

Research Books

Quantum techniques for stochastic mechanics

J Baez and J Biamonte

World Scientific Publishing Co Pte Ltd, 276 print pages (2018)

ISBN: 978-981-3226-96-8 (softcover), 978-981-3226-93-7 (hardcover)

Theses

On the mathematical structure of quantum models of computation based on Hamiltonian minimisation

Doctor of Physical and Mathematical Sciences, Mathematical Physics

Moscow Institute of Physics and Technology, Department of Higher Mathematics, Moscow, Russia

242 pages (2022)

doi.org/10.48550/arXiv.2009.10088

Categorical models of quantum information in many-body systems

Doctor of Philosophy, Computer Science

University of Oxford, Department of Computer Science, Oxford, United Kingdom

127 pages (2010)

Undergraduate Thesis

Portland State University, The Department of Electrical and Computer Engineering and The Department of Physics, Portland Oregon, United States. Advised by M Perkowski and published as: Automated Test Pattern Generation for Quantum Circuits, Portland State University Ronald E McNair Scholars Online Journal **1**(3), 38 (2004), doi.org/10.15760/mcnair.2005.38

Book Chapters

Tensor networks for entanglement evolution

S Meznaric and J Biamonte

Book Series: Advances in Chemical Physics, Quantum Information and Computation for Chemistry

Edited by S Rice and R Dinner

John Wiley & Sons Ltd, pages 567-580 (2014)

ISBN: 978-111-8742-63-1

[10.1002/9781118742631.ch17](https://doi.org/10.1002/9781118742631.ch17)

Articles

Circuit depth scaling for quantum approximate optimization

V Akshay, H Philathong, E Campos, D Rabinovich, I Zacharov, X-M Zhang and J Biamonte

Physical Review A **106**, 042438 (2022)

[10.1103/PhysRevA.106.042438](https://doi.org/10.1103/PhysRevA.106.042438)

Quantum-machine-learning channel discrimination

A Kardashin, A Vlasova, A Pervishko, D Yudin and J Biamonte

Physical Review A **106**, 032409 (2022)

[10.1103/PhysRevA.106.032409](https://doi.org/10.1103/PhysRevA.106.032409)

Ion-native variational ansatz for quantum approximate optimization

D Rabinovich, S Adhikary, E Campos, V Akshay, E Anikin, R Sengupta, O Lakhmanskaya, K Lakhmanskiy and J Biamonte
Physical Review A **106**, 032418 (2022)
10.1103/PhysRevA.106.032418

Progress towards analytically optimal angles in quantum approximate optimisation

D Rabinovich, R Sengupta, E Campos, V Akshay and J Biamonte
Mathematics **10**, 2601 (2022)
10.3390/math10152601

Tensor networks in machine learning

R Sengupta, S Adhikary, I Oseledets and J Biamonte
European Mathematical Society Magazine **101**, 1 (2022)
10.4171/mag/101

Reachability deficits implicit in quantum approximate optimization of graph problems

V Akshay, H Philathong, I Zacharov and J Biamonte
Quantum **5**, 532 (2021)
10.22331/q-2021-08-30-532

Parameter concentrations in quantum approximate optimization

V Akshay, D Rabinovich, E Campos and J Biamonte
(Letter) Physical Review A **104**, L010401 (2021)
10.1103/PhysRevA.104.L010401

Universal variational quantum computation

J Biamonte
(Letter) Physical Review A **103**, L030401 (2021)
10.1103/PhysRevA.103.L030401

Topological classification of time-asymmetry in unitary quantum processes

J Biamonte and J Turner
Journal of Physics A: Mathematical and Theoretical **54**, 235301 (2021)
10.1088/1751-8121/abf9d0

Variational simulation of Schwinger's Hamiltonian with polarization qubits

O Borzenkova, G Struchalin, A Kardashin, V Krasnikov, N Skryabin, S Straupe, S Kulik and J Biamonte
Applied Physics Letters **118**, 144002 (2021)
10.1063/5.0043322

Abrupt transitions in variational quantum circuit training

E Campos, A Nasrallah and J Biamonte
Physical Review A **103**, 032607 (2021)
10.1103/PhysRevA.103.032607

Training saturation in layerwise quantum approximate optimisation

E Campos, D Rabinovich, V Akshay and J Biamonte
(Letter) Physical Review A **104**, L030401 (2021)
10.1103/PhysRevA.104.L030401

Unraveling the effects of multiscale network entanglement on empirical systems

A Ghavasieh, M Stella, J Biamonte and M De Domenico
Communications Physics **4**, 129 (2021)
10.1038/s42005-021-00633-0

Numerical hardware-efficient variational quantum simulation of a soliton solution

A Kardashin, A Pervishko, J Biamonte and D Yudin
(Letter) Physical Review A **104**, L020402 (2021)
10.1103/PhysRevA.104.L020402

Quantum machine learning tensor network states

A Kardashin, A Uvarov and J Biamonte
Frontiers in Physics **8**, 586374 (2021)
10.3389/fphy.2020.586374

Deep learning super-diffusion in multiplex networks

V Leli, S Osat, T Tlyachev, D Dylov and J Biamonte
Journal of Physics: Complexity **2**, 035011 (2021)
10.1088/2632-072X/abe6e9

Computational phase transitions: benchmarking Ising machines & quantum optimisers

H Philathong, V Akshay, K Samburskaya and J Biamonte
Journal of Physics: Complexity **2**, 011002 (2021)
10.1088/2632-072x/abdadc

On barren plateaus and cost function locality in variational quantum algorithms

A Uvarov and J Biamonte
Journal of Physics A: Mathematical and Theoretical **54**, 245 (2021)
10.1088/1751-8121/abfac7

Reachability deficits in quantum approximate optimization

V Akshay, H Philathong, M Morales and J Biamonte
Physical Review Letters **124**, 090504 (2020)
10.1103/PhysRevLett.124.090504

Probing criticality in quantum spin chains with neural networks

A Berezutskii, M Beketov, D Yudin, Z Zimborás and J Biamonte
Journal of Physics: Complexity **1**, 03LT01 (2020)
10.1088/2632-072x/abaa2b

Entanglement scaling in quantum advantage benchmarks

J Biamonte, M Morales and D Koh
Physical Review A **101**, 012349 (2020)
10.1103/PhysRevA.101.012349

Certified variational quantum algorithms for eigenstate preparation

A Kardashin, A Uvarov, D Yudin and J Biamonte
Physical Review A **102**, 052610 (2020)
10.1103/PhysRevA.102.052610

The urgent need for integrated science to fight COVID-19 pandemic and beyond

N Moradian, H Ochs, C Sedikies, M Hamblin, C Camargo, J Martinez, J Biamonte, M Abdollahi, P Torres, J Nieto, S Ogino, J Seymour, A Abraham, V Cauda, S Gupta, S Ramakrishna, F Sellke, A Sorooshian, A Hayes and N Rezaei
Journal of Translational Medicine **18**, 205 (2020)
10.1186/s12967-020-02364-2

On the universality of the quantum approximate optimization algorithm

M Morales, J Biamonte and Z Zimborás
Quantum Information Processing **19**, 291 (2020)
10.1007/s11128-020-02748-9

Experimental neural network enhanced quantum tomography

A Palmieri, E Kovlakov, F Bianchi, D Yudin, S Straupe, J Biamonte and S Kulik
npj Quantum Information **6**, 20 (2020)
10.1038/s41534-020-0248-6

Variational quantum eigensolver for frustrated quantum systems

A Uvarov, J Biamonte and D Yudin
Physical Review B **102**, 075104 (2020)

10.1103/PhysRevB.102.075104

Machine learning phase transitions with a quantum processor

A Uvarov, A Kardashin and J Biamonte

Physical Review A **102**, 012415 (2020)

10.1103/PhysRevA.102.012415

Adiabatic quantum computation

J Biamonte

Frontiers in Physics **7**, 130 (2019)

10.3389/fphy.2019.00130

Keep quantum computing global and open

J Biamonte, P Dorozhkin and I Zacharov

Nature **573**, 190 (2019)

10.1038/d41586-019-02675-5

Complex networks from classical to quantum

J Biamonte, M Faccin and M De Domenico

Communications Physics **2**, (2019)

10.1038/s42005-019-0152-6

Quantum technologies in Russia

A Fedorov, A Akimov, J Biamonte, A Kavokin, F Ya Khalili, E Kiktenko, N Kolachevsky, Y Kurochkin, A Lvovsky, A Rubtsov, G Shlyapnikov, S Straupe, A Ustinov and A Zheltikov

Quantum Science and Technology **4**, 040501 (2019)

10.1088/2058-9565/ab4472

Pushing tensor networks to the limit

A Pervishko and J Biamonte

Physics **12**, 59 (2019)

10.1103/Physics.12.59

Variational learning of Grover's quantum search algorithm

M Morales, T Tlyachev and J Biamonte

Physical Review A **98**, 062333 (2018)

10.1103/PhysRevA.98.062333

Charged string tensor networks

J Biamonte

Proceedings of the National Academy of Sciences **114**, 2447 (2017)

10.1073/pnas.1700736114

Quantum machine learning

J Biamonte, P Wittek, N Pancotti, P Rebentrost, N Wiebe and S Lloyd

Nature **549**, 195 (2017)

10.1038/nature23474

Spectral entropies as information-theoretic tools for complex network comparison

M De Domenico and J Biamonte

Physical Review X **6**, 041062 (2016)

10.1103/PhysRevX.6.041062

Chiral quantum walks

D Lu, J Biamonte, J Li, H Li, T Johnson, V Bergholm, M Faccin, Z Zimborás, R Laflamme, J Baugh and S Lloyd

Physical Review A **93**, 042302 (2016)

10.1103/PhysRevA.93.042302

Tensor network contractions for #SAT

J Biamonte, J Morton and J Turner
Journal of Statistical Physics **160**, 1389 (2015)
10.1007/s10955-015-1276-z

Hamiltonian gadgets with reduced resource requirements

Y Cao, R Babbush, J Biamonte and S Kais
Physical Review A **91**, 012315 (2015)
10.1103/PhysRevA.91.012315

Quantum simulation of helium hydride cation in a solid-state spin register

Y Wang, F Dolde, J Biamonte, R Babbush, V Bergholm, S Yang, I Jakobi, P Neumann, A Aspuru-Guzik, J Whitfield and J Wrachtrup
ACS Nano **9**, 7769 (2015)
10.1021/acsnano.5b01651

Tensor networks and graphical calculus for open quantum systems

C Wood, J Biamonte and D Cory
Quantum Information & Computation **15**, 759 (2015)
10.26421/QIC15.9-10-3

High-fidelity spin entanglement using optimal control

F Dolde, V Bergholm, Y Wang, I Jakobi, B Naydenov, S Pezzagna, J Meijer, F Jelezko, P Neumann, T Schulte-Herbrüggen, J Biamonte and J Wrachtrup
Nature Communications **5**, 3371 (2014)
10.1038/ncomms4371

Community detection in quantum complex networks

M Faccin, P Migdał, T Johnson, V Bergholm and J Biamonte
Physical Review X **4**, 041012 (2014)
10.1103/PhysRevX.4.041012

Tensor network methods for invariant theory

J Biamonte, V Bergholm and M Lanzagorta
Journal of Physics A: Mathematical and Theoretical **46**, 475301 (2013)
10.1088/1751-8113/46/47/475301

Degree distribution in quantum walks on complex networks

M Faccin, T Johnson, J Biamonte, S Kais and P Migdał
Physical Review X **3**, 041007 (2013)
10.1103/PhysRevX.3.041007

Solving search problems by strongly simulating quantum circuits

T Johnson, J Biamonte, S Clark and D Jaksch
Scientific Reports **3**, 1235 (2013)
10.1038/srep01235

Quantum transport enhancement by time-reversal symmetry breaking

Z Zimborás, M Faccin, Z Kadar, J Whitfield, B Lanyon and J Biamonte
Scientific Reports **3**, 2361 (2013)
10.1038/srep02361

Algebraically contractible topological tensor network states

S Denny, J Biamonte, D Jaksch and S Clark
Journal of Physics A: Mathematical and Theoretical **45**, 015309 (2012)
10.1088/1751-8113/45/1/015309

Undecidability in tensor network states

J Morton and J Biamonte
Physical Review A Rapid Communications **86**, 030301 (2012)

10.1103/PhysRevA.86.030301

Ground-state spin logic

J Whitfield, M Faccin and J Biamonte
European Physics Letters **99**, 57004 (2012)
10.1209/0295-5075/99/57004

Categorical quantum circuits

V Bergholm and J Biamonte
Journal of Physics A: Mathematical and Theoretical **44**, 245304 (2011)
10.1088/1751-8113/44/24/245304

Adiabatic quantum simulators

J Biamonte, V Bergholm, J Whitfield, J Fitzsimons and A Aspuru-Guzik
American Institute of Physics Advances **1**, 022126 (2011)
10.1063/1.3598408

Categorical tensor network states

J Biamonte, S Clark and D Jaksch
American Institute of Physics Advances **1**, 042172 (2011)
10.1063/1.3672009

Simulation of electronic structure Hamiltonians using quantum computers

J Whitfield, J Biamonte and A Aspuru-Guzik
Molecular Physics **109**, 735 (2011)
10.1080/00268976.2011.552441

Racing a quantum computer through Minkowski spacetime

J Biamonte
Journal of Physics: Conference Series **229**, 012020 (2010)
10.1088/1742-6596/229/1/012020

Fault models for quantum mechanical switching networks

J Biamonte, J Allen and M Perkowski
Journal of Electronic Testing **26**, 499 (2010)
10.1007/s10836-010-5171-x

Towards quantum chemistry on a quantum computer

B Lanyon, J Whitfield, G Gillett, M Goggin, M Almeida, I Kassal, J Biamonte, M Mohseni, B Powell, M Barbieri, A Aspuru-Guzik and A White
Nature Chemistry **2**, 106 (2010)
10.1038/nchem.483

Nonperturbative k-body to two-body commuting conversion Hamiltonians and embedding problem instances into Ising spins

J Biamonte
Physical Review A **77**, 052331 (2008)
10.1103/PhysRevA.77.052331

Realizable Hamiltonians for universal adiabatic quantum computers

J Biamonte and P Love
Physical Review A **78**, 012352 (2008)
10.1103/PhysRevA.78.012352

Sign-and magnitude-tunable coupler for superconducting flux qubits

R Harris, A Berkley, M Johnson, P Bunyk, S Govorkov, M Thom, S Uchaikin, A Wilson, J Chung, E Holtham and J Biamonte
Physical Review Letters **98**, 177001 (2007)
10.1103/PhysRevLett.98.177001

Four-level realisation of 3-qubit reversible functions

G Yang, X Song, M Perkowski, W Hung, J Biamonte and Z Tang
IET Computers & Digital Techniques **1**, 382 (2007)
10.1049/iet-cdt:20060097

The cost of quantum gates

S Lee, S-J Lee, T Kim, J-S Lee, J Biamonte and M Perkowski
Journal of Multiple-Valued Logic and Soft Computing **12**, 561 (2006)

Proceedings

Quantum chemistry on a quantum computer: first steps and prospects

B Lanyon, J Whitfield, G Gillett, M Goggin, M Almeida, I Kassal, J Biamonte, M Mohseni, B Powell, M Barbieri, A Aspuru-Guzik and A White
Frontiers in Optics (2009)
10.1364/FIO.2009.JWD3

Extending classical test to quantum

J Biamonte, M Jeong, J-S Lee and M Perkowski
Fluctuations and Noise in Photonics and Quantum Optics III
Proceedings of the International Society for Optical Engineering **5842**, 194 (2005)
10.1117/12.623715

Test generation and fault localization for quantum circuits

M Perkowski, J Biamonte and M Lukac
Proceedings of The IEEE International Symposium on Multiple-Valued Logic, pages 62–68, (2005)
10.1109/ismvl.2005.46

In Press

Experimental quantum adversarial learning with programmable superconducting qubits

W Ren, W Li, S Xu, K Wang, W Jiang, F Jin, X Zhu, J Chen, Z Song, P Zhang, H Dong, X Zhang, J Deng, Y Gao, C Zhang, Y Wu, B Zhang, Q Guo, H Li, Z Wang, J Biamonte, C Song, D Deng and H Wang
(to appear) Nature Computational Science (2022)
10.48550/arXiv.2204.01738

Milestones of research activity in quantum computing: EPS grand challenges

Z Seskir and J Biamonte
(to appear) Book Chapter in European Physical Society Grand Challenges: Physics for Society in the Horizon 2050, Institute of Physics Publishing, London, United Kingdom (2022)
10.48550/arXiv.2207.02857

JPhys complexity editorial: celebrating complex systems

G Bianconi, A Arenas, J Biamonte, L Carr, B Kahng, J Kertesz, J Kurths, L Lü, C Masoller, A Motter, M Perc, F Radicchi, R Ramaswamy, F Rodrigues, M Sales-Pardo, M Miguel, S Thurner and T Yasseri
(to appear) Journal of Physics: Complexity (2022)

In Review

On symmetric pseudo-Boolean functions: factorization, kernels and applications

R Sengupta and J Biamonte
10.48550/arXiv.2209.15009

Tensor networks in a nutshell

J Biamonte and V Bergholm

10.48550/arXiv.1708.00006

A quantum algorithm to train neural networks using low-depth circuits

G Verdon, M Broughton and J Biamonte

10.48550/arXiv.1712.05304

Lectures on quantum tensor networks [book draft]

J Biamonte

10.48550/arXiv.1912.10049