

SIMPAC-2024-159 / README.md

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5e5ba94 · 1 hour ago

141 lines (106 loc) · 10.5 KB

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QFLCS: Quantum Field Lens Coding Simulator

Technical: [GitHub](#) [SoftwareImpacts](#) [Mendeley Data v.3+](#) [Code in VS Code v.1.3](#) [Python v.3+](#) [Jupyter Lab](#) [Open in Code Ocean](#)

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Academic: [ORCID](#) [0000-0003-1037-018X](#)

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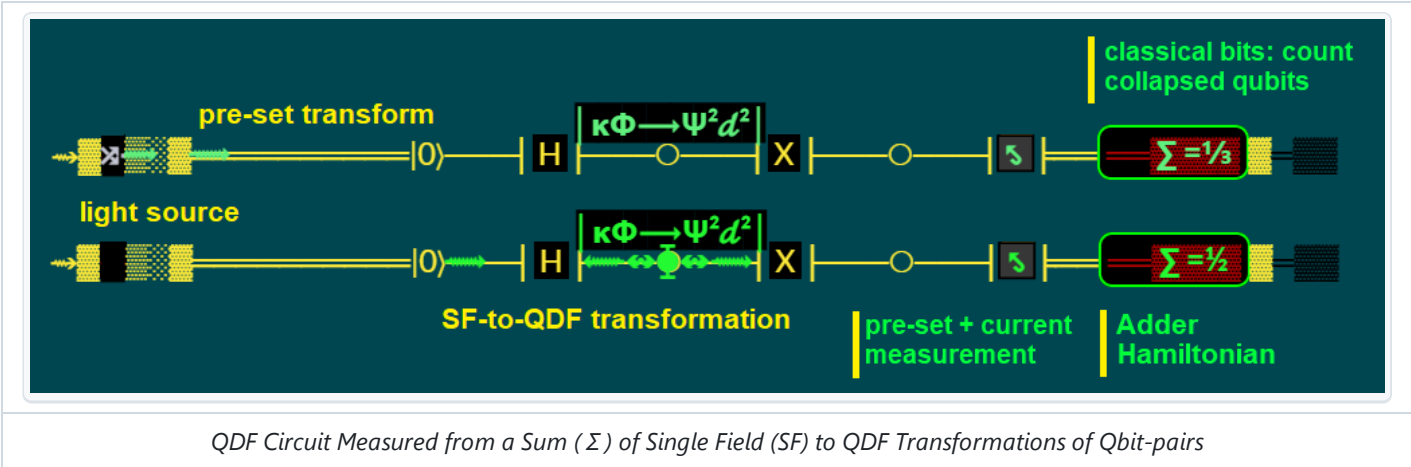
This repository contains the code for the QFLCS (Quantum Field Lens Coding Simulator) as part of its algorithm, QFLCA (Quantum Field Lens Coding Algorithm) project. The project repositories are available at <https://data.mendeley.com/datasets/gf2s8jkdjf/3> and <https://doi.org/10.24433/CO.9905505.v2>, which include the code, project website documentation, and demo video files.



The QFLCS program analyzes the measurement outcome probability (P) data from datasets generated by Quantum Double-field (QDF) Circuits. The datasets are compared between ES and GS states as a P indicator generated for measurement samples. Small dataset samples denote:

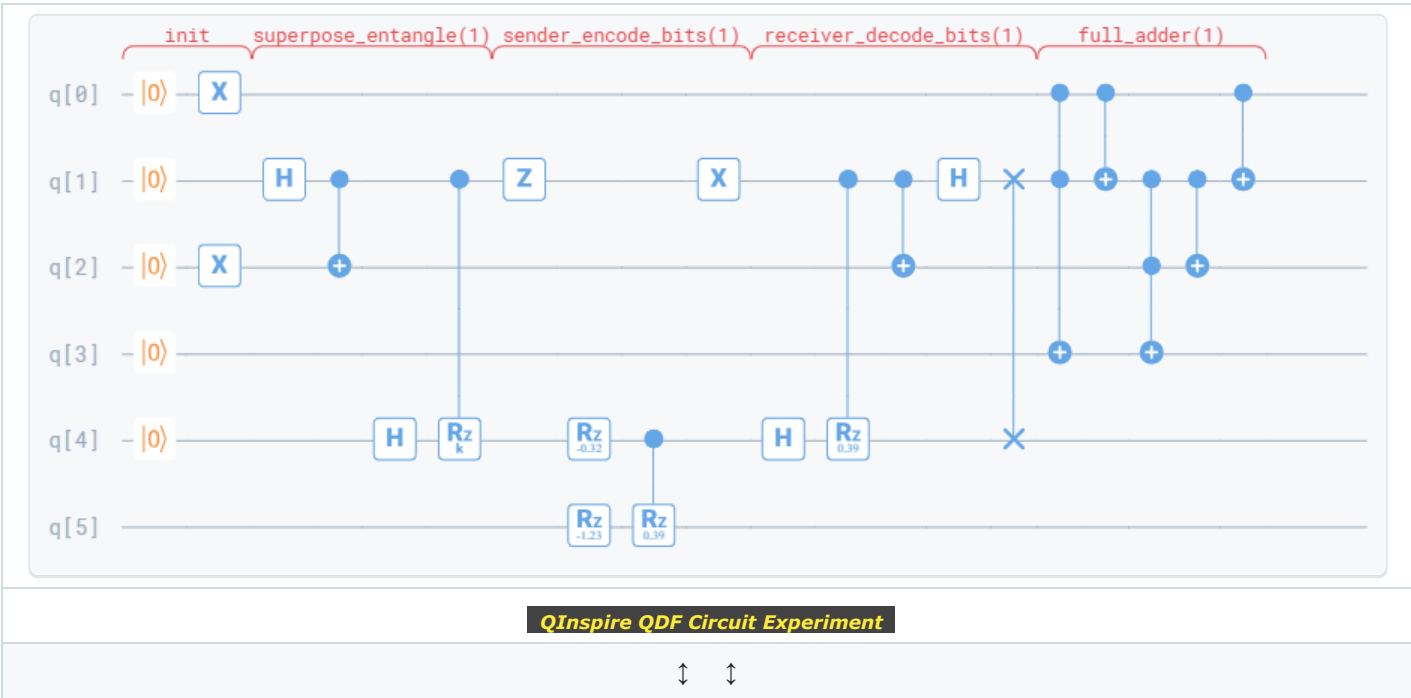
QDF Heat Engine Sampling from the Oldest Postal Stamp and Simulating the I/O by QFLCS

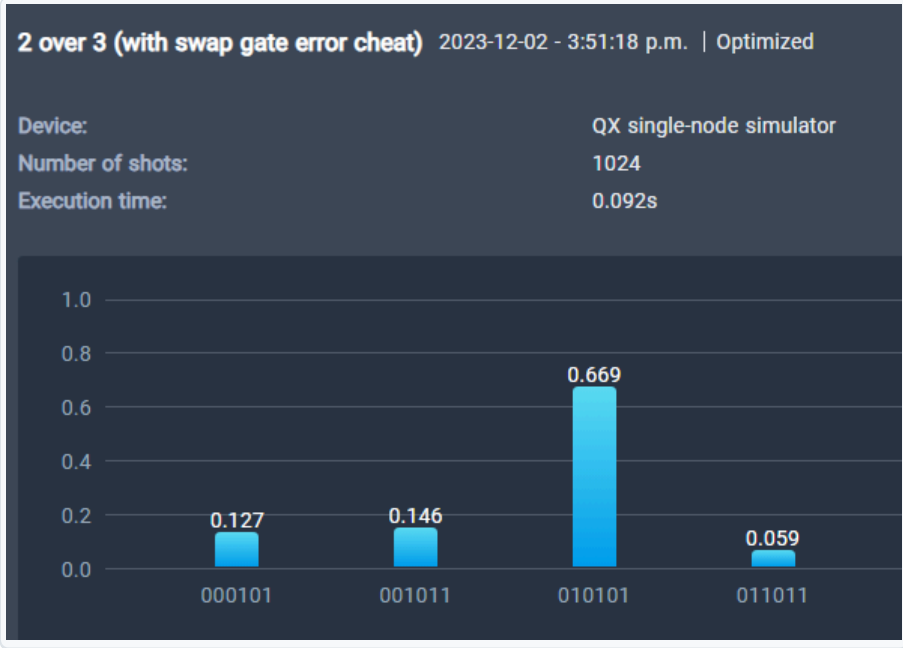
- a) A particle pair’s energy state in a QDF (different GS states or sublevels of a GS, or see Sec. 3 of the published article),
- b) a particle state in an SF, an ES relative to a GS from (a.), prior to its transform into a QDF, and,
- c) the expected transformation of fields (ES ↔ GS) and their $\langle M(P, \psi_{ij}) \rangle$, as in Sec. 3 of the published article.



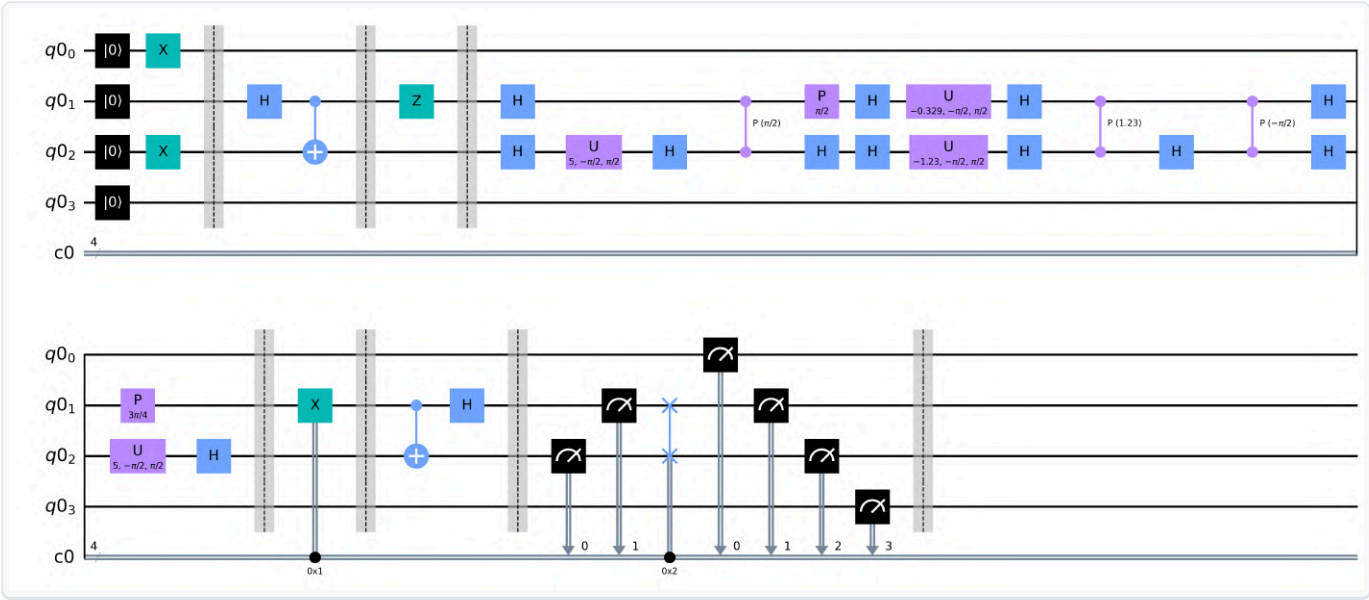
This repository's file structure is a sample mirror of the Mendeley repository file structure of v3+ at <https://data.mendeley.com/datasets/qf2s8jkdjf/3>, but with a much smaller file size for efficient download and use of the QFLCA project's code without the documentation (website) and demo video files. Certain small updates have been made in the main python file uploaded on Code Ocean for minor debugging purposes at <https://doi.org/10.24433/CO.9905505.v2> or [Code Ocean](#).

- QFLCA project's code without the documentation (website) and demo video files can be found under the `</code>root/lab/sim/QFLCC classifiers>` directory in `</code>root/lab/sim/QFLCC classifiers/docs>` and `</code>root/lab/sim/QFLCC classifiers/site>` folders at <https://doi.org/10.24433/CO.9905505.v2> or [Code Ocean](#).
- The main file is `</code>root/lab/sim/QFLCC classifiers/QAI-LCode_QFLCC>` which imports and executes the `</code>root/lab/sim/QFLCC classifiers/QDF-LCode_IBMQ-2024-codable>` OR `QDF-LCode_IBMQ-2024` code for the simulation under Win OS or Linux OS.





QInspire QDF Circuit Experiment Result



IBM QDF Circuit Experiment

In ([QInspire, IBMQ] QDF Circuit) \rightarrow **QFLCS** \rightarrow **Out** ([QInspire, IBMQ] QDF Circuit Data) \rightarrow **In** (**QFLCC**) \rightarrow **Out** (\uparrow)

An ideal QDF circuit I/O model running realtime producing an IBMQ-based QDF dataset is from the QDF-LCode IBMQ-2024.py file. This circuit is compared to the analyzed dataset to show how close the match is for a desired Hamiltonian and expected measurement outcome as a point of reference.

```

=====
on 0: Please Wait!...
on 0: *- Program is processing the analyzed dataset circuit P's after:
on 2: *- Import + Simulate the IBM QDF circuit by { Qiskit Aer Simulator, IBMQ Provider } [QUANTUM MODE ENVIRONMENT] on this computer.
on 3: *- Dataset P results are compared on the imported circuit by the { QDF-LCode IBMQ-2024.py } module on this computer [SAFE MODE ENVIRONMENT]
|=====| 100% [3/3] in 3.1s (1.13/s)
=====
Quantum simulation of a quantum field lens coding algorithm with entanglement scaling between a
multi-well (barrier) interaction potential of internal system B interacting and external system A from the method article:
https://www.sciencedirect.com/science/article/pii/S221501612300136X
*- QDF Circuit Built and Simulator generates its realtime datasets from { Qiskit Aer, IBMQ } Qasm_Simulator
Workspace and/or Virtual Environment on user's computer in Python.
*- Created by: Philip B. Alipour, Supervisor: T. A. Gulliver, at the University of Victoria,
Dept. ECE, Victoria BC, Canada.
*- Code updated based on Qiskit 2023--2024 changes specified in code comments of this simulator.
*- Sidenotes: You can also run code with the right packages installed in pipx or python.
Examples of package installation changes and features can be found on:
https://docs.quantum.ibm.com/api/migration-guides/qiskit-1.0-installation and
https://docs.quantum.ibm.com/api/migration-guides/qiskit-1.0-features
=====
<-- { Qiskit Aer, IBM } QDF CIRCUIT SIMULATION BEGINS -->
=====
Dynamic Providers: QasmSimulator('qasm_simulator')
Counts for Qubit Pairs out of 8192 shots: {'0101': 5541, '0111': 2243, '0001': 408}
Σ (5541, 2243, 408) = 8192 shots → { P(bij) } = { { (n1, n2, n3)/8192 } bij }
= { p1(0101) = 0.6763916015625 } + { p2(0111) = 0.2738037109375 } + { p3(0001) = 0.0498046875 } = 1
=====
Plot = [Experimented n of N counts ∝ p of total circuit events P on pairwise qubits = P(bij)]; |ij⟩ ≡ |qi qj⟩ = |q1q2⟩.
=====
P(bij)          [1.00000000000000]
p1(bij) = p1(0101) [0.6763916015625]
p2(bij) = p2(0111) [0.2738037109375]
p3(bij) = p3(0001) [0.0498046875000]
=====
<-- IBM QDF Circuit Measurement Results by Qiskit Aer Simulator Plotted Successfully! End of Task... -->
=====
=====
q1_0: -|0⟩
q1_1: -|0⟩
q1_2: -|0⟩
q1_3: -|0⟩
c0: 4/

«
« q1_0:
«
« q1_1:
« q1_2:
« q1_3:
« c0: 4/
«




Color-coded between the red and green range. Red for low p's and green for p's close to a total of P = 1.0, and yellow for superposition, dual between qubit pairs (0.25, 1/2).



⟨M⟩ on circuit components used per QDF circuit simulation run generating new/updated dataset results



```

<-- QDF Circuit BUILT & RAN Successfully! End of Task... -->
=====
<-- { Qiskit Aer, IBM } QDF CIRCUIT SIMULATION CONCLUDED -->
=====

```


```

[QInspire, IBMQ] QDF Circuit Simulation and Dataset Analysis by QFLCS and QFLCC

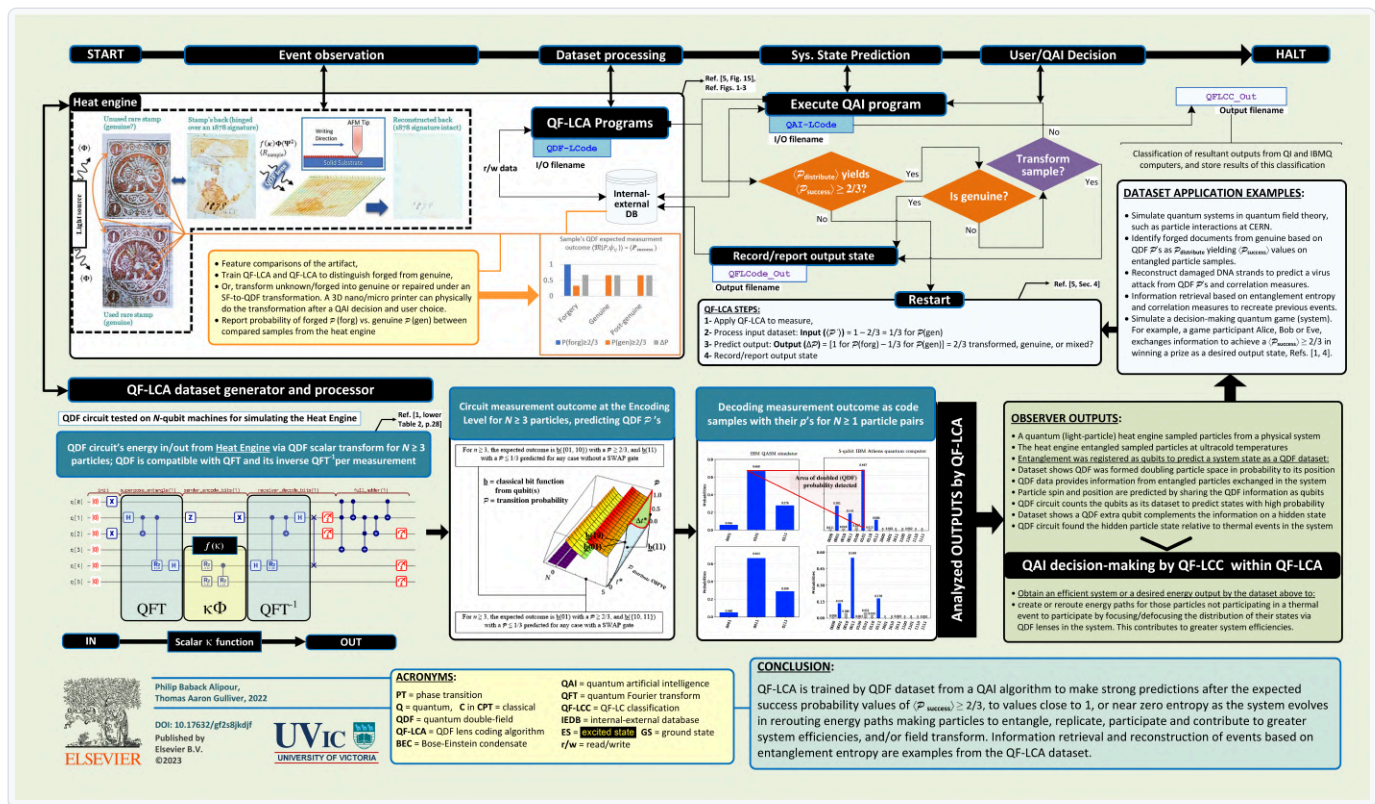
- We recommend downloading the entire `<root/...>` directory according to the folder structure and run `[QAI-LCode_QFLCC.py]` in VSC with python latest packages installed for Windows OS (the QDF game is developed for Windows OS, yet parts of the code for sound and display can be rewritten for Linux OS), e.g. `"winsound"` package as a compatible option. Other packages are needed to be installed or code rewritten for `"sound"` and `"display"` compatibility under other operating systems.
- The `[QAI-LCode_QFLCC.py]` file has a Pygame GUI and other packages suited for local machine runs, rather than running this file on the [Code Ocean](#) platform which could take hours to compile and run a compatible program/game with packages. However, the `[QDF-LCode_IBMQ-2024-codable.py]` can be run here as the core of the simulation program simulating the QDF circuit. A short presentation explaining these points are given in the `</site/assets/video>` directory as the `[QAI-COcean-Demo.mp4]` file from [Code Ocean](#).

QDF Game Intro from the QFLCA/QFLCS program

- The User and Developer's documentation/manual/demo is found under the `</code>root/lab/sim/QFLCC classifiers</code> directory, as <site-prints/...> and <site/...> contents.`
- In each folder: `<QFLCC classifiers/IBMQ>`, `<.../sim/QAI>`, `</QFLCC classifiers>`, and `<QI/...>`, under `</code>root/lab/sim</code>, [Tips.txt] and/or [ReadMe.txt] files exist to explain the contents of that directory. Also, under </code>root/lab</code> directory, a ReadMe file exists explaining the manual computation and presentation parts of the project.`

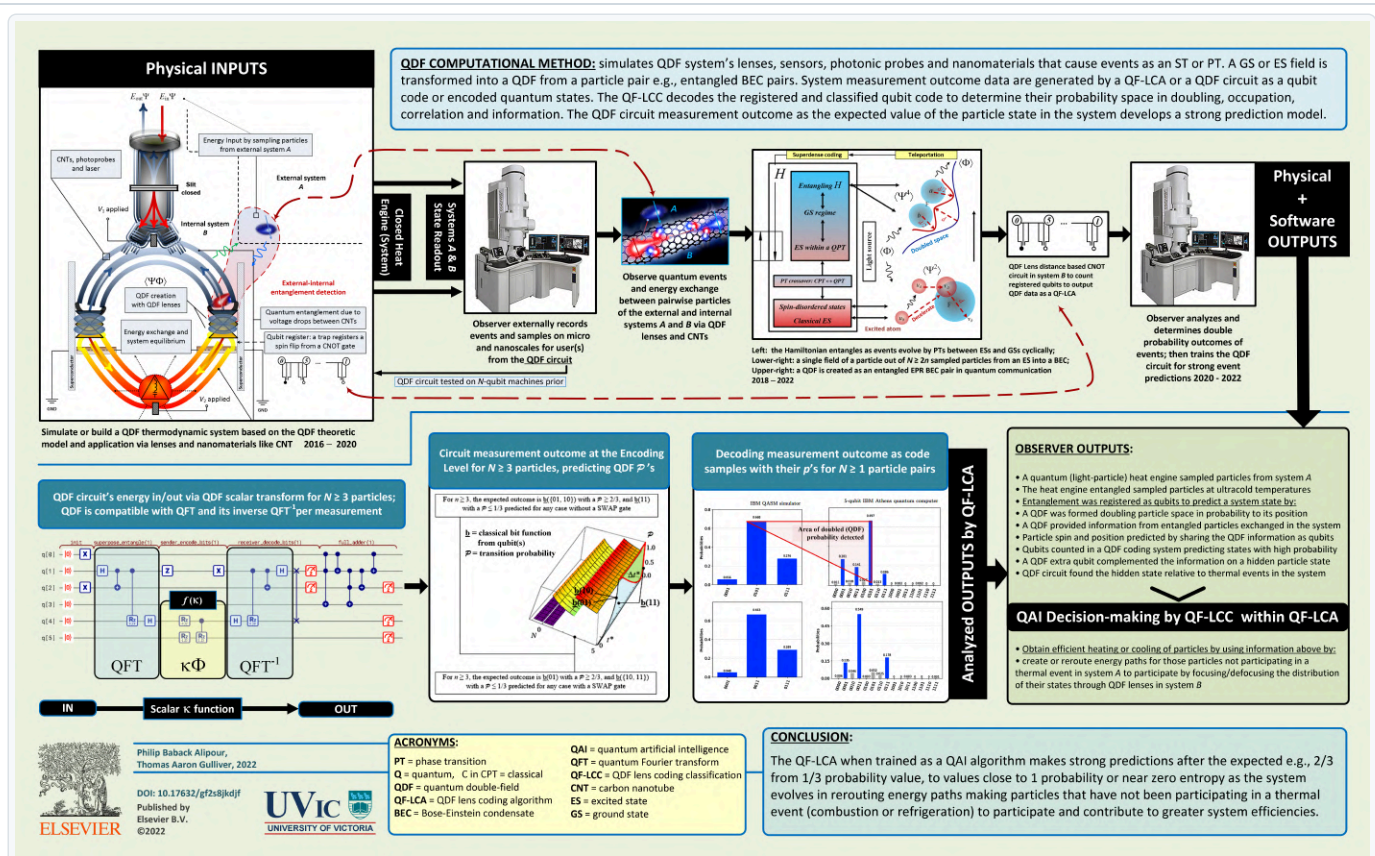
A close hit and gain of a prize [★].
This scores a good win due to w being close to 1.

6/9



Graphical Abstract of QFLCA Dataset

- The following figure is a downloadable High-Res Graphical Abstract of the published QFLCA article in MethodsX, Elsevier BV, at <https://www.sciencedirect.com/science/article/pii/S221501612300136X>



Graphical Abstract of QFLCA Model and Method

Citation

If you find this repository useful in your research, please cite one or both of the following articles as:

- P. B. Alipour, T. A. Gulliver, QF-LCA Dataset: Quantum Field Lens Coding Algorithm for System State Simulation and Strong Predictions, Data in Brief, Eslevier BV, 2024, 110789, ISSN 2352-3409, <https://doi.org/10.1016/j.dib.2024.110789>.

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@article{110789,  
  author = {Alipour, P.B. and Gulliver, T.A.},  
  title = {QF-LCA Dataset: Quantum Field Lens Coding Algorithm for System State Simulation and Strong  
  Predictions},  
  journal = {Data in Brief, Eslevier BV},  
  year = {2024},  
  artnum = {110789},  
  doi = {10.1016/j.dib.2024.110789},  
  url = {https://www.sciencedirect.com/science/article/pii/S2352340924007546}  
}
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- P. B. Alipour, T. A. Gulliver, QF-LCS: Quantum Field Lens Coding Simulator and Game Tool for Strong System State Predictions, Software Impacts, Eslevier BV, 2024, 100703, ISSN 2665-9638, <https://doi.org/10.1016/j.simpa.2024.100703>.

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@article{100703,  
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  title = {QF-LCS: Quantum Field Lens Coding Simulator and Game Tool for strong system state predictions},  
  journal = {Software Impacts, Eslevier BV},  
  pages = {100703},  
  year = {2024},  
  issn = {2665-9638},  
  doi = {doi.org/10.1016/j.simpa.2024.100703},  
  url = {https://www.sciencedirect.com/science/article/pii/S2665963824000915}  
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