

# Daan Camps, PhD

COMPUTATIONAL SCIENTIST · APPLIED MATHEMATICIAN

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Dated: May 15, 2025.

Quantum computing and high performance computing (HPC) engineer in the Advanced Technologies Group at the National Energy Research Scientific Computing Center (NERSC) at Lawrence Berkeley National Laboratory. Working on the leading edge of technology, integrating quantum technologies with future HPC systems, and developing a quantum computing program at NERSC. Over 5 years research experience in quantum information and quantum algorithms, 9+ years experience in computational mathematics, and 2+ years experience as project engineer. Recent collaborations resulted in a robust publication record of 21 journal articles and 6 conference papers.

## Work Experience

### National Energy Research Scientific Computing Center (NERSC), Lawrence Berkeley National Laboratory

Berkeley, USA

QUANTUM COMPUTING AND HPC ARCHITECTURE AND PERFORMANCE ENGINEER IN  
ADVANCED TECHNOLOGIES GROUP

Apr. 2022 - Current

- Working on integrating HPC with future quantum technologies,
- Benchmarking of heterogeneous quantum-classical systems,
- Developing and driving NERSC's quantum computing program and strategy,
- Research on quantum algorithms for scientific computing.

### Lawrence Berkeley National Laboratory

Berkeley, USA

POSTDOCTORAL RESEARCHER IN COMPUTATIONAL MATHEMATICS

Nov. 2019 - Apr. 2022

- Research on quantum information and quantum algorithms with a focus on circuit compilation and synthesis,
- Completed projects on Hamiltonian simulation, quantum chemistry, quantum linear algebra, and quantum image processing,
- Software engineering of nonlinear tensor factorization package,
- Developed QCLAB, QCLAB++, F3C, F3C++, QPIXL++ and FunFact, FABLE,
- Team scientist.

### KU Leuven

Leuven, Belgium

TEACHING ASSISTANT

Sep. 2015 - Jun. 2019

- Exercise sessions for courses on numerical modeling and approximation, numerical mathematics,
- Mentor of master student projects.

### IPCOS NV

Leuven, Belgium

PROJECT ENGINEER IN DIGITAL OILFIELD TEAM

Aug. 2013 - Sep. 2015

- Deployment and maintenance of upstream production monitoring models based on real-time process data,
- Development and deployment of new data-driven pipeline leak detection models,
- Customer-oriented role: presenting on-site training sessions and providing end user support.

## Skills, Competencies & Training

### Programming

- MATLAB, C++, Python, Fortran 90.
- OpenMP and MPI.
- git, CMake

### Open source projects

- QCLAB and QCLAB++: quantum circuit development, analysis and simulation.
- F3C and F3C++: fast and scalable quantum circuit compilation for Hamiltonian simulation.
- QPIXL++: efficient and compressible representations for quantum images.
- FunFact: tensor algebra and deep learning via Einstein notations.
- FABLE: generate quantum circuits for block encodings.

<b>Research interests</b>	Quantum algorithms, Scalable quantum benchmarking, Quantum circuit synthesis, Numerical linear algebra, Tensor decomposition techniques, Manifold optimization, Eigenvalue problems, Randomized algorithms, Scientific machine learning,
	<ul style="list-style-type: none"> <li>• Communications Excellence (Haas Business School, UC Berkeley, 2023)</li> <li>• Mathematics of Big Data: Sketching and (Multi-)Linear Algebra (MSRI Graduate Summer School, 2021)</li> </ul>
<b>Formal training</b>	<ul style="list-style-type: none"> <li>• Fundamentals of Machine Learning (SOCN Graduate School, 2018)</li> <li>• Low-Rank Tensor Techniques (Hausdorff School, 2016)</li> </ul>

## Personal & Communication

<b>Languages</b>	<ul style="list-style-type: none"> <li>• Dutch: Native</li> <li>• English: Fluent</li> <li>• French: Moderate</li> </ul>
<b>Teaching &amp; Mentorship</b>	<ul style="list-style-type: none"> <li>• TA for B.Sc. courses on numerical modeling and approximation, numerical mathematics at KU Leuven.</li> <li>• Mentor of M.Sc. thesis projects at KU Leuven.</li> <li>• Mentor of summer interns at Lawrence Berkeley National Laboratory.</li> <li>• Mentor of postdoctoral researchers at Lawrence Berkeley National Laboratory.</li> </ul>

## Journal Publications, Conference Publications & Preprints

- 2025 *The RQR algorithm*, Camps D., T. Mach, R. Vandebril, D. S. Watkins, Lin. Algebra Appl., arXiv:2411.17671.
- 2025 *QCaMP: A 4-Week Summer Camp Introducing High School Students to Quantum Information Science and Technology*, Ivory M., Balewski J., Bettale A., Brewer J., Boren R., Camps D., Hackett L., Juarez M., Kononov A., Lee K.-H., Long M., Mounce A., Naik R. K., Pakin S., Sanchez E., arXiv:2504.15977.
- 2025 *A Practical Framework for Assessing the Performance of Observable Estimation in Quantum Simulation*, Niu S., Kökcü E., Johri S., Ramesh A., Chatterjee A., Bernal Neira D. E., Camps D., Lubinski T. arXiv:2504.09813.
- 2025 *QCLAB: A Matlab Toolbox for Quantum Computing*, Keip S., Camps D., Van Beeumen R., arXiv:2503.03016.
- 2025 *Diagrammatic Quantum Circuit Compression for Hamiltonian Simulation*, Wadewitz V., Szasz A., Camps D., Klymko K., Stollenwerk T., Software Engineering 2025 – Companion Proceedings, DOI: 10.18420/se2025-ws-24.
- 2024 *HamLib: A library of Hamiltonians for benchmarking quantum algorithms and hardware*, Sawaya N., Marti-Dafcik D., Ho Y., Tabor D., Bernal D., Magann A., Premaratne S., Dubey P., Matsuura A., de Jong W., Benjamin S., Parekh O., Tubman N., Klymko K., Camps D. Quantum 8, 1559, arXiv:2306.13126.
- 2024 *Long-lived oscillations of metastable states in neutral atom systems*, Darbha S., Kornjača M., Liu F., Balewski J., Hirsbrunner M. R., Lopes P., Wang S., Van Beeumen R., Klymko K., Camps D., Phys. Rev. B 110, 155114, arXiv:2404.12371.
- 2024 *False vacuum decay and nucleation dynamics in neutral atom systems*, Darbha S., Kornjača M., Liu F., Balewski J., Hirsbrunner M. R., Lopes P., Wang S., Van Beeumen R., Camps D., Klymko K., Phys. Rev. B 110, 155103, arXiv:2404.12360.
- 2024 *Efficient Measurement-Driven Eigenenergy Estimation with Classical Shadows*, Shen Y., Buzali A., Hu H.-Y., Klymko K., Camps D., Yelin S. F., Van Beeumen R., arXiv:2409.13691.
- 2024 *Non-Clifford diagonalization for measurement shot reduction in quantum expectation value estimation*, Sawaya N., Camps D., Tubman N., Rotskoff G., LaRose R., arXiv:2408.11898.
- 2024 *Quantum Rational Transformation Using Linear Combinations of Hamiltonian Simulations*, Shen Y., Van Bugghenout N., Camps D., Klymko K., Van Beeumen R., arXiv:2408.07742.
- 2024 *Quantum-centric supercomputing for materials science: A perspective on challenges and future directions*, Future Generation Computer Systems, DOI:10.1016/j.future.2024.04.060, arXiv:2312.09733.

- Evaluation of the classical hardware requirements for large-scale quantum computations*, 2024 Camps D., Rrapaj E., Klymko K., Austin B., Wright N.J. Proceedings of ISC-HPC24 Conference, DOI:10.23919/ISC.2024.10528937
- Engineering quantum states with neutral atoms*, 2024 Balewski J., Kornjača M., Klymko K., Darbha S., Hirsbrunner M. R., Lopes P., Liu F., Camps D. arXiv:2404.04411.
- Explicit Quantum Circuits for Block Encodings of Certain Sparse Matrices*, 2024 Camps D., Lin L., Van Beeumen R., Yang C., SIAM J. Matrix Anal. Appl. 45(1)DOI:10.1137/22M1484298, arXiv:2203.10236.
- Quantum-parallel vectorized data encodings and computations on trapped-ions and transmon QPUs*, 2024 Balewski J., Amankwah M., Van Beeumen R., Bethel E., Perciano T., Camps D. Scientific Reports,DOI: 10.1038/s41598-024-53720-x, arXiv:2301.07841.
- Simple Diagonal Designs with Reconfigurable Real-Time Circuits*, 2024 Shen Y., Klymko K., Rabani E., Camps D., Van Beeumen R., Lindsey M. arXiv:2401.04176.
- Simulating dirty bosons on a quantum computer*, 2024 Bassman Oftelie L., Van Beeumen R., Camps D., de Jong W., Dupont M., New Journal of Physics, DOI:10.1088/1367-2630/ad1a2d, arXiv:2210.08386.
- k-Commutativity and Measurement Reduction for Expectation Values*, 2023 Delfavero B., Sarkar R., Camps D., Sawaya N., LaRose R. arXiv:2312.11840.
- A Performance Model for Estimating the Cost of Scaling to Practical Quantum Advantage*, 2023 Camps D., Klymko K., Austin B., Wright N. J., A, Proceedings of the SC '23 Workshops of The International Conference on High Performance Computing, Network, Storage, and Analysis, DOI:10.1145/3624062.3625533.
- Efficient Quantum Counting and Quantum Content-Addressable Memory for DNA similarity*, 2023 Balewski J., Camps D., Klymko K., Tritt A, 2023 IEEE International Conference on Quantum Computing and Engineering (QCE), DOI:10.1109/QCE57702.2023.00050, arXiv:2308.00699.
- Estimating Eigenenergies from Quantum Dynamics: A Unified Noise-Resilient Measurement-Driven Approach*, 2023 Shen Y., Camps D., Darbha S., Szasz A., Klymko K., Williams-Young D., Tubman N., Van Beeumen R. arXiv:2306.01858.
- Algebraic Compression of Free Fermionic Quantum Circuits: Particle Creation, Arbitrary Lattices and Controlled Evolution*, 2023 Kökcü E., Camps D., Bassman Oftelie L., de Jong W., Van Beeumen R., Kemper A. arXiv:2303.09538.
- QCLAB++: Simulating Quantum Circuits on GPUs*, 2023 Van Beeumen R., Camps D., Mehta N. arXiv:2303.00123.
- Exploring Finite Temperature Properties of Materials with Quantum Computers*, 2023 Powers C., Bassman Oftelie L., Camps D., de Jong W. A., Scientific Reports,DOI: 10.1038/s41598-023-28317-5, arXiv:2205.00081.
- FABLE: Fast Approximate Quantum Circuits for Block-Encodings*, 2022 Camps D., Van Beeumen R. IEEE International Conference on Quantum Computing and Engineering (QCE), DOI: 10.1109/QCE53715.2022.00029, arXiv:2205.00081.
- Quantum pixel representations and compression for N-dimensional images*, 2022 Amankwah M. G., Camps D., Bethel E.W., Van Beeumen R., Perciano T. Scientific Reports,DOI: 10.1038/s41598-022-11024-y.
- Algebraic compression of quantum circuits for Hamiltonian evolution*, 2022 Kökcü E., Camps D., Bassman L., Freericks J.K., de Jong W.A., Van Beeumen R., Kemper A.F., Phys. Rev. A,DOI:10.1103/PhysRevA.105.032420.
- An algebraic quantum circuit compression algorithm for Hamiltonian simulation*, 2021 Camps D., Kökcü E., Bassman L., de Jong W.A., Kemper A.F., Van Beeumen R., SIAM J. Matrix Anal. Appl. 43(3), DOI:10.1137/21M1439298,arXiv:2108.03283.
- A multishift, multipole rational QZ method with aggressive early deflation*, 2021 Steel T., Camps D., Meerbergen K., Vandebril R., SIAM J. Matrix Anal. Appl. 42(2), 753–774. DOI: 10.1137/19M1249631
- Approximate quantum circuit synthesis using block encodings*, 2020 Camps D., Van Beeumen R., Phys. Rev. A 102, 052411. DOI: 10.1103/PhysRevA.102.052411
- Chemistry on quantum computers with virtual quantum subspace expansion*, 2020 Urbanek M., Camps D., Van Beeumen R., de Jong W. A., J. Chem. Theory Comput. 16(9), 5425–5431. DOI: 10.1021/acs.jctc.0c00447
- Quantum Fourier transform revisited*, 2020 Camps D., Van Beeumen R., Yang C., Numer. Linear Algebra Appl. 28(1). DOI: 10.1002/nla.2331

- 2020 *On pole-swapping algorithms for the eigenvalue problem*, Camps D., Mach T., Vandebril R., Watkins D. S., Electron. Trans. Numer. Anal. 52, 480–508. DOI: 10.1553/etna\_vol52s480
- 2019 *Swapping 2x2 blocks in the Schur and generalized Schur form*, Camps D., Mastronardi N., Vandebril R., Van Dooren P., J. Comput. Appl. Math. 373, 112274. DOI: 10.1016/j.cam.2019.05.022
- 2019 *A rational QZ method*, Camps D., Meerbergen K., Vandebril R., SIAM J. Matrix Anal. Appl. 40(3), 943–972. DOI: 10.1137/18M1170480
- 2019 *An implicit filter for rational Krylov using core transformations*, Camps D., Meerbergen K., Vandebril R., Linear Algebra and its Applications, DOI: 10.1016/j.laa.2018.09.021
- 2014 *Block term decomposition for modelling epileptic seizures*, Hunyadi B., Camps D., Sorber L., Van Paesschen W., De Vos M., Van Huffel S., De Lathauwer L., EURASIP Journal on Advances in Signal Processing, DOI: 10.1186/1687-6180-2014-139

## Book Publications

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- 2025 *Pole-Swapping Algorithms for the Eigenvalue Problem*, Camps D., Mach T., Vandebril R., Watkins D.S., SIAM Spotlights.

## Education

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### KU Leuven (University of Leuven)

PHD IN COMPUTER SCIENCE AND APPLIED MATHEMATICS

Leuven, Belgium

Sep. 2015 - Sep. 2019

- Thesis: *Pole swapping methods for the eigenvalue problem — Rational QR algorithms*.
- Generalized dense QR eigenvalue algorithms to rational QR methods.
- Implicitly restarted rational Krylov methods for large-scale, sparse eigenvalue problems.
- Focus on theory, numerical stability and efficient implementations.

### KU Leuven (University of Leuven)

M.SC.ENG. IN MATHEMATICAL ENGINEERING

Leuven, Belgium

Sep. 2011 - Jun. 2013

- Thesis: ‘Epileptic seizure monitoring using tensor decomposition techniques’.

### KU Leuven (University of Leuven)

M.SC. IN PHYSICS: ASTRONOMY AND ASTROPHYSICS

Leuven, Belgium

Sep. 2009 - Sep. 2011

- Thesis: ‘Herschel/PACS observations of water in the carbon-rich AGB star V Hya’.

### UHasselt (University of Hasselt)

B.SC. IN PHYSICS

Hasselt, Belgium

Sep. 2006 - Jun. 2010

## Talks

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### Teratec Workshop

From HamLib to HamPerf: A Hamiltonian-Oriented Approach to Quantum Benchmarking

Reims, France

June 2024

### ISC High Performance 2024

Evaluation of the classical hardware requirements for large-scale quantum computations

Hamburg, Germany

May 2024

### DW75 Workshop

On Block Encodings of Matrices

Leuven, Belgium

May 2024

### APS March Meeting

Exploring the Lieb lattice phase diagram using Rydberg atom quantum simulators

Minneapolis, MN, USA

March 2024

### SC23 – The International Conference for High Performance Computing, Networking, Storage, and Analysis

A Performance Model for Estimating the Cost of Scaling to Practical Quantum Advantage

Denver, CO

November 2023

### Intel Labs Quantum Seminar Series

Algebraic Compression of Free Fermionic Quantum Circuits

Virtual

September 2023

### 10th International Congress on Industrial and Applied Mathematics

FunFact: Tensor Decomposition, Your Way

Tokyo, Japan

August 2023

<b>IonQ Quantum Seminar Series</b> Algebraic Compression of Free Fermionic Quantum Circuits	<i>Virtual</i> May 2023
<b>Guest lecture at San Francisco State University</b> Algebraic Compression of Free Fermionic Quantum Circuits	<i>San Francisco, CA, USA</i> April 2023
<b>APS March Meeting</b> Classical and Quantum Strategies to Boost Quantum Subspace Methods	<i>Las Vegas, NV, USA</i> March 2023
<b>IEEE International Conference on Quantum Computing and Engineering</b> FABLE: Fast Approximate Quantum Circuits for Block-Encodings	<i>Broomfield, CO, USA</i> September 2022
<b>XXI Householder Symposium on Numerical Linear Algebra</b> An Algebraic Quantum Circuit Compression Algorithm for Hamiltonian Simulation	<i>Selva di Fasano, Italy</i> June 2022
<b>CS Area 3rd Annual Postdoc Symposium</b> FunFact: a Tensor Algebra Language with Applications in Deep Learning	<i>Berkeley, USA</i> Feb. 2022
<b>SIAM Conference on Applied Linear Algebra</b> Approximate quantum circuit synthesis using block encodings	<i>Virtual</i> May 2021
<b>AIDE-QC All-Hands Meeting</b> An Algebraic and Scalable Synthesis Algorithm for Computing Dynamic Simulation Constant-Depth Circuits	<i>Virtual</i> Apr. 2021
<b>APS March Meeting</b> Approximate quantum circuit synthesis using block encodings	<i>Virtual</i> Mar. 2021
<b>SIAM Conference on Computational Science and Engineering</b> Understanding the quantum Fourier transform through matrix decompositions	<i>Virtual</i> Mar. 2021
<b>QIP Conference</b> Approximate quantum circuit synthesis using block encodings	<i>Virtual (Munich, Germany)</i> Feb. 2021
<b>CS Area 2nd Annual Postdoc Symposium</b> Approximate quantum circuit synthesis using block encodings	<i>Berkeley, USA</i> Feb. 2021
<b>Berkeley Lab Seminar</b> Pole swapping methods for the eigenvalue problem – Rational QR algorithms	<i>Berkeley, USA</i> Sep. 2019
<b>ICIAM Conference</b> Pole swapping methods for the eigenvalue problem – Rational QR algorithms	<i>Valencia, Spain</i> Jul. 2019
<b>ETNA25 Conference</b> Approximate inverse-free rational Krylov methods and the link with FOM and GMRES	<i>Sardinia, Italy</i> May 2019
<b>NASCA Conference</b> A rational QZ method	<i>Kalamata, Greece</i> Jul. 2018
<b>SIAM Conference on Applied Linear Algebra</b> RQZ: A rational QZ method for the generalized eigenvalue problem	<i>Hong Kong</i> May. 2018
<b>NUMA Internal Seminar</b> Rational matrix algorithms for the generalized eigenvalue problem — Iterative and direct methods	<i>Leuven, Belgium</i> Oct. 2017
<b>ILAS Conference</b> Implicit restart of the rational Krylov method — Chasing algorithms for polynomial, extended and rational Krylov	<i>Iowa, USA</i> Jul. 2017
<b>ILAS Conference</b> Towards a computational efficient, implicitly restarted rational Krylov method	<i>Leuven, Belgium</i> Jul. 2016

Academic service

	IOP New Journal of Physics, ACM Transactions on Quantum Computing, IEEE Transactions on Quantum Engineering, npj Quantum Information, Quantum – the open journal for quantum science, Quantum Information & Computation, Journal of Computational Physics, Applied Mathematics and Computation, SIAM Journal on Matrix Analysis and Applications, Linear and Multilinear Algebra, Electronic Transactions on Numerical Analysis, IEEE International Conference on Quantum Computing and Engineering, The Journal of Supercomputing, Nature Communications
Reviewer for	
Program Committee for	IEEE International Conference on Quantum Computing and Engineering 2022 & 2024

Honors & Awards

2024	1st Place Best Research Paper in Quantum Technologies and Systems Engineering (QTEM) track, IEEE International Conference on Quantum Computing and Engineering (QCE24).	Montreal, Canada
2024	Hans Meuer Award for Best Research Paper, ISC High Performance.	Hamburg, Germany
2018	SIAM Student Travel Award, SIAM Conference on Applied Linear Algebra.	Hong Kong