

Daan Camps, PhD

COMPUTATIONAL SCIENTIST · APPLIED MATHEMATICIAN

San Francisco, California

+1 510-388-2095 | daancamps@gmail.com | campsd.github.io | [campsd](#) | [campsd](#) | [Daan Camps](#)

Dated: May 22, 2024.

Staff member in Advanced Technologies Group at NERSC working on integrating quantum technologies with future HPC systems. Previously, computational mathematics postdoctoral researcher at Lawrence Berkeley National Laboratory with a broad scientific interest and a passion for problem-solving. Almost 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.

Work Experience

NERSC, Lawrence Berkeley National Laboratory

Berkeley, USA

COMPUTER SYSTEMS ENGINEER/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.

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

Personal & Communication

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

Publications & Preprints

- 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
- Long-lived oscillations of false and true vacuum states in neutral atom systems*, 2024 Kornjača M., Liu F., Balewski J., Hirsbrunner M. R., Lopes P., Wang S., Van Beeumen R., Klymko K., [Camps D.](#) arXiv:2404.12371.
- False vacuum decay and nucleation dynamics in neutral atom systems*, 2024 M., Liu F., Balewski J., Hirsbrunner M. R., Lopes P., Wang S., Van Beeumen R., [Camps D.](#), Klymko K. arXiv:2404.12360.
- 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.
- Efficient Quantum Trace Estimation 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 Otelie 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.
- Quantum-centric Supercomputing for Materials Science: A Perspective on Challenges and Future Directions*, 2023 arXiv:2312.09733.
- 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.
- HamLib: A library of Hamiltonians for benchmarking quantum algorithms and hardware*, 2023 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.](#) arXiv:2306.13126.

- Estimating Eigenenergies from Quantum Dynamics: A Unified Noise-Resilient Measurement-Driven Approach*, 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*, Kökcü E., [Camps D.](#), Bassman Otfelie L., de Jong W., Van Beeumen R., Kemper A. arXiv:2303.09538.
- QCLAB++: Simulating Quantum Circuits on GPUs*, Van Beeumen R., [Camps D.](#), Mehta N. arXiv:2303.00123.
- Exploring Finite Temperature Properties of Materials with Quantum Computers*, Powers C., Bassman Otfelie 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*, [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*, 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*, 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*, [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*, Steel T., [Camps D.](#), Meerbergen K., Vandebriel R., SIAM J. Matrix Anal. Appl. 42(2), 753–774. DOI: 10.1137/19M1249631
- Approximate quantum circuit synthesis using block encodings*, [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*, 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*, [Camps D.](#), Van Beeumen R., Yang C., Numer. Linear Algebra Appl. 28(1). DOI: 10.1002/nla.2331
- On pole-swapping algorithms for the eigenvalue problem*, [Camps D.](#), Mach T., Vandebriel R., Watkins D. S., Electron. Trans. Numer. Anal. 52, 480–508. DOI: 10.1553/etna_vol52s480
- Swapping 2x2 blocks in the Schur and generalized Schur form*, [Camps D.](#), Mastronardi N., Vandebriel R., Van Dooren P., J. Comput. Appl. Math. 373, 112274. DOI: 10.1016/j.cam.2019.05.022
- A rational QZ method*, [Camps D.](#), Meerbergen K., Vandebriel R., SIAM J. Matrix Anal. Appl. 40(3), 943–972. DOI: 10.1137/18M1170480
- An implicit filter for rational Krylov using core transformations*, [Camps D.](#), Meerbergen K., Vandebriel R., Linear Algebra and its Applications, DOI: 10.1016/j.laa.2018.09.021
- 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

Education

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

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

Leuven, Belgium

Sep. 2009 - Sep. 2011

UHasselt (University of Hasselt)

B.Sc. IN PHYSICS

Hasselt, Belgium

Sep. 2006 - Jun. 2010

Talks

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

IonQ Quantum Seminar Series

Algebraic Compression of Free Fermionic Quantum Circuits

Virtual

May 2023

Guest lecture at San Francisco State University

Algebraic Compression of Free Fermionic Quantum Circuits

San Francisco, CA, USA

April 2023

APS March Meeting

Classical and Quantum Strategies to Boost Quantum Subspace Methods

Las Vegas, NV, USA

March 2023

IEEE International Conference on Quantum Computing and Engineering

FABLE: Fast Approximate Quantum Circuits for Block-Encodings

Broomfield, CO, USA

September 2022

XXI Householder Symposium on Numerical Linear Algebra

An Algebraic Quantum Circuit Compression Algorithm for Hamiltonian Simulation

Selva di Fasano, Italy

June 2022

CS Area 3rd Annual Postdoc Symposium

FunFact: a Tensor Algebra Language with Applications in Deep Learning

Berkeley, USA

Feb. 2022

SIAM Conference on Applied Linear Algebra

Approximate quantum circuit synthesis using block encodings

Virtual

May 2021

AIDE-QC All-Hands Meeting

An Algebraic and Scalable Synthesis Algorithm for Computing Dynamic Simulation Constant-Depth Circuits

Virtual

Apr. 2021

APS March Meeting

Approximate quantum circuit synthesis using block encodings

Virtual

Mar. 2021

SIAM Conference on Computational Science and Engineering

Understanding the quantum Fourier transform through matrix decompositions

Virtual

Mar. 2021

QIP Conference

Approximate quantum circuit synthesis using block encodings

Virtual (Munich, Germany)

Feb. 2021

CS Area 2nd Annual Postdoc Symposium

Approximate quantum circuit synthesis using block encodings

Berkeley, USA

Feb. 2021

<i>Berkeley Lab Seminar</i>	<i>Berkeley, USA</i>
Pole swapping methods for the eigenvalue problem – Rational QR algorithms	Sep. 2019
<i>ICIAM Conference</i>	<i>Valencia, Spain</i>
Pole swapping methods for the eigenvalue problem – Rational QR algorithms	Jul. 2019
<i>ETNA25 Conference</i>	<i>Sardinia, Italy</i>
Approximate inverse-free rational Krylov methods and the link with FOM and GMRES	May 2019
<i>NASCA Conference</i>	<i>Kalamata, Greece</i>
A rational QZ method	Jul. 2018
<i>SIAM Conference on Applied Linear Algebra</i>	<i>Hong Kong</i>
RQZ: A rational QZ method for the generalized eigenvalue problem	May. 2018
<i>NUMA Internal Seminar</i>	<i>Leuven, Belgium</i>
Rational matrix algorithms for the generalized eigenvalue problem — Iterative and direct methods	Oct. 2017
<i>ILAS Conference</i>	<i>Iowa, USA</i>
Implicit restart of the rational Krylov method — Chasing algorithms for polynomial, extended and rational Krylov	Jul. 2017
<i>ILAS Conference</i>	<i>Leuven, Belgium</i>
Towards a computational efficient, implicitly restarted rational Krylov method	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
Reviewer for	
Program Committee for	IEEE International Conference on Quantum Computing and Engineering 2022 & 2024

Honors & Awards

2024	<i>Hans Meuer Award for Best Research Paper</i> , ISC High Performance.	<i>Hamburg, Germany</i>
2018	<i>SIAM Student Travel Award</i> , SIAM Conference on Applied Linear Algebra.	<i>Hong Kong</i>