploma thesis: *Quantum 2-SAT in 1D*
(*continuing as a graduate student at IPSAS Bratislava*)

Bc. Mária Kieferová, bachelors and diploma student, Comenius University, Bratislava 2011 – 2014
bachelor thesis: *Quantum Walks in Continuous Time*
diploma thesis: *The Adiabatic Theorem in Physics and Computation*

Bc. Jozef Melicher, diploma student, Comenius University, Bratislava 2014 – present
diploma thesis: *Scattering in continuous time quantum walks*

INTERESTS & SKILLS

English (active), German & Polish (passive).
Physics outreach and popularization.
Choral conducting, hiking, photography, go.
Matlab, Mathematica, Illustrator.

Publications in peer-reviewed journals | Daniel Nagaj

PUBLICATIONS: 24 (3×PRL, 2×FOCS), the 5 most important ones are marked *

CITATIONS: 140 (WOK+SCOPUS, without self-cit, including citations of preprint versions, h-index: 7)

1. **Daniel Nagaj**, Peter Štelmachovič, Myungshik Kim, Vladimír Bužek
Quantum homogenization for continuous variables: Realization with linear optical elements
Phys. Rev. A 66, 062307 (2002) [IF: 2.866, citations: 2]
2. **Daniel Nagaj**, Iordanis Kerenidis
On the Optimality of Quantum Encryption Schemes
J. Math. Phys. 47, 092102 (2006) [IF: 1.291, citations: 4]
3. **Daniel Nagaj**, Shay Mozes
A new construction for a QMA complete 3-local Hamiltonian
J. Math. Phys. 48, 072104 (2007) [IF: 1.291, citations: 9]
4. * Edward Farhi, Jeffrey Goldstone, Sam Gutmann, **Daniel Nagaj**
How to make the quantum adiabatic algorithm fail
International Journal of Quantum Information, Vol. 6, No. 3, 503-516 (2008) [IF: 0.864, citations: 34]
5. **Daniel Nagaj**, Edward Farhi, Jeffrey Goldstone, Peter Shor, Igor Sylvester
The Quantum Transverse Field Ising Model on an Infinite Tree from Matrix Product States
Phys. Rev. B 77, 214431 (2008) [IF: 3.772, citations: 18]
6. Chen-Fu Chiang, **Daniel Nagaj**, Paweł Wocjan
Efficient Circuits for Quantum Walks
Quantum Information & Computation Vol.10, No.5&6, 0420-0434 (2010) [IF: 3.584, citations: 4]
7. **Daniel Nagaj**, Paweł Wocjan, Yong Zhang
Fast Amplification of QMA
Quantum Information & Computation Vol.9, No.11&12, 1053-1068 (2009) [IF: 3.584, citations: 6]
8. **Daniel Nagaj**
Fast Universal Quantum Computation with Railroad Switch Hamiltonians
J. Math. Phys., 51 (6), 062201 (2010) [IF: 1.291, citations: 7]
9. Ramis Movassagh, Edward Farhi, Jeffrey Goldstone, **Daniel Nagaj**, Tobias Osborne, Peter Shor
Unfrustrated Qudit Chains and their Ground States
Phys. Rev. A 82, 012318 (2010) [IF: 2.866, citations: 1]
10. **Daniel Nagaj**, Paweł Wocjan
Hamiltonian Quantum Cellular Automata in 1D
Phys. Rev. A 78, 032311 (2008) [IF: 2.866, citations: 11]
11. Paweł Wocjan, Chen-Fu Chiang, **Daniel Nagaj**, Anura Abeyesinghe
Quantum Speed-up for Approximating Partition Functions
Phys. Rev. A 80, 022340 (2009) [IF: 2.866, citations: 9]
12. Edward Farhi, David Gosset, Avinandan Hassidim, Andrew Lutomirski, **Daniel Nagaj**, Peter Shor
Quantum state restoration and single-copy tomography
Phys. Rev. Lett. 105, 190503 (2010) [IF: 7.621, citations: 2]
13. Man-Hong Yung, **Daniel Nagaj**, James D. Whitfield, Alán Aspuru-Guzik
Simulation of Classical Thermal States on a Quantum Computer: A Transfer Matrix Approach
Phys. Rev. A 82, 060302 (2010) [IF: 2.866, citations: 4]

14. Stephen Jordan, Hirotada Kobayashi, **Daniel Nagaj**, Harumichi Nishimura
Achieving perfect completeness in classical-witness quantum Merlin-Arthur proof systems
Quantum Information & Computation Vol.12, No.5&6, 0461-0471 (2012) [IF: 3.584, citations: 1]
15. Daniel Reitzner, **Daniel Nagaj**, Vladimír Bužek
Quantum Walks
Acta Physica Slovaca, vol.61, no.6, pp.603-725 (2011) [IF: 2.167, citations: 9]
16. Mária Kieferová, **Daniel Nagaj**
Quantum Walks on Necklaces and Mixing
International Journal of Quantum Information, Vol.10, Issue 2, 1250025 (2012) [IF: 0.864, citations: 1]
17. **Daniel Nagaj**
Universal 2-local Hamiltonian Quantum Computing
Phys. Rev. A 85, 032330 (2012) [IF: 2.866, citations: 1]
18. * Rolando Somma, **Daniel Nagaj**, Mária Kieferová
Quantum Speedup by Quantum Annealing
Phys. Rev. Lett. 109, 050501 (2012) [IF: 7.621, citations: 7]
19. * Sergey Bravyi, Libor Caha, Ramis Movassagh, **Daniel Nagaj**, Peter Shor
Criticality without Frustration
Phys. Rev. Lett. 109, 207202 (2012) [IF: 7.621, citations: 1]
20. Sean Hallgren, **Daniel Nagaj**, Sandeep Narayanaswami
The Local Hamiltonian on a Line with Eight States is QMA-complete
Quantum Information & Computation Vol.13, No.9&10, pp.0721-0750 (2013) [IF: 3.584, citations: 1]
21. * David Gosset, **Daniel Nagaj**
Quantum 3-SAT is QMA₁-complete
FOCS 2013, arXiv: 1302.0290, invited to a special issue of SICOMP [IF: 1.51, citations: 1]
22. Marco Bardoscia, Antonello Scardicchio, **Daniel Nagaj**
Satisfiability-unsatisfiability transition in the adversarial satisfiability problem
Physical Review E 89, 032128 (2014) [IF: 2.326]
23. * Dorit Aharonov, Aram W. Harrow, Zeph Landau, **Daniel Nagaj**, Mario Szegedy, Umesh Vazirani
Local tests of global entanglement and a counterexample to the generalized area law
to appear in FOCS 2014, arXiv:1410.0951 [IF: 1.51]
24. Andrew M. Childs, David Gosset, **Daniel Nagaj**, Mouktik Raha, Zak Webb
Momentum switches
to appear in Quantum Information & Computation, arXiv:1406.4510 [IF: 3.379]

Lectures, presentations & activities | Daniel Nagaj

*the 5 most important talks are marked **

INVITED TALKS AT CONFERENCES

1. Invited lectures on Quantum computation, Joint ICTP-VAST-APCTP Regional School and Conf. on Theor. Physics in Topological Phases and Quantum Computation, Hanoi, Vietnam, 12/2013
2. CEQIP 2013, Valtice, *Quantum 3-SAT is QMA₁ complete*, 6/2013
3. ISI Torino, tensor networks and algebraic geometry workshop
Quantum Hamiltonian Complexity tutorial, 11/2012
4. * QIP 2010 Zürich, long tutorial, *Local Hamiltonians in Quantum Computation*, 1/2010
5. Quantum Hamiltonian Complexity workshop, ESI Wien, *Local Hamiltonians and Complexity*, 8/2009

CONTRIBUTED TALKS AT MAJOR CONFERENCES

1. * QIP 2015, Sydney, *Local tests of global ent. and a counterexample to the generalized area law*, 1/2015
2. * FOCS 2013, Berkeley, *Quantum 3-SAT is QMA₁ complete*, 10/2013
3. * QIP 2013, Beijing, *Towards Perfect Completeness in QMA*, 1/2013
4. * QCMC 2012, Vienna, *Quantum Speedup by Quantum Annealing*, 8/2012
5. Dagstuhl workshop on Quantum cryptanalysis, *What can you hide in qutrits*, 9/2011

POSTER PRESENTATIONS AT CONFERENCES AND WORKSHOPS

1. QIP 2013, Beijing, *Quantum Speedup by Quantum Annealing*, 1/2013 (best poster award)
2. QIP 2012, Montreal, *Qutrits on a line*, 12/2011 (best poster award)
3. QIP 2011, Singapore, *Adversary SAT*, 1/2011
4. QIP 2009, Santa Fe, *Railroad Switch – from Circuits to Hamiltonians*, 1/2009
5. Frontiers in computation, Bad Honnef, *Hamiltonian Quantum Cellular automata in 1D*, 11/2008

INVITED SEMINARS AT MAJOR INSTITUTIONS

1. MIT, quantum information colloquium, *The good, bad and ugly side of Quantum Satisfiability*, 10/2013
2. Isaac Newton Institute, Cambridge, UK, *Introduction to Quantum Complexity*, 9/2013
3. CoQuS Colloquium, Vienna, *Quantum Walks and Scattering*, 3/2013
4. IQC Waterloo, colloquium, *Criticality without Frustration*, 9/2012
5. ICTP Trieste, condensed-matter colloquium, *Local Hamiltonians in Quantum Computation*, 3/2010
6. MIT, quantum information seminar, *Fast Amplification of QMA*, 5/2009
7. IQC Waterloo, colloquium, *Fast Amplification of QMA*, 3/2009

PHYSICS POPULARIZATION & RESEARCH DISSEMINATION

1. numerous talks at high schools & elementary schools all around Slovakia
2. numerous group seminars & lunch clubs at MIT, in Bratislava and Vienna, 2008-2013

ESTEEM FACTORS

1. Best poster prize at QIP 2013 Beijing (*Quantum Speedup by Quantum Annealing*)
2. Best poster prize at QIP 2012 Montreal (*Criticality without frustration*)
3. Young researchers (under 35) competition: 1st prize (Slovak Physics Society, 2011)
4. Schwarz Postdoctoral Fellowship (Slovak Academy of Sciences, 2009-2012)
5. MIT Presidential Fellowship (2003-2004)

Third party funds | Daniel Nagaj

SELF-ACTIVE ACQUIRED THIRD-PARTY FUNDS

1. QWAC APVV LPP-0430-09, *Quantum walks and computation complexity*
Slovak Research and Development Agency, 11/2009 - 10/2012, 40 000 EUR, Project leader: V. Bužek
My position: main contributor (the project was funding my postdoc position)

INVOLVEMENT IN THIRD-PARTY PROJECTS

1. QUERG, *Quantum entanglement and the renormalization group*
ERC Starting grant 2009, 9/2012 – present, Project leader: Frank Verstraete
My position: contributor
2. Q-ESSENCE 2010-248095, *Quantum interfaces, sensors and communication based on entanglement*
European 7th FP, 02/2010 - 01/2013, 150 000 EUR, Project leader: Vladimír Bužek
My position: contributor
3. COQI APVV-0646-10, *Complexity of quantum information*
Slovak Research and Development Agency, 05/2011 - 08/2012, 90 000 EUR, Project leader: M. Ziman
My position: WP leader
4. QWAEN VEGA 2/0092/09, *Quantum Walks and Entanglement*
Slovak Scientific and Grant Agency, 1/2009 – 12/2011, 8 000 EUR, Project leader: V. Bužek, D. Nagaj
My position: contributor, project leader in the last year of the project

Supervision of Theses | Daniel Nagaj

1. *Quantum walks* (bachelor's thesis)
Faculty for Mathematics, Physics and Informatics, Comenius University, Bratislava, Slovakia
Mária Kieferová, 2012
2. *The Adiabatic Theorem in Physics and Computation* (diploma thesis)
Faculty for Mathematics, Physics and Informatics, Comenius University, Bratislava, Slovakia
Mária Kieferová, 2014,
3. *Quantum Satisfiability in 1D* (diploma thesis)
Faculty of Informatics, Masaryk University, Brno, Czech Republic
Libor Caha, 2012, *presently continuing to a doctoral thesis, co-advised with Mário Ziman*

Teaching | Daniel Nagaj

1. *Quantum Information Exercises* (complementing Časlav Brukner's lectures)
Faculty of Physics, University of Vienna, Austria
fall 2013, 2 semester hours
2. *Advanced Quantum Information* (with Frank Verstraete)
Faculty of Physics, University of Vienna, Austria
spring 2013, 2 semester hours
3. *Introduction to Quantum Information* (for 3rd year physicists)
Faculty for Mathematics, Physics and Informatics, Comenius University, Bratislava, Slovakia
spring 2012, 2 semester hours
4. *Introduction to Quantum Information* (for 3rd year physicists)
Faculty for Mathematics, Physics and Informatics, Comenius University, Bratislava, Slovakia
spring 2011, 2 semester hours
5. teaching assistant, Massachusetts Institute of Technology
8.02x (electricity & magnetism, fall 2004),
8.044 (statistical physics I, spring 2005),
8.01t (classical mechanics, fall 2006),
8.33 (special relativity, iap 2008)
3 semester hours each