A Living Review of Quantum Computing for Plasma Physics

Abstract

A recent report of the United States Department of Energy "Quantum for Fusion, Fusion for Quantum" has highlighted several opportunities for scientific discovery and technology advances at the interface of quantum computing and quantum technologies with fusion and plasma physics.

Quantum Computing promises accelerated simulation of certain classes of problems, in particular in plasma physics. The goal of this document is to provide a comprehensive list of citations for those developing and applying these approaches to experimental or theoretical analyses. As a living document, it will be updated as often as possible to incorporate the latest developments. Suggestions are most welcome.

The purpose of this note is to collect references for quantum algorithms already relevant to plasma physics. A minimal number of categories is chosen in order to be as useful as possible. Note that papers may be referenced in more than one category.

To facilitate search, the tags NISQ (noisy-intermediate scale quantum computing), FTol (fault-tolerant quantum computing), QAnn (quantum annealing), QIns (quantum-inspired), and Tool (generally useful tool) are applied if clearly appropriate.

Color-filled tags indicate the type of content. Since most papers contain some form of theoretical analysis, we use the theoretical tag Theo solely for the papers with analytical results, and no considerable numerical or experimental results. The tag Num marks papers with numerical simulations, but no experimental results run on quantum devices. Finally, Exp marks papers with displayed experimental results. We may ommit this tag if the paper is referenced and tagged in a subsequent subsection.

The fact that a paper is listed in this document does not endorse or validate its content - that is for the community (and for peer-review) to decide. Furthermore, the classification here is a best attempt and may have flaws - please let us know if (a) we have missed a paper you think should be included, (b) a paper has been misclassified or wrongly tagged, or (c) a citation for a paper is not correct or if the journal information is now available.

In order to be as useful as possible, this document will continue to evolve so please check back[1] before you write your next paper. You can simply download the .bib file to get all of the latest references. Please consider citing Ref. [AC22] when referring to this living review.

- **Modern Reviews**
  Below are links to (static) general and specialized reviews.
  - Review of Plasma Physics Problems Reformulated for Quantum Computing [DS20]
  - Review of Fusion Plasma Physics Problems Reformulated for Quantum Computing[Jos+22]
- System of linear equations NISQ Num [HBR19] Exp[Bra+20; Xu+21], FTol Theo [HHL09; CJS13; CKS17; WX22], QAnn Exp [BL22], QIns Theo [SM21].
- System of nonlinear equations FTol Theo [DS21] Num [XWG21; Xue+22].
  - System of polynomial equations QAnn Exp [Cha+19].
- Ordinary differential equations QAnn Exp [Zan+21].
  - Linear FTol Theo [Ber14; Ber+17; CL20; FLT22; JLY22a], Num [JLY22b], QAnn Exp [Zan+21].
    - Second-order QAnn Exp [SS19].

[1]See http://epp.ist.utl.pt/qppq/.

      - Quantum harmonic oscillator FTol Num [Ric+22].
  - Nonlinear NISQ [KPE21; Shi+21] FTol Theo [LO08; DS21] Num [JLY22b; Liu+20; SGS22], QAnn Num [Zan+21].
    - Laguerre QAnn Num [CS22].

- Partial differential equations FTol Theo [CLO21], QIns [Gar21]
  - Linear NISQ [OMa+22], FTol Theo [JLY22a], Num [JLY22b], QAnn Num [CS22].
    - Non-homogeneous NISQ Exp [Bra+20], FTol Theo [Arr+19; Ric+22].
      - Vlasov FTol Num [ESP19]
      - Poisson NISQ [Bra+20; Sat+21; AK22; Sah+22; Lub+20], FTol Theo [Cao+13], Num [Arr+19; Ric+22; Liu+21; Wan+20].
    - Semi-classical Schrödinger FTol Num [JLL22].
    - Time-dependent Schrödinger NISQ [Jou22] FTol Num [JLL22].
    - Stochastic PDE NISQ Num [Kub+21; Alg+22]
      - Fokker-Planck FTol Num [JLY22b], QIns Num [Gar21].
      - Linear Boltzmann FTol Num [JLY22b].
    - Hyperbolic/Wave-related FTol Theo [JLY22d; JL22].
      - Wave FTol Num [CJO19], QAnn Num [CS22].
      - Maxwell's FTol Theo [CJO19], Num [NSD21; NDS22]
      - Klein-Gordon FTol Theo [CJO19].
      - Helmholtz NISQ Num [Ewe+22].
    - Parabolic QIns Num [Pat+22].
      - Heat NISQ [LEK22; Alb+22], FTol Theo [LMS22; JLY22a; JLY22d] Num [JLY22b].
      - Black-Scholes NISQ [FJO21; MK22], FTol Num [JLY22b].
      - Convection FTol Num [JLY22b].
      - Hamilton-Jacobi-Bellman QIns Num [Pat+22].
  - Nonlinear FTol Theo [JL22].
    - Vlasov-Poisson QIns Num [YL22]
    - Schrödinger-Poisson NISQ Num [MS21]
    - Nonlinear-Schrödinger NISQ Exp [Lub+20]
    - Burger's FTol Num [Oz+21].
    - Evolution equation NISQ Theo [LEK22].
      Partial Differential Equations with time-domain.
    - Reaction-diffusion NISQ Num [LEK22] NISQ Exp [Dem+22], FTol Num [An+22].
    - Navier-Stokes FTol Num [Gai20].

      · Incompressible NISQ [LEK22], QIns Num [Lap22].
    * Hamilton-Jacobi FTol Theo [JLY22c; JL22].
    * Black-Scholes-Barenblatt QIns Num[Pat+22].
      The Black-Scholes-Barenblatt equation is a nonlinear extension to the Black-Scholes equation, which models uncertain volatility and interest rates derived from the Black-Scholes equation.

- Koopman–von Neumann formulation FTol Theo [Jos20; JLY22c].
- Nonlinear Schrödinger equation formulation FTol Theo [Llo+20]
- Linear embedding of nonlinear dynamical systems FTol Theo [ESP21; JLY22c] Num [Liu+20]
- Finite element method FTol Theo [MP16].
- Quantum simulation FTol Theo [BCK15].
  - Sparse Hamiltonians FTol Theo [Ber+07; Ber+14].
  - Imaginary time evolution NISQ Num [McA+19].
- Lattice Boltzmann algorithms Ftol Num [Bud21]
- Quantum lattice algorithms QIns Num [And+22; Kou+22; Oga+18; Ram+21; Vah+20a; Vah+20b; Vah+21a; Vah+21b; Vah+22; VSV20; VVS20; Vah+21c; Vah+20c; Vah+19; Vah+20d; Yep02; Yep05; Yep16; VYV03; Vah+11; Vah+10; Oga+16a; Oga+16b; Oga+15; Shi+18; And+23]

  Highly parallelizable approach amenable to classical supercomputers, allowing the study of (Klein-Gordon-)Maxwell's equations, the Gross-Pitaevski equation, the nonlinear Schrödinger equation, and the KdV equation. In some cases, the method may also be suitable for fault-tolerant quantum computers.

References

[AC22] Óscar Amaro and Diogo Cruz. *A Living Review of Quantum Computing for Plasma Physics*. 2022. DOI: NONE. URL: https://arxiv.org/abs/none.

[AK22] Mazen Ali and Matthias Kabel. *A Performance Study of Variational Quantum Algorithms for Solving the Poisson Equation on a Quantum Computer*. Nov. 2022. DOI: 10.48550/arXiv.2211.14064. arXiv: 2211.14064 [quant-ph].

[Alb+22] Anton Simen Albino et al. *Solving Partial Differential Equations on Near-Term Quantum Computers*. Aug. 2022. DOI: 10.48550/arXiv.2208.05805. arXiv: 2208.05805 [physics, physics:quant-ph].

[Alg+22] Hedayat Alghassi et al. "A variational quantum algorithm for the Feynman-Kac formula". In: *Quantum* 6 (June 2022), p. 730. ISSN: 2521-327X. DOI: 10.22331/q-2022-06-07-730. URL: https://doi.org/10.22331/q-2022-06-07-730.

[An+22] Dong An et al. "Efficient Quantum Algorithm for Nonlinear Reaction-Diffusion Equations and Energy Estimation". In: (2022). DOI: 10.48550/ARXIV.2205.01141.

[And+22] Paul Anderson et al. *Some Comments on Unitary Qubit Lattice Algorithms for Classical Problems*. Nov. 2022. arXiv: 2211.16661 [physics, physics:quant-ph].

[And+23] Paul Anderson et al. *Some Comments on Unitary Qubit Lattice Algorithms for Classical Problems*. Jan. 2023. DOI: 10.48550/arXiv.2211.16661. arXiv: 2211.16661 [physics, physics:quant-ph].

[Arr+19] Juan Miguel Arrazola et al. "Quantum Algorithm for Nonhomogeneous Linear Partial Differential Equations". In: *Physical Review A* 100.3 (Sept. 2019), p. 032306. DOI: 10.1103/PhysRevA.100.032306.

[BCK15] Dominic W. Berry, Andrew M. Childs, and Robin Kothari. "Hamiltonian Simulation with Nearly Optimal Dependence on All Parameters". In: *2015 IEEE 56th Annual Symposium on Foundations of Computer Science*. Oct. 2015, pp. 792–809. DOI: 10.1109/FOCS.2015.54. arXiv: 1501.01715 [quant-ph].

[Ber+07] Dominic W. Berry et al. "Efficient Quantum Algorithms for Simulating Sparse Hamiltonians". In: *Communications in Mathematical Physics* 270.2 (Mar. 2007), pp. 359–371. ISSN: 0010-3616, 1432-0916. DOI: 10.1007/s00220-006-0150-x.

[Ber+14] Dominic W. Berry et al. "Exponential Improvement in Precision for Simulating Sparse Hamiltonians". In: *Proceedings of the Forty-Sixth Annual ACM Symposium on Theory of Computing*. New York New York: ACM, May 2014, pp. 283–292. ISBN: 978-1-4503-2710-7. DOI: 10.1145/2591796.2591854.

[Ber+17] Dominic W. Berry et al. "Quantum Algorithm for Linear Differential Equations with Exponentially Improved Dependence on Precision". In: *Communications in Mathematical Physics* 356.3 (Dec. 2017), pp. 1057–1081. ISSN: 0010-3616, 1432-0916. DOI: 10.1007/s00220-017-3002-y.

[Ber14] Dominic W Berry. "High-Order Quantum Algorithm for Solving Linear Differential Equations". In: *Journal of Physics A: Mathematical and Theoretical* 47.10 (Mar. 2014), p. 105301. ISSN: 1751-8113, 1751-8121. DOI: 10.1088/1751-8113/47/10/105301.

[BL22] Ajinkya Borle and Samuel J. Lomonaco. *How Viable Is Quantum Annealing for Solving Linear Algebra Problems?* June 2022. DOI: `10.48550/arXiv.2206.10576`. arXiv: `2206.10576 [quant-ph]`.

[Bra+20] Carlos Bravo-Prieto et al. *Variational Quantum Linear Solver*. en. arXiv:1909.05820 [quant-ph]. June 2020. URL: `http://arxiv.org/abs/1909.05820` (visited on 09/23/2022).

[Bud21] Ljubomir Budinski. "Quantum algorithm for the Navier-Stokes equations". en. In: *arXiv:2103.03804 [quant-ph]* (Mar. 2021). arXiv: 2103.03804. URL: `http://arxiv.org/abs/2103.03804` (visited on 03/09/2021).

[Cao+13] Yudong Cao et al. "Quantum Algorithm and Circuit Design Solving the Poisson Equation". In: *New Journal of Physics* 15.1 (Jan. 2013), p. 013021. ISSN: 1367-2630. DOI: `10.1088/1367-2630/15/1/013021`.

[Cha+19] Chia Cheng Chang et al. "Quantum Annealing for Systems of Polynomial Equations". In: *Scientific Reports* 9.1 (July 2019), p. 10258. ISSN: 2045-2322. DOI: `10.1038/s41598-019-46729-0`.

[CJO19] Pedro C. S. Costa, Stephen Jordan, and Aaron Ostrander. "Quantum Algorithm for Simulating the Wave Equation". In: *Physical Review A* 99.1 (Jan. 2019), p. 012323. ISSN: 2469-9926, 2469-9934. DOI: `10.1103/PhysRevA.99.012323`.

[CJS13] B. D. Clader, B. C. Jacobs, and C. R. Sprouse. "Preconditioned Quantum Linear System Algorithm". In: *Physical Review Letters* 110.25 (June 2013), p. 250504. ISSN: 0031-9007, 1079-7114. DOI: `10.1103/PhysRevLett.110.250504`.

[CKS17] Andrew M. Childs, Robin Kothari, and Rolando D. Somma. "Quantum Algorithm for Systems of Linear Equations with Exponentially Improved Dependence on Precision". In: *SIAM Journal on Computing* 46.6 (Jan. 2017), pp. 1920–1950. ISSN: 0097-5397, 1095-7111. DOI: `10.1137/16M1087072`.

[CL20] Andrew M. Childs and Jin-Peng Liu. "Quantum Spectral Methods for Differential Equations". In: *Communications in Mathematical Physics* 375.2 (Apr. 2020), pp. 1427–1457. ISSN: 1432-0916. DOI: `10.1007/s00220-020-03699-z`.

[CLO21] Andrew M. Childs, Jin-Peng Liu, and Aaron Ostrander. "High-Precision Quantum Algorithms for Partial Differential Equations". In: *Quantum* 5 (Nov. 2021), p. 574. ISSN: 2521-327X. DOI: `10.22331/q-2021-11-10-574`. arXiv: `2002.07868 [quant-ph]`.

[CS22] Juan Carlos Criado and Michael Spannowsky. *Qade: Solving Differential Equations on Quantum Annealers*. Apr. 2022. arXiv: `2204.03657 [hep-ph, physics:hep-th, physics:quant-ph]`.

[Dem+22] Reuben Demirdjian et al. *Variational Quantum Solutions to the Advection-Diffusion Equation for Applications in Fluid Dynamics*. Aug. 2022. DOI: 10.48550/arXiv.2208.11780. arXiv: 2208.11780 [physics, physics:quant-ph].

[DS20] I. Y. Dodin and E. A. Startsev. "On applications of quantum computing to plasma simulations". In: (2020). arXiv: 2005.14369 [physics.plasm-ph]. URL: https://arxiv.org/abs/2005.14369. Overview of plasma physics problems that quantum computers might solve efficiently in the future, namely linear radio-frequency, general fluid and kinetic waves.

[DS21] I. Y. Dodin and E. A. Startsev. "Quantum computation of nonlinear maps". In: (2021). arXiv: 2105.07317 [quant-ph]. URL: https://arxiv.org/abs/2105.07317.

[ESP19] Alexander Engel, Graeme Smith, and Scott E. Parker. "Quantum algorithm for the Vlasov equation". In: *Phys. Rev. A* 100 (6 2019), p. 062315. DOI: 10.1103/PhysRevA.100.062315. Solving the linearized (and classical) Vlasov equation using quantum Hamiltonian simulation.

[ESP21] Alexander Engel, Graeme Smith, and Scott E. Parker. "Linear embedding of nonlinear dynamical systems and prospects for efficient quantum algorithms". In: *Physics of Plasmas* 28.6 (2021), p. 062305. DOI: 10.1063/5.0040313. eprint: https://doi.org/10.1063/5.0040313. URL: https://doi.org/10.1063/5.0040313.

[Ewe+22] Wei-Bin Ewe et al. "Variational Quantum-Based Simulation of Waveguide Modes". In: *IEEE Transactions on Microwave Theory and Techniques* 70.5 (May 2022). Conference Name: IEEE Transactions on Microwave Theory and Techniques, pp. 2517–2525. ISSN: 1557-9670. DOI: 10.1109/TMTT.2022.3151510.

[FJO21] Filipe Fontanela, Antoine Jacquier, and Mugad Oumgari. "Short Communication: A Quantum Algorithm for Linear PDEs Arising in Finance". en. In: *SIAM Journal on Financial Mathematics* 12.4 (Jan. 2021), SC98–SC114. ISSN: 1945-497X. DOI: 10.1137/21M1397878. URL: https://epubs.siam.org/doi/10.1137/21M1397878 (visited on 09/23/2022).

[FLT22] Di Fang, Lin Lin, and Yu Tong. *Time-Marching Based Quantum Solvers for Time-Dependent Linear Differential Equations*. Aug. 2022. DOI: 10.48550/arXiv.2208.06941. arXiv: 2208.06941 [quant-ph].

[Gai20] Frank Gaitan. "Finding Flows of a Navier–Stokes Fluid through Quantum Computing". In: *npj Quantum Information* 6.1 (July 2020), pp. 1–6. ISSN: 2056-6387. DOI: 10.1038/s41534-020-00291-0.

[Gar21] Juan José García-Ripoll. "Quantum-Inspired Algorithms for Multivariate Analysis: From Interpolation to Partial Differential Equations". In: *Quantum* 5 (Apr. 2021), p. 431. ISSN: 2521-327X. DOI: 10.22331/q-2021-04-15-431. arXiv: 1909.06619.

[HBR19] Hsin-Yuan Huang, Kishor Bharti, and Patrick Rebentrost. *Near-term quantum algorithms for linear systems of equations*. arXiv:1909.07344 [quant-ph]. Dec. 2019. DOI: 10.48550/arXiv.1909.07344. URL: http://arxiv.org/abs/1909.07344 (visited on 09/23/2022).

[HHL09] Aram W. Harrow, Avinatan Hassidim, and Seth Lloyd. "Quantum Algorithm for Linear Systems of Equations". In: *Physical Review Letters* 103.15 (Oct. 2009), p. 150502. ISSN: 0031-9007, 1079-7114. DOI: 10.1103/PhysRevLett.103.150502.

[JL22] Shi Jin and Nana Liu. *Quantum Algorithms for Computing Observables of Nonlinear Partial Differential Equations*. Feb. 2022. DOI: 10.48550/arXiv.2202.07834. arXiv: 2202.07834 [physics, physics:quant-ph].

[JLL22] Shi Jin, Xiantao Li, and Nana Liu. "Quantum Simulation in the Semi-Classical Regime". In: *Quantum* 6 (June 2022), p. 739. DOI: 10.22331/q-2022-06-17-739.

[JLY22a] Shi Jin, Nana Liu, and Yue Yu. *Quantum Simulation of Partial Differential Equations via Schrodingerisation*. Dec. 2022. DOI: 10.48550/arXiv.2212.13969. arXiv: 2212.13969 [quant-ph].

[JLY22b] Shi Jin, Nana Liu, and Yue Yu. *Quantum Simulation of Partial Differential Equations via Schrodingerisation: Technical Details*. Dec. 2022. DOI: 10.48550/arXiv.2212.14703. arXiv: 2212.14703 [quant-ph].

[JLY22c] Shi Jin, Nana Liu, and Yue Yu. "Time Complexity Analysis of Quantum Algorithms via Linear Representations for Nonlinear Ordinary and Partial Differential Equations". In: (2022). DOI: 10.48550/ARXIV.2209.08478.

[JLY22d] Shi Jin, Nana Liu, and Yue Yu. "Time Complexity Analysis of Quantum Difference Methods for Linear High Dimensional and Multiscale Partial Differential Equations". In: *Journal of Computational Physics* 471 (Dec. 2022), p. 111641. ISSN: 00219991. DOI: 10.1016/j.jcp.2022.111641.

[Jos+22] I. Joseph et al. *Quantum Computing for Fusion Energy Science Applications*. Dec. 2022. DOI: 10.48550/arXiv.2212.05054. arXiv: 2212.05054 [math-ph, physics:physics, physics:quant-ph].

[Jos20] Ilon Joseph. "Koopman–von Neumann approach to quantum simulation of nonlinear classical dynamics". In: *Phys. Rev. Research* 2 (4 Oct. 2020), p. 043102. DOI: 10.1103/PhysRevResearch.2.043102. URL: https://link.aps.org/doi/10.1103/PhysRevResearch.2.043102.

[Jou22] Loïc Joubert-Doriol. "A Variational Approach for Linearly Dependent Moving Bases in Quantum Dynamics: Application to Gaussian Functions". In: *arXiv:2205.02358 [physics, physics:quant-ph]* (May 2022). arXiv: 2205.02358 [physics, physics:quant-ph].

[Kou+22] Efstratios Koukoutsis et al. *Dyson Maps and Unitary Evolution for Maxwell Equations in Tensor Dielectric Media*. Sept. 2022. DOI: 10.48550/arXiv.2209.08523. arXiv: 2209.08523 [physics, physics:quant-ph].

[KPE21] Oleksandr Kyriienko, Annie E. Paine, and Vincent E. Elfving. "Solving nonlinear differential equations with differentiable quantum circuits". In: *Phys. Rev. A* 103 (5 May 2021), p. 052416. DOI: 10.1103/PhysRevA.103.052416. URL: https://link.aps.org/doi/10.1103/PhysRevA.103.052416.

[Kub+21] Kenji Kubo et al. "Variational quantum simulations of stochastic differential equations". In: *Phys. Rev. A* 103 (5 May 2021), p. 052425. DOI: 10.1103/PhysRevA.103.052425. URL: https://link.aps.org/doi/10.1103/PhysRevA.103.052425.

[Lap22] Leigh Lapworth. *A Hybrid Quantum-Classical CFD Methodology with Benchmark HHL Solutions*. June 2022. DOI: 10.48550/arXiv.2206.00419. arXiv: 2206.00419 [quant-ph].

[LEK22] Fong Yew Leong, Wei-Bin Ewe, and Dax Enshan Koh. "Variational Quantum Evolution Equation Solver". In: *arXiv:2204.02912 [physics, physics:quant-ph]* (Apr. 2022). arXiv: 2204.02912 [physics, physics:quant-ph].

[Liu+20] Jin-Peng Liu et al. "Efficient Quantum Algorithm for Dissipative Nonlinear Differential Equations". In: *arXiv:2011.03185 [physics, physics:quant-ph]* (Nov. 2020). arXiv: 2011.03185 [physics, physics:quant-ph].

[Liu+21] Hai-Ling Liu et al. "Variational quantum algorithm for the Poisson equation". en. In: *Physical Review A* 104.2 (Aug. 2021), p. 022418. ISSN: 2469-9926, 2469-9934. DOI: 10.1103/PhysRevA.104.022418. URL: https://link.aps.org/doi/10.1103/PhysRevA.104.022418 (visited on 09/23/2022).

[Llo+20] Seth Lloyd et al. "Quantum algorithm for nonlinear differential equations". In: (2020). arXiv: 2011.06571 [quant-ph]. URL: https://arxiv.org/abs/2011.06571. Description on how to model any nonlinear problem as a Bose-Einstein condensate.

[LMS22] Noah Linden, Ashley Montanaro, and Changpeng Shao. "Quantum vs. Classical Algorithms for Solving the Heat Equation". In: *Communications in Mathematical Physics* (Aug. 2022). ISSN: 1432-0916. DOI: 10.1007/s00220-022-04442-6.

[LO08] Sarah K. Leyton and Tobias J. Osborne. *A Quantum Algorithm to Solve Nonlinear Differential Equations*. Dec. 2008. DOI: 10.48550/arXiv.0812.4423. arXiv: 0812.4423 [quant-ph].

[Lub+20] Michael Lubasch et al. “Variational quantum algorithms for nonlinear problems”. In: *Phys. Rev. A* 101 (1 Jan. 2020), p. 010301. DOI: 10.1103/PhysRevA.101.010301. URL: https://link.aps.org/doi/10.1103/PhysRevA.101.010301.

[McA+19] Sam McArdle et al. “Variational ansatz-based quantum simulation of imaginary time evolution”. en. In: *npj Quantum Information* 5.1 (Sept. 2019). Number: 1 Publisher: Nature Publishing Group, pp. 1–6. ISSN: 2056-6387. DOI: 10.1038/s41534-019-0187-2. URL: https://www.nature.com/articles/s41534-019-0187-2 (visited on 09/23/2022).

[MK22] Koichi Miyamoto and Kenji Kubo. “Pricing Multi-Asset Derivatives by Finite-Difference Method on a Quantum Computer”. In: *IEEE Transactions on Quantum Engineering* 3 (2022). Conference Name: IEEE Transactions on Quantum Engineering, pp. 1–25. ISSN: 2689-1808. DOI: 10.1109/TQE.2021.3128643.

[MP16] Ashley Montanaro and Sam Pallister. “Quantum Algorithms and the Finite Element Method”. In: *Physical Review A* 93.3 (Mar. 2016), p. 032324. DOI: 10.1103/PhysRevA.93.032324.

[MS21] Philip Mocz and Aaron Szasz. “Toward Cosmological Simulations of Dark Matter on Quantum Computers”. In: *The Astrophysical Journal* 910.1 (Mar. 2021), p. 29. ISSN: 1538-4357. DOI: 10.3847/1538-4357/abe6ac. URL: http://dx.doi.org/10.3847/1538-4357/abe6ac.

[NDS22] I. Novikau, I. Y. Dodin, and E. A. Startsev. *Simulation of Linear Non-Hermitian Boundary-Value Problems with Quantum Singular Value Transformation*. Dec. 2022. DOI: 10.48550/arXiv.2212.09113. arXiv: 2212.09113 [physics, physics:quant-ph].

[NSD21] I. Novikau, E. A. Startsev, and I. Y. Dodin. “Quantum Signal Processing (QSP) for simulating cold plasma waves”. In: (2021). arXiv: 2112.06086 [physics.plasm-ph]. URL: http://arxiv.org/abs/2112.06086.

[Oga+15] Armen Oganesov et al. “Unitary Quantum Lattice Gas Algorithm Generated from the Dirac Collision Operator for 1D Soliton–Soliton Collisions”. In: *Radiation Effects and Defects in Solids* 170.1 (Jan. 2015), pp. 55–64. ISSN: 1042-0150. DOI: 10.1080/10420150.2014.988625.

[Oga+16a] Armen Oganesov et al. “Benchmarking the Dirac-generated Unitary Lattice Qubit Collision-Stream Algorithm for 1D Vector Manakov Soliton Collisions”. In: *Computers & Mathematics with Applications* 72.2 (July 2016), pp. 386–393. ISSN: 08981221. DOI: 10.1016/j.camwa.2015.06.001.

[Oga+16b] Armen Oganesov et al. “Imaginary Time Integration Method Using a Quantum Lattice Gas Approach”. In: *Radiation Effects and Defects in Solids* 171.1-2 (Feb. 2016), pp. 96–102. ISSN: 1042-0150. DOI: 10.1080/10420150.2015.1137916.

[Oga+18] Armen Oganesov et al. "Effect of Fourier Transform on the Streaming in Quantum Lattice Gas Algorithms". In: *Radiation Effects and Defects in Solids* 173.3-4 (Apr. 2018), pp. 169–174. ISSN: 1042-0150. DOI: 10.1080/10420150.2018.1462364.

[OMa+22] Daniel O'Malley et al. "A Near-Term Quantum Algorithm for Solving Linear Systems of Equations Based on the Woodbury Identity". In: *arXiv:2205.00645 [quant-ph]* (May 2022). arXiv: 2205.00645 [quant-ph].

[Oz+21] Furkan Oz et al. "Solving Burgers' Equation with Quantum Computing". In: *Quantum Information Processing* 21.1 (Dec. 2021), p. 30. ISSN: 1573-1332. DOI: 10.1007/s11128-021-03391-8.

[Pat+22] Raj Patel et al. *Quantum-Inspired Tensor Neural Networks for Partial Differential Equations*. Aug. 2022. DOI: 10.48550/arXiv.2208.02235. arXiv: 2208.02235 [cond-mat, physics:physics, physics:quant-ph].

[Ram+21] Abhay K. Ram et al. "Reflection and Transmission of Electromagnetic Pulses at a Planar Dielectric Interface: Theory and Quantum Lattice Simulations". In: *AIP Advances* 11.10 (Oct. 2021), p. 105116. DOI: 10.1063/5.0067204.

[Ric+22] Alexandre C. Ricardo et al. "Alternatives to a Nonhomogeneous Partial Differential Equation Quantum Algorithm". In: *Physical Review A* 106.5 (Nov. 2022), p. 052431. DOI: 10.1103/PhysRevA.106.052431.

[Sah+22] Kamal K. Saha et al. *Advancing Algorithm to Scale and Accurately Solve Quantum Poisson Equation on Near-term Quantum Hardware*. Oct. 2022. DOI: 10.48550/arXiv.2210.16668. arXiv: 2210.16668 [quant-ph].

[Sat+21] Yuki Sato et al. "Variational quantum algorithm based on the minimum potential energy for solving the Poisson equation". en. In: *Physical Review A* 104.5 (Nov. 2021), p. 052409. ISSN: 2469-9926, 2469-9934. DOI: 10.1103/PhysRevA.104.052409. URL: https://link.aps.org/doi/10.1103/PhysRevA.104.052409 (visited on 09/23/2022).

[SGS22] Amit Surana, Abeynaya Gnanasekaran, and Tuhin Sahai. *Carleman Linearization Based Efficient Quantum Algorithm for Higher Order Polynomial Differential Equations*. Dec. 2022. arXiv: 2212.10775 [quant-ph].

[Shi+18] Yuan Shi et al. "Simulations of relativistic quantum plasmas using real-time lattice scalar QED". In: *Phys. Rev. E* 97 (5 May 2018), p. 053206. DOI: 10.1103/PhysRevE.97.053206. URL: https://link.aps.org/doi/10.1103/PhysRevE.97.053206.

[Shi+21] Yuan Shi et al. "Simulating non-native cubic interactions on noisy quantum machines". In: *Phys. Rev. A* 103 (6 June 2021), p. 062608. DOI: 10.1103/PhysRevA.103.062608. URL: https://link.aps.org/doi/10.1103/PhysRevA.103.062608.

[SM21] Changpeng Shao and Ashley Montanaro. “Faster Quantum-Inspired Algorithms for Solving Linear Systems”. In: *arXiv:2103.10309 [quant-ph]* (Mar. 2021). arXiv: `2103.10309 [quant-ph]`.

[SS19] Siddhartha Srivastava and Veera Sundararaghavan. “Box Algorithm for the Solution of Differential Equations on a Quantum Annealer”. In: *Physical Review A* 99.5 (May 2019), p. 052355. ISSN: 2469-9926, 2469-9934. DOI: `10.1103/PhysRevA.99.052355`.

[Vah+10] George Vahala et al. “Unitary Quantum Lattice Gas Algorithms for Quantum to Classical Turbulence”. In: *2010 DoD High Performance Computing Modernization Program Users Group Conference*. June 2010, pp. 184–191. DOI: `10.1109/HPCMP-UGC.2010.15`.

[Vah+11] George Vahala et al. “Unitary Qubit Lattice Simulations of Multiscale Phenomena in Quantum Turbulence”. In: *SC ’11: Proceedings of 2011 International Conference for High Performance Computing, Networking, Storage and Analysis*. Nov. 2011, pp. 1–11. DOI: `10.1145/2063384.2063416`.

[Vah+19] Linda Vahala et al. “Unitary Qubit Lattice Algorithm for Three-Dimensional Vortex Solitons in Hyperbolic Self-Defocusing Media”. In: *Communications in Nonlinear Science and Numerical Simulation* 75 (Aug. 2019), pp. 152–159. ISSN: 1007-5704. DOI: `10.1016/j.cnsns.2019.03.016`.

[Vah+20a] George Vahala et al. “Building a Three-Dimensional Quantum Lattice Algorithm for Maxwell Equations”. In: *Radiation Effects and Defects in Solids* 175.11-12 (Nov. 2020), pp. 986–990. ISSN: 1042-0150. DOI: `10.1080/10420150.2020.1845685`.

[Vah+20b] George Vahala et al. *The Effect of the Pauli Spin Matrices on the Quantum Lattice Algorithm for Maxwell Equations in Inhomogeneous Media*. Oct. 2020. DOI: `10.48550/arXiv.2010.12264`. arXiv: `2010.12264 [physics, physics:quant-ph]`.

[Vah+20c] George Vahala et al. “Unitary Quantum Lattice Simulations for Maxwell Equations in Vacuum and in Dielectric Media”. In: *Journal of Plasma Physics* 86.5 (Oct. 2020), p. 905860518. ISSN: 0022-3778, 1469-7807. DOI: `10.1017/S0022377820001166`.

[Vah+20d] George Vahala et al. “Unitary quantum lattice simulations for Maxwell equations in vacuum and in dielectric media”. In: *Journal of Plasma Physics* 86.5 (2020), p. 905860518. DOI: `10.1017/S0022377820001166`.

[Vah+21a] George Vahala et al. “One- and Two-Dimensional Quantum Lattice Algorithms for Maxwell Equations in Inhomogeneous Scalar Dielectric Media I: Theory”. In: *Radiation Effects and Defects in Solids* 176.1-2 (Feb. 2021), pp. 49–63. ISSN: 1042-0150. DOI: `10.1080/10420150.2021.1891058`.

[Vah+21b] George Vahala et al. “One- and Two-Dimensional Quantum Lattice Algorithms for Maxwell Equations in Inhomogeneous Scalar Dielectric Media. II: Simulations”. In: *Radiation Effects and Defects in Solids* 176.1-2 (Feb. 2021), pp. 64–72. ISSN: 1042-0150. DOI: 10.1080/10420150.2021.1891059.

[Vah+21c] George Vahala et al. *Two Dimensional Electromagnetic Scattering from Dielectric Objects Using Quantum Lattice Algorithm*. SSRN Scholarly Paper. Rochester, NY, Dec. 2021. DOI: 10.2139/ssrn.3996913.

[Vah+22] George Vahala et al. “Quantum Lattice Representation for the Curl Equations of Maxwell Equations”. In: *Radiation Effects and Defects in Solids* 177.1-2 (Feb. 2022), pp. 85–94. ISSN: 1042-0150. DOI: 10.1080/10420150.2022.2049784.

[VSV20] George Vahala, Min Soe, and Linda Vahala. “Qubit Unitary Lattice Algorithm for Spin-2 Bose-Einstein Condensates: II - Vortex Reconnection Simulations and Non-Abelain Vortices”. In: *Radiation Effects and Defects in Solids* 175.1-2 (Jan. 2020), pp. 113–119. ISSN: 1042-0150. DOI: 10.1080/10420150.2020.1718136.

[VVS20] George Vahala, Linda Vahala, and Min Soe. “Qubit Unitary Lattice Algorithm for Spin-2 Bose–Einstein Condensates. I – Theory and Pade Initial Conditions”. In: *Radiation Effects and Defects in Solids* 175.1-2 (Jan. 2020), pp. 102–112. ISSN: 1042-0150. DOI: 10.1080/10420150.2020.1718135.

[VYV03] George Vahala, Jeffrey Yepez, and Linda Vahala. “Quantum Lattice Gas Representation of Some Classical Solitons”. In: *Physics Letters A* 310.2 (Apr. 2003), pp. 187–196. ISSN: 0375-9601. DOI: 10.1016/S0375-9601(03)00334-7.

[Wan+20] Shengbin Wang et al. “Quantum Fast Poisson Solver: The Algorithm and Complete and Modular Circuit Design”. In: *Quantum Information Processing* 19.6 (Apr. 2020), p. 170. ISSN: 1573-1332. DOI: 10.1007/s11128-020-02669-7.

[WX22] Hefeng Wang and Hua Xiang. *Efficient Quantum Algorithms for Solving Quantum Linear System Problems*. Aug. 2022. DOI: 10.48550/arXiv.2208.06763. arXiv: 2208.06763 [quant-ph].

[Xu+21] Xiaosi Xu et al. “Variational algorithms for linear algebra”. en. In: *Science Bulletin* 66.21 (Nov. 2021), pp. 2181–2188. ISSN: 2095-9273. DOI: 10.1016/j.scib.2021.06.023. URL: https://www.sciencedirect.com/science/article/pii/S2095927321004631 (visited on 09/23/2022).

[Xue+22] Cheng Xue et al. “Quantum Algorithm for Solving a Quadratic Nonlinear System of Equations”. In: *Physical Review A* 106.3 (Sept. 2022), p. 032427. ISSN: 2469-9926, 2469-9934. DOI: 10.1103/PhysRevA.106.032427.

[XWG21] Cheng Xue, Yuchun Wu, and Guoping Guo. "Quantum Newton's Method for Solving the System of Nonlinear Equations". In: *SPIN* 11.03 (Sept. 2021), p. 2140004. ISSN: 2010-3247. DOI: 10.1142/S201032472140004X.

[Yep02] Jeffrey Yepez. *An Efficient and Accurate Quantum Algorithm for the Dirac Equation*. Oct. 2002. DOI: 10.48550/arXiv.quant-ph/0210093. arXiv: quant-ph/0210093.

[Yep05] Jeffrey Yepez. "Relativistic Path Integral as a Lattice-based Quantum Algorithm". In: *Quantum Information Processing* 4.6 (Dec. 2005), pp. 471–509. ISSN: 1573-1332. DOI: 10.1007/s11128-005-0009-7.

[Yep16] Jeffrey Yepez. "Quantum Lattice Gas Algorithmic Representation of Gauge Field Theory". In: *Quantum Information Science and Technology II*. Vol. 9996. SPIE, Oct. 2016, pp. 66–87. DOI: 10.1117/12.2246702.

[YL22] Erika Ye and Nuno F. G. Loureiro. *A Quantum-Inspired Method for Solving the Vlasov-Poisson Equations*. May 2022. arXiv: 2205.11990 [physics].

[Zan+21] Benjamin Zanger et al. "Quantum Algorithms for Solving Ordinary Differential Equations via Classical Integration Methods". In: *Quantum* 5 (July 2021), p. 502. ISSN: 2521-327X. DOI: 10.22331/q-2021-07-13-502. arXiv: 2012.09469 [quant-ph].