

Fujitsu Quantum Application Research Package (Fujitsu QARP)

The Quantum Applications Research Package (QARP) is a comprehensive Python package for research and development of quantum computing applications. It enables quantum circuit simulation across physics, chemistry, mathematical optimisation, data science, and other research domains—combining problem modelling with circuit compilation for real quantum hardware and circuit cutting techniques.

Key Features

- Quantum Algorithms

- ✓ VQE — Variational Quantum Eigensolver
- ✓ VQD — Variational Quantum Deflation
- ✓ ADAPT-VQE/ADAPT-VQD — Adaptive derivative-assembled pseudo-Trotter ansatz
- ✓ QAOA — Quantum Approximate Optimisation Algorithm
- ✓ QPE — Quantum Phase Estimation
- ✓ DOS-QPE — Density-of-States QPE
- ✓ SSVQE — Subspace-Search Variational Quantum Eigensolver
- ✓ PCE — Pauli Correlation Encoding

- Modular Circuit Construction

- ✓ Block-based architecture — Build circuits using composable, reusable blocks
- ✓ Predefined blocks — QAOA ansatzes, hardware-efficient ansatzes, Trotterised circuits
- ✓ Custom blocks — Easily define your own circuit components

- Fermionic Systems

- ✓ Create and manipulate fermionic systems for electronic structure calculations
- ✓ Built on PySCF and OpenFermion
- ✓ Support for various fermion-to-qubit mappings

- Simulation & Backends

- ✓ State vector simulation — Compute expectation values, overlaps, and transition amplitudes
- ✓ Gradient backpropagation — Enabled for quantum algorithms
- ✓ Multiple backends — Pytket, Qulacs, and Qiskit support
- ✓ Circuit cutting — Gate-based decomposition for large circuits

- Visualisation & Hardware

- ✓ Customizable circuit plotting powered by Matplotlib
- ✓ Hardware compilation for specific qubit layouts
- ✓ Noise model support via Pytket's Architecture